MINISTRY OF REGIONAL DEVELOPMENT AND TOURISM

THE INTERNATIONAL EMERGENCY MANAGEMENT SOCIETY

GENERAL INSPECTORATE FOR EMERGENCY SITUATIONS

Proceedings of the International Emergency Management Society (TIEMS) 18th Annual Conference

"Natural and Technological Risk Reduction through Global Cooperation"

Edited by:
Snjezana Knezic
Meen Poudyal Chhetri
Alexandru Ozunu

Bucharest, Romania, June 7th-10th, 2011

Volume: 18
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The International Emergency Management Society

TIEMS Romanian Chapter

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The International Emergency Management Society

TIEMS Romanian Chapter

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Event organized with the generous support of the National Bank of Romania

Preface

The proceedings of the 18th TIEMS Conference is realised under joint effort of TIEMS International and TIEMS Romanian Chapter members. In such a way TIEMS stays strongly on its main mission to bring both scientific findings and practical experience from global level to local emergency management communities. The Proceedings is published electronically and it is organised through menu-designed user interface. The papers are organised by topics and were reviewed by TIEMS International Scientific Committee. We are very proud that the Conference attracted many researchers and practitioners from different countries worldwide covering diverse topics and problems in the field of emergency and disaster management.

Following the revision of the papers, from 70 abstracts of research papers, 22 best practice papers and 6 posters, only 49 full research papers, 16 full best practice papers and 2 full posters were selected, based on their original contribution. The authors are researchers and practitioners from different countries. The papers cover diverse areas of disaster management and have analysed the issues of disaster risk reduction strategies and problems very clearly. Most papers are of best quality and high standard. It is our firm belief that the papers which are going to be presented at the conference will benefit the participants by providing new and updated information and data.

Despite their very busy schedule, all the reviewers devoted their precious time in reviewing the abstracts and full paper in due time. It can be imagined that reviewing the abstracts particularly the full papers requires a good amount of time. So the reviewers need to be applauded by TIEMS and the organizer of the conference. It is to be noted that all the reviewers were professional and/or expert in disaster management. More importantly, the review was on voluntary basis.

The conference will be instrumental in providing excellent opportunity to the participants to exchange knowledge and share experiences each other which will benefit them and their organization.

The Editors of the proceedings would like to thank the members of the TIEMS International Scientific Committee for their assistance in reviewing the abstracts and full papers. Special thanks go to the authors without whom we could not have achieved the high quality of the proceedings.

The Editors
Bucharest, Romania
June 2011

FOREWORD FROM THE PRESIDENT

We are looking back at year 2010 full of natural disasters: Haiti earthquake, Chilean earthquake and tsunami, Pakistan floods, Australian floods and hurricanes, and not to forget the latest Japanese earthquake and tsunami, just to mention a few. Many lives are lost and families are made homeless and are suffering. Every loss of life in a disaster is a tragedy and results in suffering for both family and friends, because the material damage, despite being enormous, can be rebuilt. We need to learn from these disasters and use these lessons learned to develop better methods and systems and advocate for better policies in emergency and disaster management to be standardized and implemented all over the world.

TIEMS annual conference in Bucharest, Romania 7th – 10th June 2011 is focusing on all these issues, and gives the attending international experts in emergency and disaster management the opportunity to meet and exchange experiences and hopefully find better solutions which can improve the international preparedness for disastrous events.

TIEMS is a Global Forum for Education, Certification and Policy in Emergency and Disaster Management and is dedicated to developing and bringing the benefits of modern emergency management tools and techniques and best practice to society for a safer world, through exchanging information of the use of innovative methods, technologies and operations to improve society's ability to avoid, mitigate, respond to and recover from natural and technological disasters. TIEMS provides a platform for all stakeholders within the global emergency and disaster management community to meet and network, learn about technologies and operational methods, and exchange experience on best practice, and influence policy makers worldwide to improve global cooperation and establish global standards within emergency and disaster management.

The importance of TIEMS global events only grows, and TIEMS Romania Chapter, with particularly Stela Petrescu, Aurel Bilanici and Carmen Dumitriu, as the hosts for TIEMS annual conference in Bucharest 2011, with the support of Professor Alexandru Ozunu from Babes-Bolyai

University of Cluj-Napoca and Emil Roman of Romanian Red Cross National Society, have made impressive preparations for this event, in cooperation with Happy Tour, which is our local event manager partner. The event is visited by around 200 participants from all over the world. The participants attend a comprehensive program of around 100 important presentations. Simultaneous translations English – Romanian, and with two co-chairs for each session, one international and one Romanian, there is a good exchange of experience between Romanian experts and international experts, which again may hopefully lead to even more global cooperation in emergency and disaster management. The above technical program integrated with relaxing social events showing the Romanian culture, certainly makes the 4 days at TIEMS annual conference 2011 in Bucharest a memorable event.

The papers will be presented in the conference proceedings, and give a broad international view on emergency and disaster management in an international perspective, and with these proceedings TIEMS likes to stimulate to a continuous ongoing global dialogue on emergency and disaster management. Many thanks go to Meen Chhetri, Chair of the Paper Review Committee, together with his co-chair Snjezana Knezic and their review team for doing an excellent job with reviewing the papers and preparing the proceedings. I trust that the authors at TIEMS 2011 appreciate this quality improvement of the event and the feed-back on their papers from the review team.

TIEMS is an international non political and not for profit NGO and has limited financial resources. TIEMS 2011 in Bucharest had not been possible without the support and co-organizing of the event by the Romanian MINISTRY OF REGIONAL DEVELOPMENT AND TOURISM and the Romanian MINISTRY OF ADMINISTRATION AND INTERIOR – The General Inspectorate for Emergency Situations and, of course, the financial support from the Romanian sponsors. TIEMS is very thankful to all of them for making all of this possible.

I welcome all participants to TIEMS annual conference 2011 in Bucharest 7th – 10th June 2011.

Bucharest 7th June 2011

K. Harald Drager

TIEMS President

International Scientific Committee

Organizing Committee

Chair

K.Harald Drager, TIEMS President

Organizing Committee

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Supplier for organizing services is Happy Tour Corporate Travel Management

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Session chair, ***Garry de la Pomerai***

Session co-chair, ***Jack Zhang***

The SOLUZION product range offers a dynamic opportunity to develop real time early warnings directly into the Home, Office, School, Hospital, Emergency Services, the Military facilities, Utilities and other critical infrastructure and indirectly via SMS or Pager messaging integration to support the ever increasing more reliable prediction sciences, giving vital reactionary seconds before the destructive forces hit. Mobile sensor alarms packs have been assemble for USAR and Local Emergency Teams in field.

Workshop on *"Communication – Key Tool for Risk Management"*

Session chair, ***K. Harald Drager***

Session co-chair, ***Carmen Dumitriu***

The very recent events all over the world but also the more and more pro-active initiatives of key actors inside European area and Global Village had as a positive impact the commitment of not few professional groups to make effective contributions based on the specific models of their field in order to provide tools for risk management

Workshop on *"TIEMS Research and Development Project Service for Members"*

Session chair, ***Cerasela Tanasescu***

Session co-chair, ***K. Harald Drager***

TIEMS Officer for Coordination of TIEMS Research and Development Activities shall engage in the following:
Starting from TIEMS members needs, develop a research development plan with TIEMS Director for Scientific Program and President, and be responsible for the execution of the plan.
Involve TIEMS members in various cooperation research programs and projects.
Develop and maintain a cooperation strategy in research between TIEMS members.
Keep a continuous dialogue with the members of TIEMS International Program Committee, and involve them in the development of diverse research programs.
Maintain and update the web-site information for research opportunities.

Workshop on *"TIEMS International Education, Training and Certification Program"*

Session chair, *Jim Hagen*

Session co-chair, *K. Harald Drager*

TIEMS China Chapter has expressed the need for developing a program in China for emergency and disaster education, training and certification. Such a Program may also be needed in other countries worldwide. Other available international education and certification programs are evaluated and their strong sides as well as weak sides are considered when addressing TIEMS China Chapter concept. The Program to be developed is first addressed in an international context and thereafter made specific in a pilot project for TIEMS China chapter.

Sponsors and exhibitors

AGEXIMCO

We are **Motorola Authorised Distributor and Service Center** for Romania and the Republic of Moldova. Our company is located in **Bucharest/Romania** having branches throughout the country and in Republic Of Moldova.
We are also a part of **AMERICAN INTERNATIONAL RADIO Inc.** group, our international distributor center, located in **Chicago/USA** which distributes products and services to locations all over the world through a network of associated and independent dealerships.
On our effort to satisfy today's complex operational needs, we serve our customers in three interdependent areas of communication market: distribution of communications technology and services, systems integration and public operating services.
We are fully dedicated to providing products, systems and services and specialised land mobile radio, wireless data as well as wire communications.
We have a wide range of customers, including industrial, commercial, agriculture, construction, public safety, mining, petroleum and transportation companies and utilities.
Our management, factory trained engineers and customer service representatives listen and dedicate themselves to truly understanding the customers' needs.
We strive to achieve our fundamental goal of **TOTAL CUSTOMER SATISFACTION** by providing to our customers what they want, where they want it, with top-quality and innovative technology.

MIRA TELECOM

MIRA TELECOM – company with 100% Romanian private capital – has started activity in October 1998, with distribution of radio communication equipments. Diversification of services has represented a basic principle in the evolution of the company, today **MIRA TELECOM** providing complete solution of security, IT and telecom, backed by an effective and operative integrated service that brings added value to the customers operations.
At 25 years from the terrifying nuclear accident from Chernobyl and after just one month since the largest earthquake shook Japan, it became clear that security and emergency intervention represents a worldwide priority. Reality has once again confirmed the correctness of **MIRA TELECOM**'s management decision to engage even more in projects aimed at preserving life.
Until the end of the first semester of 2011, **MIRA TELECOM** will equip and deliver several **N**uclear **B**acteriological **C**hemical **R**adiological mobile laboratories and **M**obile **C**enters for **C**ommand and **C**ontrol.
With the completion of this major project, **MIRA TELECOM** makes another step in achieving the goal of becoming a benchmark player on the security market.

Mobius Solutions

Mobius Solutions is a supplier of solutions in the information technology field. Set up in 2001, they especially centered on implementing concepts of collaborative management, on the collection, integration and transformation of data necessary for the decision support systems. Starting 2004, the company started implementing decision support systems in the flood management field for the Romanian Waters (Apele Romane) and for the National Institute for Hydrology and Water Management, through direct contracts or subcontracts within the WATMANN project. This determined the development of competences in the area of risk management and decision support systems orientated towards the management of emergency situations.

Proposed services

- Analysis from the informatics point of view of companies, analysis of existing applications, analysis of the efficiency of the existing systems.
- Risks and decision support management systems.
- Informatics audit, design of informatics systems, system security.
- Consultancy in the development/ design of databases, replicate databases.
- Business Intelligence solutions – analysis, design, development/ implementation.
- Technical support and assistance services.

Products/ solutions:

Our company is oriented towards creating unique applications for each client, completely adapted to their specific activities. As Mobius Solutions is a IMM type company, we refer here to solutions and component parts that relate**.**

ROKURA

S&T

With 17 years of local experience, S&T Romania designs and implements complex IT solutions based on a comprehensive portfolio of software applications, hardware and communication infrastructure added with a complete range of consultancy, design, project management and software development. Target customers are large and mid-sized organizations in the governmental, telecommunications, manufacturing, financial services, utilities and healthcare

sectors.
S&T also provides training, technical support and maintenance services based on Service Level Agreements as well as outsourcing services.
S&T Romania is ISO 9001:2000, ISO 140001:2005, SR OHSAS 18001:2008 and ISO/CEI 27001:2005, IQNet and TUV CERT certified and received “J.M.Juran Romanian Quality Award” for excellence in quality management.

TeamNet

Since the founding in 2001 until now **TeamNet**, member of the **Asesoft** group has become one of the most important companies on the IT system integrators market in Romania. **TeamNet** is a company which specializes in the development and implementation of the software applications based on the latest technologies which meet the client requirements. Quality is the common denominator which defines the people, technologies, solutions and services offered by the company.
TeamNetis also one of the few private companies in Romania which was involved in the leading research conducted within the European Commission Framework 6 Program. Through its involvement together with **Asesoft** in the development of integrated solutions for the projects financed through European programs (PHARE, ISPA) and the World Bank, TeamNet has consolidated its position as a solution supplier with European standards.
Throughout the time the company achieved a solid reputation and now has strong partners such as Microsoft, Oracle and other important European technology providers.
Currently **TeamNet** has over 200 employees, top specialists in their activity fields and an important experience achieved through the complex projects it coordinated.

ZETRON

Global Reach, Local Presence
Zetron is a subsidiary of Kenwood Corporation. For over 25 years, Zetron has been manufacturing mission-critical communications solutions for public safety, transportation, utilities, manufacturing, healthcare and business applications throughout the world.
Zetron has installed thousands of systems and deployed over 15,000 console operator positions worldwide. The scope and success of these projects demonstrate the performance, effectiveness, robustness, and reliability of Zetron's products.
Zetron's wide range of communication solutions include:

- Custom systems
- Integrated communication-and-control systems (ICCS)
- Radio dispatch consoles
- Emergency call-taking systems
- Paging infrastructure
- Trunked radio
- Wireless SCADA and remote-monitoring products

Through its alliances with world-class system integrators, a global network of resellers in over 60 countries, and Zetron’s own international facilities, Zetron is able to maintain a strong local presence in the areas it serves.

TIEMS Annual Conference 2011

Keynote Speakers

Bucharest, Romania 7th – 10th June 2011

1. THE ROMANIAN EMERGENCY MANAGEMENT SYSTEM

Marcel LUCACIU

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Abstract

The Romanian Emergency Management System is a mechanism of multi-stakeholders which provides coordination and response in case of emergencies, and serves as an advocate for prevention and disaster risk reduction at different levels. The objectives of the creation of the NEMS are the setting-up, organization and management of emergencies, as well as the procurement and coordination of human, material and financial resources.

The new emergency management system represents an integration of all respective Romanian and international expertise and lessons learned. This system has the form of a hierarchic, with a single command structure – the General Inspectorate for Emergency Situations.

The General Inspectorate for Emergency Situations (GIES) is the main tool for the coordination of all organizations involved in emergency management, according to the existing national and international legal framework. It is a subordinated to the Ministry of Administration and Interior and is organised centrally (the general inspectorate) and regionally (the subordinated county inspectorates for emergency situations). The main functions are to set and maintain the preparation for, response to, and recovery from disasters. Approximately 30.000 non-commissioned officers man the fire engines, search and rescue teams, CBRN teams, height and water rescue teams, emergency medical teams and also support structures such as: logistics, human resources, administrative, media etc.

The GIES is a result of the merge between the Civil Protection Command and the Military Firefighters Corps in 2005. Prior to that, the Civil Protection Command was tasked in the population protection in case of disaster and also in case of armed conflict (early warning, sheltering, evacuation, mass care, intervention a.s.o.).

By bringing together the two above mentioned structures all activities were rendered more efficient. The main reason for this efficiency boost was that the civil protection disaster management responsibilities and lessons learned were merged with the intervention resources of the firefighters structures. This pattern was successfully applied to countries like Hungary, Croatia, Slovenia, Bulgaria, the Czech Republic and Poland, and Romania makes no exception.

2. Failures and Successes Observed in 2011 Tohoku Japan Earthquake

Dr. Kit Miyamoto

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Abstract

This paper presents the results of a field investigation of the unprecedented disaster of the tsunami caused by the M 9.0 Tohoku Taiheiyo oki earthquake. Loss of over 15,000 lives is expected. Direct damage alone is estimated to be over $300 billion. The financial impact will be far greater. The author visited devastated cities one day after the earthquake to collect critical information for response, recovery and reconstruction. Much can be learned from success and failure of Japanese practices in tsunami preparedness.

An extensive seawall system constructed to mitigate the tsunami risk failed. Although advanced tsunami warning system saved more than 500,000 people, highly essential structures were not protected from the seawall failure. Breach by the tsunami compromised the emergency generator system in Fukushima nuclear plant and caused eventual meltdown of the nuclear reactors. The tsunami destroyed the large fuel tanks in Kesennuma causing the ignition of leaked fuel in the bay burning a major area of the city.

The implication for the rest of world, including the United States, is significant. Worst-case scenarios must be understood and contingency plans must be developed. The design decision risk must be communicated to stakeholders and the public. Cost-effective, resilient, engineering solutions must be developed to make cities sustainable.

3. Reasonable Earthquake Disasters Emergency Responses and on-site Multi-sub Operation Coordination Models

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Abstract

Depends on the response plan of earthquake disaster of China, if the death toll is over 300 caused by one strong earthquake, the first level response would be started. Recent years, many strong earthquakes cause light, moderate or serious disasters, but there are few discussions on the different response degrees and SAR operation if the death toll is over 300. By the comparative studies of

different responses and SAR missions in recent year earthquakes, such as, Southeast Asia earthquake in 2005, Yogyakarta earthquake in Indonesian in 2006, Wenchuan earthquake in China in 2008, Padong earthquake in Indonesian in 2009, Haiti earthquake in 2010, and Yushu earthquake in China in 2010, as well as northeast Japan earthquake and tsunami, it is found that due to the large difference of large variation of death toll, the scale of disaster distribution, and different collapse building types in different earthquake disaster, the more detailed response levels, the needs of total number of SAR teams, the needs of the rescue supports, period of emergency response and rescue, the settlements of homeless people, the supply of life needs of residents in disaster area, and recovery periods. We divided into three detail response levels depends on the death toll, that is the death toll between 300-2000 (I-I Level, or Padong type), 2000-10000 (I-II type, or Yushu and Yogyakarta type), and large then 10000 (I-III type, or Wenchuan and Haiti type). I-I Level response mainly start up national and local SAR teams. I-II type response mainly start up local, national and neighboring country's SAR teams. I-III type response will involve whole of local, national and international SAR teams. The response, emergency rescue, settlement of homeless people, and recovery periods also will be different in these three scales of disasters. The models of multi-sub OSOCC for USAR teams will be discussed also in the case of catastrophe of earthquake in domestic of China corresponding to the different responses levels and regions.

4. Future Public Safety Communication Systems

Morten Alexander Gustavsen

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Abstract

How new technology supports existing processes within the emergency sector – a holistic view of technology and crisis management. Background: There has been a major leap in technology the last decade. How can this leap transfer into saving lives and minimize damage? Based on experience from 20 countries we found there is a common understanding of the challenges, but no common way of evaluating how new technology can be implemented in a cost efficient way. The holistic view: To be able to give an answer to this one must focus on the total process of each kind of incident: from the inbound 112 call through the analysis and decision making at the command centre to the communication with the citizens. Used in the right way technology can support, not only communication to citizens, but also logistic functions and two way channels for enhanced performance of crisis handling. Using existing bandwidth within the mobile networks to support a broader range of information exchange between control room and first responder is equally important. Additional information could for instance be live updated maps with points of interest (location of people, structure of buildings etc.). Controlling the network is also of great importance. If you control the network in a crisis situation you will be able to let all necessary communication take advantage of available capacity. How to choose solutions: Different technological solutions will give alternative support for the processes used for each type of crisis. What should be the basis for choosing technological solutions? In this presentation we focus on how the change in Mobile phone networks from 2G/3G to LTE (4G) will result in a huge potential for both inbound and outbound 112.

5. The Application of Internet of Things (IOT) for a "Smart" Emergency Management System in China

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Abstract

Public safety emergency management capacity is an important indicator of the modernization degree to major cities. It is directly related to people's lives and property, social stability and the safety of state.

At present, emergency management system is in a rapid development stage in China. In against snow disaster in South China in 2008, May-12 Wenchuan earthquake, Beijing 2008 Olympic Games, November-15 Big fire in Shanghai and other big events, emergency management system has played an important role in disaster prediction, emergency reporting and commanding, rescue implementation etc.

The emergency management system for public safety has been listed into the prior areas of long-term development plan in China. The internet of things (IOT) technology is one of the foundations for the function of disaster prevention and can be useful for the next-generation emergency management system (or "smart" emergency management) because of its comprehensive advantages.

This presentation mainly discusses how to use the IOT technology in emergency management system, including application framework, solutions, and cases description.

Attendees will learn how the traditional emergency management system turns to be a smarter platform by adopting IOT technology into applications like preliminary surveillance, early warning system, and intelligent rescue tracking etc.

6. Global Disaster Management Education

James Hagen

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Abstract

The fact that the population of the globe is rapidly growing concomitantly with the ever-increasing reality of natural and man-made disasters is not coincidental. Civil strife, stress on the natural world, immense need for energy, and rapid rise of economies in developing countries are the result of this convergence. As the largest countries struggle with the pressing need for disaster management, there has been an increasing interest in structured and consistent disaster management education of first responders and emergency managers. Developing nations have a critical need for structured learning programs. In the United States, although there has been great activity in creating academic programs at all levels, there is work on standardization yet to be done.

An international perspective must be taken on what the most important knowledge and skills would be for basic training in emergency management. First is the need to clearly define critical global

competencies, followed by development of courses in which to provide knowledge and skill. This paper identifies and critically examines competencies that are common between nations, and describes a four course series that will provide a foundation on which international emergency management can be built. It is based on a combination of current research, perceived required competencies, existing courses, and expert deliberations on core knowledge. There is great respect for the experiences possessed by all nations, as well as the wealth of knowledge possessed by indigenous populations that must be applied.

Such an intense international academic undertaking is possible through TIEMS, due to its reputation, its membership, and the expertise it represents. A global perspective and merging of academic needs with practical application is vital. Despite the wide range of countries, cultures, and languages, a common platform exists for emergency management.

7. Information Systems to Support on Site Emergency Response Operations

Lili Yang

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Abstract

This presentation introduces the methodologies of establishing an information system for supporting on-site emergency response operations from three perspectives: end-user requirement gathering, information acquisition, and information presentation. Gathering comprehensive user requirements is never an easy job. Cognitive Task Analysis (CTA) is a way of capturing human centered requirements in information system design. A CTA-based Goal Directed Information Analysis (GDIA) is introduced in this talk, which consists of seven clearly defined, repeatable steps that help the practitioner to extract information requirements. The first three steps are specifically preparing for establishing an adequate goal hierarchy, and the following four steps are focusing on refining the goal-decision-information (GDI) diagram. The comprehensive user requirements are obtained from this set of GDI diagrams. Information acquisition is a key component in any emergency response system. This talk will cover how to use the latest developed wireless technologies in the information gathering and acquisition. An UK government funded research project SafetyNET is used here as an example. When the first responders arrive on site, they have very limited information about the building, occupants and the location of the hazard. They do not know if they need to enter the building, whether it is safe to enter and how to most efficiently deal with the hazard. SafetyNET has addressed this need. Procuring the right information at the right time, in the right format, and to get it to the right people is a challenge, as poor designs can lead to response systems that are not used, are ineffective and in some cases dangerous to the emergency personnel. The third part of this presentation explores how situation awareness oriented design is used for on-site emergency information presentation. The on-site dynamic information that could be presented to emergency personnel is examined through the use of three situation awareness levels. Examples are shown in the presentation.

8. Integrated Disaster Information Analysis for Compound Disaster Risk Assessing

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Abstract

Around the world, people are being faced with environmental threats and challenges to water related issues such as water scarcity, floods, storms, droughts. Recently, flash flood, typhoons have been increasing and intensity of them also increasing due to climate change. In recent decades, around the world, catastrophic disasters such as hurricane Katrina, cyclone Nargis have occurred frequently causing a massive loss of life and negative long-term social, economic and environmental consequences. Out of damage from natural disasters in recent decade, more than 60% is due to typhoon in Korea. For last 10 years from 2000 to 2009, the annual damage cost is estimated about USD 1.8 billion and the annual recovery cost is about USD 3.0 billion from water related disasters in Korea. Timely information analysis and warning dissemination is main issues on disaster risk management. To analysis compound and complex disasters, information sharing between organizations or communities and integrating various formatted information from different systems are very important. This presentation is focused on the GIS based disaster risk management system develop by National Emergency Management Agency (NEMA), Korea for information sharing and disaster risk assessing. NEMA developed National Disaster Management System (NDMS) as a comprehensive nationwide GIS based disaster information analysis system to assess disaster risk and support decision making for all disaster management processes in terms of prevention, preparation, emergency response and recovery through information sharing and transferring based on IT technology, information analysis with GIS. In the GIS based disaster risk management system, monitoring data, simulation results and images information from CCTV and satellite are integrated and analyzed for assessing compound disaster risk and supporting timely decision making. The warning massages are disseminated by Cell Broadcasting Service (CBS), caption system using exclusive intranet, PC, cellular phone, FAX, messenger and twitter to people who being on dangerous area. To analysis integrated information and assess disaster risk of severe and broad disasters connecting with neighborhood community, sharing disaster information and technology at country and global level is important and needed. For this, NEMA hosted 4th Asian Ministerial Conference on Disaster Risk Reduction (AMCDRR) in Incheon, Korea on 25-28 October 2010 with the special partnership of UNISDR. More than 900 participants from 53 countries in Asia-Pacific region, International Organizations, UN agencies and NGOs adopted Incheon Declaration and agreed Incheon REgional RoadMAP (REMAP) and Action Plan. To follow the action plan of 4th AMCDRR, EMA has been developing a global platform as a platform of the platforms for sharing information and transferring technology related to Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA).

9. TIEMS Member Service on Research Activity

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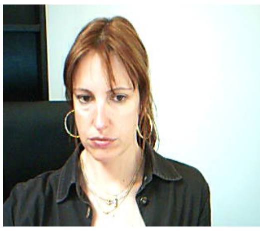

Abstract

While emergency management began in the context of improving the performance of organized events, emergencies by definition represent a disruption of such designs, providing a promising new domain for future work: the theoretical essence and practical needs of disorganizations. Recent reflections of emergency management focused on a particular sector within the field of emergency response. However as boarder body emergency management does not benefit from cohesive ongoing research stream of investigations. The thematic network of **TIEMS** brings together research institutions, universities, industry and public authorities in the emergency management area from Europe and even Worldwide seeking to achieve the following objectives:

- create an institutionalized platform for exchange of scientific information (in particular, research in progress), for pooling of (partly common, partly contrasting) experience and for facilitating research cooperation among European researchers and experts in the domain of emergency management;
- foster a better understanding of the (common and different) needs and backgrounds of emergency management, particularly with a view to the impacts of environment;
- identify how research can be the best support of operations under emergency conditions;
- establish a standard for the next generation EMERGENCY LIFECYCLE MANAGEMENT SYSTEMS with key focus on handling disasters and environmental impact effectively and efficiently.

10. ADAPTIVE LEARNING IN DISASTER MANAGEMENT FOR COMMUNITY AWARENESS AND RESILIENCE: THAILAND CASE STUDY ON TSUNAMI EARLY WARNING AND MITIGATION SYSTEMS

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Abstract

The Adaptive Learning in Disaster Management for Community Awareness and Resilience (ALDC) Project under IOC/UNESCO was initiated to focus on enhancing people's learning and participation in the planning and coordination of disaster warning, preparedness, response, mitigation, and recovery to build up awareness and resilience at the community level. The project has provided strategic integrated models and approaches for national interagency government departments and all relevant

stakeholders for implementation at the community level. The project activities targeted approximately 24 village locations in six Andaman coastal provinces of Thailand affected by the 26 December 2004 tsunami. The project duration was two years from January 2007 to December 2008, with a total cost of US$ 242,857.

The project has a bottom-up approach because local communities have better knowledge at their locality than others. With collective information, local knowledge can be integrated with technical know-how from experts in disaster management and relevant areas to establish local plans for preparedness and response that can be adapted for individuals to avoid or run away from disasters in time of crisis. This is to promote the learning process for local disaster risk management, targeting school children, teachers, the Sub-district Administrative Organizations, village leaders and government officers from different departments that are potentially exposed to hazards. The three components of the adaptive learning process for school and community-based management include their adaptive learning for school and community work plan development, ways to reduce risks in the school and community, and assessment of the preparedness and response by carrying out tsunami early warning and evacuation exercises. The process was initially started at schools, while the project then focused on communities where the schools were located.

11. A Breakthrough in the Earthquake Disaster Mitigation Education

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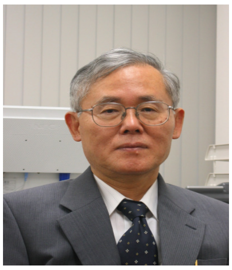

Abstract

We in Japan have a long history of the disaster mitigation education and training practices. People tend not to be eager to education and training or preparation for the threat except special counties of recent experience of large disaster or of considerable threat for serious danger. Japan started practical utilization of the so-called earthquake early warning (EEW) whole of the country October 2007. The EEW uses network seismic data at some 1,000 sites. The present system can afford the warning from several to tens of seconds before the coming of the large seismic wave of intensity 5+ (Japanese scale) for general public, and/or of much smaller ones for delicate and fragile facility as semi-conductor production factory.

During course of the development of the system, it is recognized that the EEW has both direct usefulness to decrease the possible disaster for human damage as well as properties, and the indirect ones to increase consciousness toward the disaster. The system itself can have double functions of helping people to take emergent actions before arrival of disastrous secondary seismic waves and training of prompt actions when the shock is not enough severe as causing damages. At present there is no practical earthquake prediction, so that the experiences to have alarming before the big shock induce a kind of mental shock. The strong impression of those people tends to change attitude to the disaster mitigation efforts. They begin to fix the furniture in the house, prepare emergent goods for the risk, and discuss how to response toward the assumed threat among family.

Training should have periodical characteristic and also have random ones to maintain the awareness of people. In this point the so-called the EEW for general public and that for high rank user should be both used to increase mental preparedness for the disaster mitigation.

12. Istanbul Earthquake Rapid Response System: Current Practices and Future Developments

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Abstract

Potential impact of large earthquakes on urban societies can be reduced by timely and correct action after a disastrous earthquake. Rapid estimation of ground shaking, induced intensity, damage and loss maps throughout a geographic area with earthquake location and magnitude information combined with recorded ground motion parameters and local geology data provides valuable tool for emergency response and public information.

Along the history, Istanbul was exposed to many damaging earthquakes (Ambraseys and Finkel, 1991). Between 4th and 19th centuries there were 32 earthquakes in Istanbul. Approximately, in every 300 years Istanbul is exposed to a very intensive earthquake.

It is expected that the source of earthquakes which will affect Istanbul province intensively will be active faulting system in Marmara Sea. The probability of a devastating earthquake occurrence in Marmara Sea in the following 30 years is 60% (Parsons and others, 2000).

In order to assist in the reduction of losses in a future disastrous earthquake in Istanbul a dense strong motion network, Istanbul Earthquake Rapid Response System – IERRS, has been established in 2002. One hundred of the strong motion recorders are stationed in dense settlements in the Metropolitan area of Istanbul in dial-up mode for Rapid Response information generation.

The current methodology developed for near real time estimation of losses after a major earthquake and applied in IERRS consists of the following general steps:

1) Rapid estimation of the ground motion distribution using the strong ground motion data gathered from the instruments;

2) Improvement of the ground motion estimations as earthquake parameters become available and

3) Estimation of building damage and casualties based on estimated ground motions and intensities.

13. NATECH DISASTERS IN ROMANIA

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Abstract

There is growing evidence of the fact that in the last decades natural disasters at global level had an increasing frequency of occurrence and more significant consequences. Furthermore, there are also many studies which show an increasing number of natural disasters which trigger technological disasters (known as NATECHs). NATECH disasters pose severe risks and their significant negative consequences affect local communities around the world. This paper briefly presents the NATECH concept and summarizes the definitions from the literature perspective. The NATECH concept is strongly related to the vulnerability concept, which indicates the potential of the system to suffer losses or to be affected by the negative consequences of extreme events.

The situation of the NATECH disasters in Romania is also presented. Romania is a European country characterized by a diversity of natural hazards: heavy rainfalls and snows, floods and flash-floods, earthquakes, landslides, mudflows etc. Following a number of unfortunate combinations between these factors and different deficiencies associated to the industrial operator, a series of negative events can occur, which in specific cases can become severe NATECH disasters, causing human loses and significant material damages. The consequences of these NATECH disasters can be reduced through an extensive preparedness and efficient risk emergency situations management.

14. INTEGRATED MONITORING, INFORMING AND PUBLIC WARNING SYSTEM FOR EMERGENCY SITUATION IN ROMANIA

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Abstract

The management of the emergency situations that are generated by floods, risky meteorological phenomena, hydro-technical construction related accidents and accidental pollution events is a national level interest activity since we are to take into account not only their occurrence frequency, but also the amplitude of the consequences such risk situations might trigger.

The floods that have lately occurred in many countries as a result of the climatic modifications that have been registered, more often than ever, during the past ten years, have led, based on an

increased social responsibility attitude, to the appearance of a new concept that refers to the floods risk approach. As far as Romania is concerned, the protective actions taken against floods represent a domain that is settled by means of Rules that are related to the management of emergency situations that have been generated by floods, risky meteorological phenomena, hydro-technical construction related accidents and accidental pollution events.

"The owners, holders of any title, of dams and of any other hydro-technical constructions whose damage or breakdown might endanger the population, their material goods, social objectives and the production facilities, or might even cause prejudice to the environment, are compelled to assure the maintenance of such dams or hydro-technical constructions, to carry out reparation works to the above mentioned, to properly operate them, to equip them with the AMC that are necessary for the running of the UCC activity of these ones, to install population alarm – warning systems in case of danger situations, and to organize the monitoring, intervention and vindication activities so that to be consistent with the regulations that were approved by means of the authorizations related to the water administration, the protection plans against floods, and against any other risk situations, as well as to be consistent with any other regulation documentation in force".

A special part, in setting the acoustic alarm system, the areas and the population evacuation ways, as well as the removal of the population's goods, is incumbent on the emergency situation local inspectorates with whom the above mentioned owners, as well as the engineers, shall collaborate, and from whom they shall, subsequently, obtain the approvals that such local inspectorates might request.

For the population alarm – warning system to be efficient under emergency situations, it is compulsory to monitor, round the clock, the risk factors, and further on, to send the data that refers to the critical threshold exceeding to the local Dispatchers whose responsibility is to monitor the emergency situations, as well as to assure the interconnection of such information with the local inspectorates' operational centers in view of a common management of the risk situations.

This presentation briefly presents the architecture of the only national level integrated system that has been adapted to the international concept of population acoustic warning, system that has been designed to alarm the population of the areas that are likely to be flooded further to the bursting of the dykes that are administered by SC Hidroelectrica SA. – who stands not only for the biggest energy producer of Romania, but also for one of the most important dam owners of our country. The unitary alarm – warning system was achieved by SC ROKURA SRL, based on the "turn-key" principle, and it includes: equipment supply and installation, realization of the necessary civil constructions, interfacing, putting into operation, training and maintenance.

15. ROMANIAN EMERGENCY MANGEMENT INFORMATION SYSSTEM ARCHITECTURE

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Abstract

The Romanian Emergency Management Information System – **EMIS** - (**SMISU-RO)** is an integrated system with a distributed architecture designed to support decision makers to make rapid decisions:

- Collecting data about the emergencies from all institutions involved in emergency management
- Exchanging of information and collaboration between parties involved for an enhanced decision making
- Gathering and sharing information between the organizations involved in the management of the emergency situations based on a user defined access
- Effectively communicating information between institutions
- Maintaining the emergency plans covering all emergency phases
- Maintaining an up-to-date database of all necessary human (point of contacts and intervention teams) and material resources
- Assessing the emergency situations and damages
- Executing the emergency plans and procedures
- Notifying the involved parties and report the situation
- Initiating, coordinating and monitoring search and rescue missions
- Coordinating medical assistance
- Managing the resources needed for interventions
- Coordinating evacuation and sheltering
- Recording all the transactions for post event audit and after actions reviews
- Maintaining relations with media/public relation
- Coordinating of post-event operations

The paper will presents in detail the features of the system and how it was integrated into National Emergency Situations Management System in Romania

16. Business continuity vs social responsibility in critical infrastructure protection

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Abstract

Purpose - We are all witnessing a major financial crisis; the banking system is a critical infrastructure worldwide.

Findings – The effects of the crisis led to a reverse phenomenon of critical infrastructure in nationalization of leading banks in the United States, Germany and United Kingdom in order to ensure economic stability of those states.

Methodology/approach - The partnership between Government and critical infrastructure operators, the risk-based analysis, the evaluation and investment interdependencies should be key-issues in the strategic vision for the states that aim sustainable development.

Research implications - The two concepts are in most cases known and defined correctly, the real issue is that between entities governed by the two concepts are sufficiently strong synergies that should lead to a risk management proactively

Practical implications - Our objectives are to identify the most important issues about risks and threats and critical business processes, in order to implement clear procedures, safety and security measures.

Originality/value –Integrated security management and identification of risks are particularly important in strategies for protecting citizens, taking into account the negative impact it may have partial or complete disruption of activity of critical infrastructure.

Key words: risks, critical, business

17. RISK REGISTRY AND ITS APPLICATION IN ROMANIA

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Abstract

The risk register represents a risk management system where risks are processed starting with a simple listing, appointment of risk responsible and implementation of the surveillance procedures, a quantity and quality evaluation, an elaboration of risks decreasing plans, of contingency plans of risk response plans, but also of the corresponding flows regarding the management of these intra- and inter-institutional plans and monitoring the implementation of the specific measures.

The system is based on the WEB technology and it integrates a GIS server. It is designed in order to run multi-organizational with the purpose to manage natural risks that imply the competences of more organizations. The system also has an engine for flows and procedures that can be implemented according to the specific needs of each organization or each risk. It ensures secured access elements, notification, organization on groups and/ or user roles, etc.

18. TECHOLOGIES AND CONCEPTS FOR URBAN SAFETY

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Abstract

By 2050, nearly three quarters of our planet will live in cities. The increment of inhabitants in the cities implies an increasing demand in vital services as transport, health, education or personal security. For all cities and regions competing in the global market place, safety and security are crucial factors in determining overall quality of life. Moreover, protecting citizens is the first duty of a state and also a priority for the success of businesses, communities and civil society at large.

In recent years, several cities' Town hall authorities, police and fire brigade managers have made a great effort in applying innovative approaches and new technologies to help reduce emergency response time and urban crime. However, there is still a need to enhance technologies already applied in the public safety area.

New capabilities could help make urban public safety systems not just more connected and efficient, but smarter. Instead of merely responding to crimes and emergencies after the fact, smart new systems should analyze, anticipate and actually working to prevent them.
Cities framework for urban safety is divided in four main groups depending on their functionality.

Situational awareness – sensors classification based on their functionality.

Command Centers – defines how the input data is processed and how to detect anomalous behavior.
Ad-Hoc networks – deploy an array of sensors in strategic points.

Alerting technologies to citizens – send emergency messages through telecommunication networks.

19. People and Philosophies Progressing in TIEMS - Almost a Symbiosis of Technology and Psychology

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Abstract

The people involved in The International Emergency Management Society, and the philosophies steering their activities, come from a multitude of professions - such as Physics, Engineering, Information technology, Architecture, Administration & Management, Law, Geography, Medicine &

Health Sciences, Psychology, Sociology, Politology, Media, and so on. How emergencies are perceived and assessed and handled varies across these multifarious disciplines - possibly even more than across the manifold countries from which TIEMS' member's stem.

The crucial features of many hazards, e.g., earthquakes, volcanos, floods, transport by cars/planes/trains/ships, power production, fires, storms, are technological facets. The vital characteristics of those exposed to risk situations, like knowledge, experience, robustness, frailty, preparedness, decision behavior, endurance, are essentially socio-psychological facets. For almost all hazards and emergencies and disasters, both facets need to be considered in a 'linked' perspective, and even more, cooperation and interaction of all involved professions is a 'must'.

Many hazards can be eliminated or avoided, at least principally (e.g., house fires); others can not (e.g., earthquakes), and consequences rather than causes are to be dealt with. Moreover, the preconditions of risk events require meticulous attention. Consequently, risk management entails very different tasks, dependent on the nature of the hazard. Furthermore, the exposed population, ranging from individuals to communities at large, and their specific vulnerability need to be reflected in any mitigation effort.

Analyzing emergency management processes reveals that "linking technology and psychology" is a very significant contribution for achieving the impending aims.

The nature, agenda and culture within The International Emergency Management Society is a prolific meadow for the symbiosis argued for in this - perhaps idealistic - rumination.

Future Public Safety Communication Systems

HOW NEW TECHNOLOGY SUPPORTS EXISTING PROCESSES WITHIN THE EMERGENCY SECTOR

A HOLISTIC VIEW OF TECHNOLOGY AND CRISIS MANAGEMENT

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Abstract

There has been a major leap in technology the last decade. How can this leap transfer into saving lives and minimize damage?Based on experience from 20 countries we found there is a common understanding of the challenges, but no common way of evaluating how new technology can be implemented in a cost efficient way.

The holistic view:
To be able to give an answer to this, one must focus on the total process of each kind of incident: from the inbound 112 call through the analysis and decision making at the command centre to the communication with the citizens. Used in the right way technology can support, not only communication to citizens, but also logistic functions and two way channels for enhanced performance of crisis handling.

Using existing bandwidth within the mobile networks to support a broader range of information exchange between control room and first responder is equally important. Additional information could for instance be live updated maps with points of interest (location of people, structure of buildings etc.).Controlling the network is also of great importance. If you control the network in a crisis situation you will be able to let all necessary communication take advantage of available capacity.

How to choose solutions:
Different technological solutions will give alternative support for the processes used for each type of crisis. What should be the basis for choosing technological solutions?In this paper we focus on how the change in Mobile phone networks from 2G/3G to LTE (4G) will result in a huge potential for both inbound and outbound 112.

Introduction

By act of terror, major hazards, natural or man-made catastrophes, the population is exposed and vulnerable. In such circumstances, warning of civilians is one of the most important efforts to prevent people from being harmed or killed. Through targeted and informative warnings, people can take their own precautions and efforts to protect themselves and their relatives before, during and after emergency situations. “Warning and information are just as important as food and water before, during and after the occurrence of an emergency situation.” (Source: Red Cross, World Disaster Report).

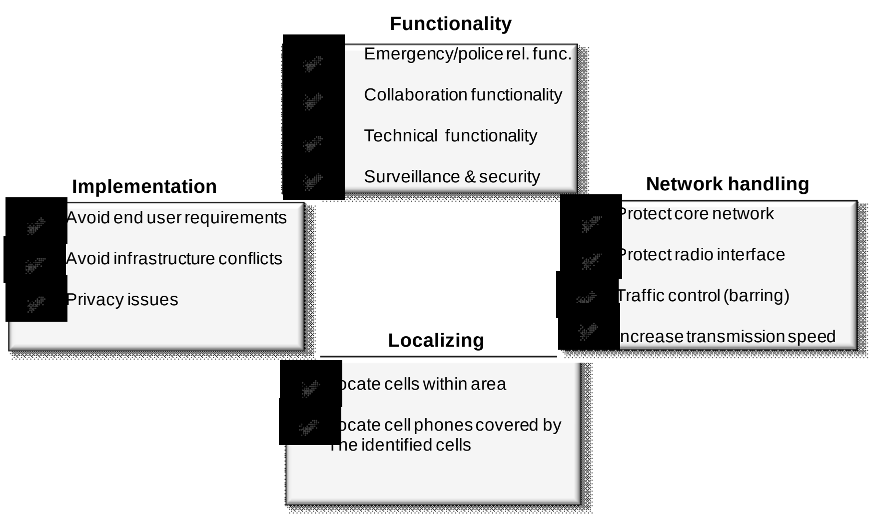
The world and its threat scenarios has changed dramatically since the second world war, but the sirens are in most countries still looked upon as the major medium for alert of citizens when exposed to some kind of threat or incident. In most industrial countries this technology is close to unusable due to the fact that:

- New generations don’t know the meaning of the signals anymore
- Buildings are so well insulated that it is difficult to hear the sirens
- Previous targets of strategic value (covered by typhoons) are no longer populated or of strategic value
- The threats today are more complex and diverse than before, requiring description and instructions in case of an emergency situation.

Due to the fast technical evolution and propagation, both mobile and IP seems like obvious technologies for alert of civilians exposed to any unexpected threat or incident. What must not be neglected is the huge strain that a geographically targeted alert (which is what alert of civilians is in practice) will have on any network (mobile, fixed phone or IP). No networks are designed for this special kind of traffic pattern. The spam-like nature of a telecom-based alert system (be able to send as many messages as possible in the shortest possible time to a limited/targeted area) must be considered. Choosing a technology able to handle challenges related to load of the network is therefore of greatest importance.

Although this paper is primarily discussing the topics related to the use of mobile telephony in context of emergency alert, it important to emphasize the use of several channels to be able to reach as many of the civilians as possible. Neither SMS nor CB will be able to create the necessary awareness in certain circumstances, for instance at night time, or when reaching groups of people with less usage of mobile phones like elderly or disabled people.TV, Radio, fixed phone and CAP should also be considered used along with mobile alert.

Although there are issues to take into consideration, it is time for the emergency authorities around the world to show their responsibility and act accordingly. Their major concern is to choose the alert technology best suited for the major risk scenarios in each country. To be able to choose the right technology, what alert channels to use etc, it is necessary to evaluate their capabilities against the requirements related to the different risk scenarios. Like any other evaluation and procurement process, the need must be evaluated against capability of the technology. Current ongoing discussions seem instead to be far too technology driven. It is important to emphasize that around the globe the different nations are exposed to different risks. Some countries are exposed to large scale earthquakes, while others are more exposed to local/regional man-made risks caused by the industry. The required EAS (Emergency Alert System) capabilities for handling of these different emergency scenarios are quite different. While some emergency scenarios require fast alert message dissemination with less functionality, others are depending more on functionality. This must of course be considered as part of the EAS evaluation process (see figure below for examples of needs and issues to consider).



Technology: Cell Broadcast versus SMS

To understand the future possibilities one needs to have a basic understanding of today's technologies.
There are two major methods and technologies used for emergency alerting via cell phones today; Cell Broadcast (CB) and location based SMS. There are several differences between the technologies, but the main difference is that while SMS is addressing each cell phone, Cell Broadcast is addressing each cell. The technological differences have great impact both on provided functionality and the implementation process.

Cell Broadcast

Cell Broadcast technology is well known to those of you planning for implementation of EAS, but let us have a brief look at its main capabilities and pros & cons:

- Addressing of cells, not the handset itself
- Ability to reach millions of mobile devices within a few minutes
- Not affected by congestion or heavy network load (using dedicated signalling resources)
- Not a natural part of standard mobile infrastructure
- Mobile devices need to be manually preconfigured or activated for reception of CB messages
- Complex implementation
- Limited functionality
  - Not possible to alert inbound roamers/visitors (unless the inbound roamer has enabled CB)
  - No knowledge about magnitude (number of people affected)
  - No knowledge about visiting nationalities affected
  - No capability for alert of outbound roamers
  - No additional functionality for 4G/LTE is provided

SMS

The arguments against the use of SMS for emergency alert purpose are also known, but maybe not in detail, and little has be done (so far) to overcome the challenges related in particular to the use of the network. Before looking at SMS in emergency alert context, let's first look at why SMS is looked upon as a less usable medium for dissemination of emergency alert messages:

There is no doubt that emergency alert is a huge strain to the mobile network, due to both the increased traffic during the emergency phase and the spam like nature of emergency alert; trying to reach as many as possible in shortest possible time in a limited geographic area. Following are the most common arguments against SMS:

- Its non location based nature
- Load of the core net, and in particular the HLR (Home Location Register, a single point of failure)
- The limited capacity of the signaling channels (Stand alone Dedicated Control Channel, SDCCH) of the air interface
- The unpredictable load generated by originated calls from the affected area or terminating calls within the area

The question is whether the SMS technology may be used at all for this critical purpose. The answer is yes, but in a modified version. The alert SMS is received like a standard SMS on the mobile handset (no configuration required), but the sending process is highly optimized to bypass the above mentioned challenges. This method is known as LBAS (Location Based Alert Service) or A-SMS (Advanced SMS) and is described below.

Advanced SMS

While ordinary SMS is addressed with a telephone number, leaving the routing process and localization of the terminating party to the sending process, LBAS has real-time knowledge of which mobile devices are covered by which cells. This information is provided by an LBAS feature storing all location updates within the network in a separate database. LBAS is also providing detailed cell coverage, which means that it is possible to identify which cells are covering a given area (polygon). Together these features make the "Location Based" capabilities of Advanced SMS. In addition to its primary function to localize handsets, this data is also a source for the optimized sending process. The key element is that by knowing the location (MSC and Cell id) of the terminating part, a lot of the heavy routing process and HLR load may be bypassed (explained in more detail below).

Protecting the core network

The HLR is vulnerable and will cause severe impact on the mobile network if overloaded. Overload may occur when too many voice calls and message transmissions are performed at the same time (typical for emergency situations). The capacity and scaling of the HLR is based on approximate number of subscribers that it is serving, combined with number of messages/calls per subscriber per hour. This is leading to a certain number of allowed transactions per second. If this number is exceeded, the HLR will usually protect itself and reject new messages/voice calls.

One of the major enhancements of the Advanced SMSC (A-SMSC), and also what separates it from ordinary handling of the SMS transmission, is the way the A-SMSC is handling the routing process within the core network. While an ordinary SMS needs the HLR to locate the destination switch (Serving MSC), LBAS knows the destination of the terminating party and will bypass the HLR.

Enhanced use of the air interface

In major incidents, several cells may be involved. The A-SMSC has an embedded feature, which is providing a method for separate and optimized parallel handling of message distribution to each cell. The "highway" on the core net is lead into several paths, one for each cell. The A-SMSC has full overview of which cells are involved, the cell type, capacity and how many mobile devices are covered by each of the cell. Thus the Cell Load Balance (CLB) functionality is able to:

- Allocate one independent sending process to each cell
- Send in parallel to all the affected cells
- Detect congestion or failure on a cell level
- Differentiate the transmission speed according to the cell capacity (throttle feature)
- Providing proportional load of the cells

Protection against unpredictable traffic

By unpredictable traffic, is meant the kind of irrational panic calling which often occur during hazards. People are concerned about their relatives etc. and when they don't get an answer, they continue on and on, without thinking about the strain to the network

The last major challenge in turning the mobile infrastructure into a 100% reliable network for critical alert messages is to avoid congestion caused by unpredictably increased traffic within the affected area during hazards. Experience has shown that during or after hazards a severe load of the network is likely to occur, resulting in a large blocking rate. Having this in mind it is of great value to control the cell phone traffic in the affected area during hazards.

Functionality

In a state of emergency, situation awareness and efficient handling of affected civilians are crucial and life saving efforts.

One major difference between CB and LBAS is; while CB is addressing the cells, not knowing which and how many mobile devices are affected, LBAS is addressing each MSISDN directly, thus providing capabilities beyond alerting:

- Showing number of affected people (magnitude indication, information that is crucial for optimized scaling of the emergency operation)
- Showing number of affected inbound roamers, divided into nationalities (enabling alert of inbound roamers, with multi lingual capability)
- Showing number of affected outbound roamers, divided into nationalities (enabling alert of outbound roamers travelling abroad)
- Location based response (provide functionality to optimize evacuation processes)
- Reactive alert, providing alert/information to civilians which have been in the area at a certain period of time (for instance in case of evacuation)

Controlling the network

Controlling the network is crucial and necessary in order to maximize the throughput, while still avoiding congestion during unpredictable circumstances. This is a contradiction in itself, but nevertheless a requirement. The above-mentioned features are some of the embedded capabilities and the basis for providing optimized and controlled handling of the mobile network. Network-control in practice includes capability to:

- Verify that the throughput of alert messages is according to expectations
- Identify any areas without coverage
- Be able to bar traffic in a certain area covered by overload
- Being able to activate priority for certain groups (e.g. emergency personnel)
- Provide load balance not only between cells, but also between network generations
- Provide extended functionality like remote video surveillance
- Provide multimedia content without overloading the network
- Congestion control

All experiences are telling the same story; during major emergency situations, the load of the network is increasing far above normal peak traffic. Actual figures confirm that voice calls increased 10 times compared to daily peak with a block rate of 92% (i.e. only 8 out of 100 calls were successfully connected).

Having this in mind, we dare espouse that an emergency alert system without network-control capability is false safety and useless for the critical purpose of alerting civilians and enhancing emergency processes during emergency situations.

Combination of mobile channels?

Will one single mobile technology (Cell Broadcast, SMS, Advanced SMS or other services) cover all needs for all countries and situations? Probably not. In most countries a combination of mobile channels will be preferred. In addition, the cost perspective is important and we will most likely see several types of solutions for emergency communication in the mobile area in the coming years.
Authorities will probably rather look into their own needs and find a total solution from a process support and functionality view –than focus on technology.

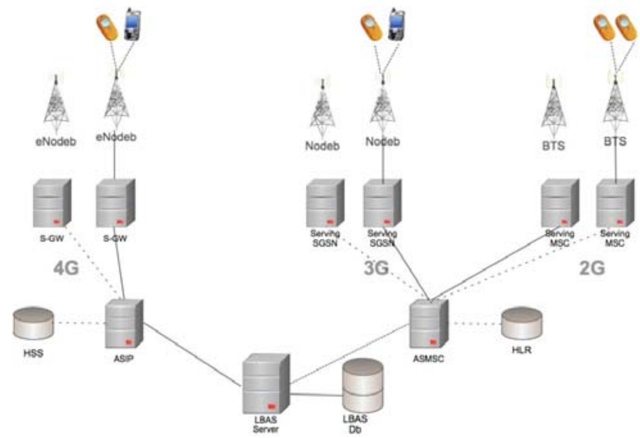
What next

SMS is, and will remain a natural and integrated part of the mobile services. Lots of features will be further improved in 3GPP Long Term Evolution (LTE). The use of LTE will be rapidly increased in the coming years. The most significant advantage of LTE and4G versus earlier generations of mobile technology is, in addition to the extended bandwidth, that all services are packet based. The limitations of circuit switched technology will at last be history. At this moment, LTE has been implemented in some network, but only for use for data services. Mobile devices will soon be available over IP along with voice and SMS services. Not only do LTE provide extended bandwidth, it is also utilizing both the core network and air interface in a much more efficient way. Since SMS so far has been looked upon as the best medium (apart from CB) for dissemination of emergency alert messages to mobile handsets, let us take a closer look at what impact LTE (or packet switched SMS) will have on the SMS technology:

- The capacity of the current CS (Circuit Switched) air interface is very limited. A 160 character message will occupy one signaling channel in close to 4-5 seconds. An average cell configuration will then have a capacity of only 120 messages per minute (given 8 SDCCHs).
- The capacity of a cell within an LTE network using PS (Packet Switched) technology with 2MB downlink speed will have a throughput of approximately 17.000 messages per minute. The capacity in an LTE network is expected to be far higher in a fully operating 4G network, this is just an example to illustrate the rather extreme increase of capacity. The air interface will no longer be the bottle-neck.
- LTE enables alert via a wide range of application interfaces like instant messaging and social networks in addition to traditional SMS
- Simpler core infrastructure will allow a much higher load than previous technology
- Technology designed for handling of congestion and Quality of Service (QOS)

With capabilities like packet labeling (MPLS) and enhanced barring feature, the LTE network may easily be turning in to a network for handling of critical emergency traffic providing required security, reliability, coverage and capacity, not only for emergency alert purpose, but even for communication among the emergency units.

Full LTE coverage will not happen overnight. The circuit switched networks will live for years, but with gradually reducing number of users. The LBAS technology is designed to coexist with them all, utilizing each of the technologies to its full extent, (see figure). Despite the extended band-width, even LTE/4G needs to be controlled to avoid congestion. Remember that along with increased capacity, new real-time services like gaming, video and movie streaming is introduced to the mobile devices. It will continue to be important to be able to control and bar such traffic during emergency situations.



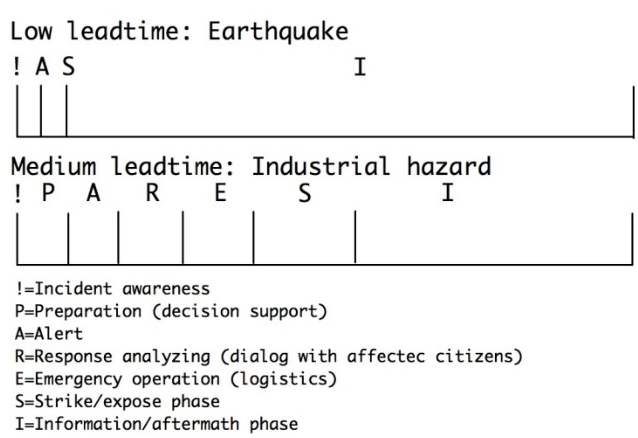
The figure shows how LBAS is utilizing the different networks. If a 2G user is identified, the message is sent via the limited circuit switched network. If a 3G user is identified with an active session (pdpContext), the message is sent as packet data via the SGSN (if SGSN is supporting SMS). Finally if a 4G user is identified the message is sent as packet data using the SIP protocol.

In other words, LTE is not only representing the general evolution of mobile technology, but also a significant evolution to the emergency alert services, providing crucial and value added technology capabilities.

Choosing the appropriate technology

Our experience is that discussions related to evaluation of alert technology have been much too technologically driven, without evaluating the primary needs against provided functionality. The nature of the two major alternatives, CB and A-SMS is quite different and so is also the functionality and capabilities provided by the two alternatives.

Let's have a look at the characteristics of two different emergency scenarios and try to see which technology is most appropriate for each.



The purpose of the figure on the left is to visualize the characteristics and steps of the different emergency scenarios, not to give an accurate and academic description. The figure shows the relative lead times, which is the time the emergency authorities have available for alert and life saving efforts like evacuation, from the incident is known until it strikes and further into the aftermath phase.

Example 1: Earthquake, illustrating a short lead time scenario:

!: Indicates the time when the incident is known. Earthquakes are normally detected only seconds in advance.

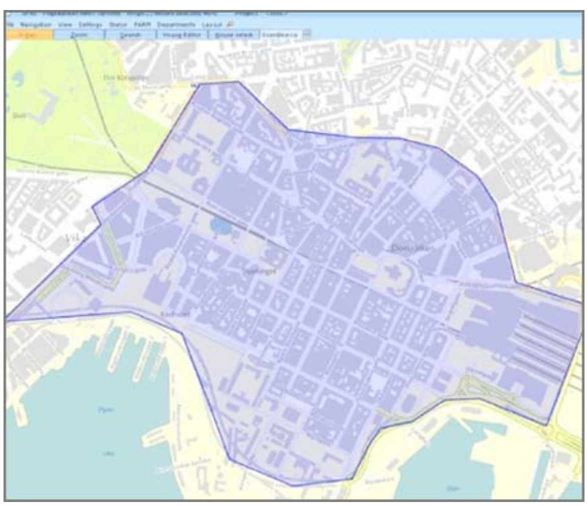
A: Alert is executed automatically immediately after the threshold values from the sensors are reached and analyzed
S: Soon after the earthquake is detected, civilians will be exposed to the earthquake. People in earthquake-exposed areas are normally trained and aware of the dangers, and know how to behave in case of earthquakes. They will react to an alert signal, not necessarily the message content. In this scenario the speed of the alert is more important than other functionality

Example 2: Industrial hazard, medium lead time scenario
Illustrates a medium lead time scenario where evacuation is required to avoid loss of human lives
!: Indicates the time when the incident is known. In this case an industrial hazard is threatening a large urban area
P: In the planning phase the emergency authorities are deciding which area to alert. Crucial data like number of civilians and which nationalities are within the critical area is provided by the alert system
A: The alert is executed. The civilians are asked to respond to the message if they are old or having disabilities and need help to evacuate
E: Emergency operation phase to assist people in need of. Lists and maps showing location of people in need of assistance eases the operation
S: The threat is either turning into reality or reaching a more happy ending
I: In the aftermath phase people evacuated will need further information. Capability to send a message to those who were in the exposed area at the time of the incident is required.

Alert example

To further highlight the capabilities provided by LBAS, we will look at a actual use case. This demonstrates alert of civilians threatened by an explosion caused by overheating of propane tanks after a train crash. An explosion will be life threatening to all people within one kilometer radius of the train crash. Several thousand people are within the danger zone. The following functionality is vital for fast and secure alert:

- Providing fast overview of the number of people within the area
- Providing fast dissemination of the alert message
- Ensuring that network congestion, caused by either civilians or the alert system, is avoided
- Identification of households with elder or disabled requiring assistance with the evacuation
- Capability to reach civilians evacuated from the area



Incident has occurred. A train with propane gas has crashed and is on fire. The fire may, with high probability, turn into a devastating BLEVE (Boiling Liquid Expanding Vapor Explosion). The lead time is estimated to be approximately 45-60 minutes. Immediate alert and evacuation of civilians is required. The affected area is urban, consisting of enterprises, households, stores and tourist attractions.

The affected area to alert is defined as a polygon. Multichannel capability is used to ensure alert of all kind of civilians. The example is showing the interface managing the Location Based (LB) feature, handling identification of all cells covering the area, and mobile handsets covered by these cells.

All operators | NetCom | Telenor

Country	CC	Queue	Delive...	Failed	Expired	Sub...	Progress
Norway	47	4143	26270	6201	0	43582	75%
Italy	39	502	210	29	0	1076	22%
Spain	34	242	95	12	0	349	31%
Philippines	63	27	1	0	0	240	0%
Germany	49	115	2	0	0	221	1%
United King...	44	122	37	6	0	182	24%
Poland	48	59	0	0	0	149	0%
Sweden	46	83	55	5	0	146	41%
Kazakstan	7	39	0	0	0	130	0%
Indonesia	62	5	0	0	0	100	0%
Denmark	45	1	64	19	0	90	92%
France	33	39	46	5	0	90	57%
Switzerland	41	45	11	5	0	75	21%
Netherlands	31	41	17	3	0	61	33%
China	86	10	0	0	0	52	0%
Canada	1	42	8	0	0	50	16%
Japan	81	12	0	0	0	41	0%
Romania	40	15	13	1	0	37	38%
Lithuania	370	9	22	3	0	34	74%
Portugal	351	23	9	1	0	33	30%
Australia	61	7	0	0	0	30	0%
India	91	4	0	0	0	30	0%
Brazil	55	10	0	0	0	29	0%
Hungary	36	17	10	2	0	29	41%
Estonia	372	15	9	0	0	24	38%
Austria	43	5	12	0	0	20	60%
Thailand	66	1	0	0	0	20	0%
Latvia	371	6	12	1	0	19	68%

In the preparation phase of the alert, the following information is shown:

-logistics showing number of civilians (mobile devices) within the area

-the number of visitors from abroad (divided into nationalities) within the affected area

-Groups opted in due to disabilities etc. which will require differentiated alert

The provided information is contributing to optimization and scaling of the emergency operation, not to forget handling of tourists who are vulnerable due to lack of local knowledge and language.

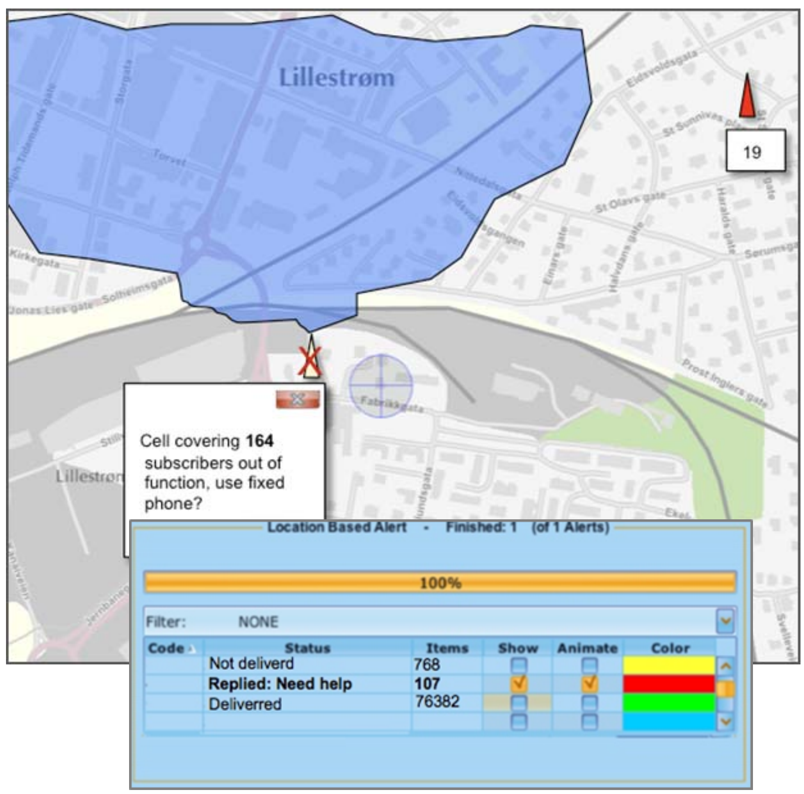
During or after the alert phase that follows, LBAS will provide status information which gives the alert operator vital knowledge both regarding technical issues (for instance lack of coverage caused by physical damage to the infrastructure) and response from civilians, in particular to identify civilians in need of some kind of assistance. Some of the functionality provided:

-GIS interface showing details about the location of response from the civilians

-Response is categorized, for instance by who are in need of help

-Response is categorized, for instance by who are in need of help

-Location of responders are shown in corresponding colored icons



All of the above-mentioned functionality and capabilities exist today and are possible within the current 2/3G networks. LTE/4G will open for a number of new features and capabilities.

Future

The above-mentioned examples are not fictive future, but what is provided by LBAS today. Let's take a brief glance at what the future may bring, and what possibilities LTE may provide:

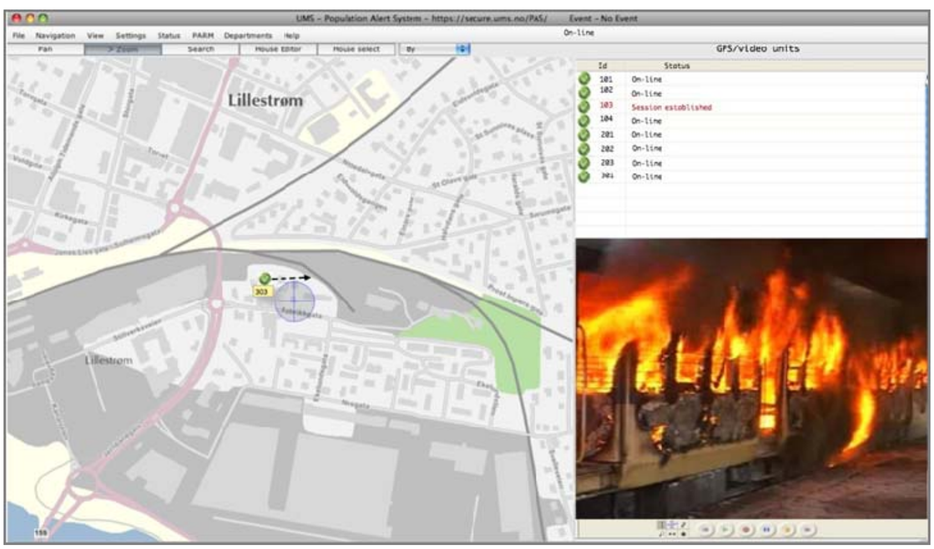
Picture tells more than 1000 words

A challenge not to underestimate is how to convey the alert content, without misunderstanding. Composing a brief and general message to be understood of everyone is a challenge. Large bandwidth combined with network control capability enables dissemination of multimedia content with more precise information than what is possible today. For instance guiding the civilians in the right direction with information containing their location compared to the hazard area and where they should evacuate to.

Other potential functionalities:

- Citizen involved rescue operations/crowd sourcing (pre registrated participants)
- Allow use of designated web pages, twitter, facebook

Remote monitoring



Remote monitoring of hazard areas is not new, but so far a dream due to lack of bandwidth. Combined with GPS it is realistic to provide real-time video streaming with location from the emergency units to the EAS (Emergency Alert System) or any other application.

Other possibilities:

- On portable devices (rugged)
  - Updated situation reports
  - Maps showing real time needs from people
  - Pictures showing construction of building etc
- Back up voice channel for Tetra
- Communication with emergency personnel without Tetra devices (medical, volunteers etc)

Conclusion

It is not easy to conclude on this matter due to the fact that the market is still quite immature, combined with a very fast technological evolution.

Either way one has to be aware that there are several technologies suitable for warning, informing and communicating with citizens in a matter of crisis.

Authorities should probably consider the following for solutions covering communication with citizens:

- Put emphasis on solutions that will support and enhance emergency processes in your country/area
- Technical solutions should be evaluated according to actual risks, not on the basis of technical preferences
- Evaluate what kind of functionality they get from each technology (may be combine several)
- There are alternatives and complementary solutions to Cell Broadcast
- Think through future evolution

One should also keep in mind that the different solutions vary a lot when it comes to implementation time, cost and functionality.

The fast technological evolution in the mobile area should also be considered when looking into future services that can enhance or replace parts of the Tetra networks. If you control the mobile network in a crisis situation the bandwidth of LTE could support a long range of new services not present in the Tetra networks today due to the lack of Spectrum. In addition it can be used as a back-up channel for voice services.

GLOBAL DISASTER MANAGEMENT EDUCATION

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Keywords: Emergency Management, Sustainability, Recovery, Education

Abstract

The fact that the population of the globe is rapidly growing concomitantly with the ever-increasing reality of natural and man-made disasters is not coincidental. Civil strife, stress on the natural world, immense need for energy, and rapid rise of economies in developing countries are the result of this convergence. As the largest countries struggle with the pressing need for disaster management, there has been an increasing interest in structured and consistent disaster management education of first responders and emergency managers. Developing nations have a critical need for structured learning programs. In the United States, although there has been great activity in creating academic programs at all levels, there is work on standardization yet to be done. An international perspective must be taken on what the most important knowledge and skills would be for basic training in emergency management. First is the need to clearly define critical global competencies, followed by development of courses in which to provide knowledge and skill. This paper identifies and critically examines competencies that are common between nations, and describes a four course series that will provide a foundation on which international emergency management can be built. It is based on a combination of current research, perceived required competencies, existing courses, and expert deliberations on core knowledge. There is great respect for the experiences possessed by all nations, as well as the wealth of knowledge possessed by indigenous populations that must be applied. Such an intense international academic undertaking is possible through TIEMS, due to its reputation, its membership, and the expertise it represents. A global perspective and merging of academic needs with practical application is vital. Despite the wide range of countries, cultures, and languages, a common platform exists for emergency management.

Introduction

Nations of the world have experienced disasters of one type of another through recorded history. There are many tragic tales of populations being caught unprepared or unaware of impending catastrophe. In that respect, little has changed through the ages. With all of our records of historic patterns, weather predictions, more advanced knowledge of the geology of the earth and seismic instruments, natural catastrophes still occur with little or no warning. In fact, it is somewhat disturbing that these events are becoming more frequent and more severe.

Natural and man-made disasters are affecting increasing numbers of people around the world (Kahn, 2005). The recent trend has been for more frequent and more severe global disasters (Block, 2008; Freeman, 2003). Concomitantly, the cost of these national disasters has risen enormously (Independent Evaluation Group, 2010). These facts are exemplified by hurricanes Ivan, Rita, and Katrina in the Gulf Coast of the United States, massive flooding in China, Europe, and Australia, and major earthquakes in Haiti, Brazil, and Japan (Smith et al., 2010; Kahn, 2005; Smith et al., 2009) The majority of deaths have occurred in nations that were the poorest (Kahn, 2005; Bandyk, 2010). In a study examining data from 73 nations, Kahn (2005) concluded that natural disasters hit wealthy and poor nations alike, although richer nations suffer less death.

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Logic follows that the wealthier nations have the means to prepare, mitigate, and evacuate if necessary, while the poor live in extremely vulnerable locations and conditions, and have no ability to mitigate against future events. The presence of stronger institutions in the area of the disaster can lead to lower death counts. Not surprisingly, larger countries with higher risk environments have suffered more deaths from their disasters.

There is a wide range of levels of preparedness of nations for natural and man-made disasters. It is interesting that those expected to be best prepared can have spectacular failures (Katrina), along with the extreme difficulties not surprising in locations of extreme poverty and unstable governmental situations (Haiti) . Not unexpectedly, nations with unstable governments, civil war, and extreme poverty have been demonstrated to be most ravaged by disaster, and least able to recover. In part, this is due to the lack of training of those involved in emergency management at all levels.

Historically, a great deal of money has been spent on mitigation and preparedness activities, while until recently little attention in the United States has been spent in the area of post-disaster recovery. It was not until a disaster the size of Katrina hit America that issues of lack of coordination, understanding of the relationship of disaster and discrimination, and lack of understanding of reconstruction and recovery became abundantly clear. In the United States, the majority of disasters resulted in the deaths of less than 100 people, many with death tolls less than 10. Our greatest death tolls have come from hurricanes and the San Francisco Earthquake of 1900, although the actual numbers of dead are difficult to determine with accuracy in earlier disasters. Hurricane Katrina has been the most costly, costing an estimated $84 billion thus far. It is most interesting that mitigation efforts to mitigate damage and loss of life in disaster may in fact have provided a false sense of security to residents who feel safe in building behind levees and dams, or on flood plains and major fault lines (Mileti, 1999).

Indigenous Cultures as a Source of Emergency Management Knowledge

Management science has grown to understand that disaster management is a new and specialized field of study. There is great importance to including all organizations and subcultures in planning and response.

So-called modern management must merge with the new with the old to take advantage of lessons embedded with the collective wisdom of the population. There is a growing sense of urgency as to the vital need to provide for those subpopulations that might be vulnerable during disaster. One of the most neglected subpopulations thought to be vulnerable is that of indigenous (autochthonous) peoples. Within these groups, it is common to find marginalization, poverty, lack of services, and heightened medical/psychological issues. However, there has been a growing realization and intense scrutiny of the special insight that these populations have into how communities can best prepare for recovery and reconstruction following natural disasters. Mercer et al. (2009) applied a process framework in the Papua New Guinea communities of Kumalu, Singas, and Baliau to demonstrate that top down risk reduction strategies often fail due to lack of taking into account local context and experience. We have learned through many painful experiences that all disasters are local and we must initially, as individuals and communities, be able to handle the disaster on our own. There is a great deal to learn from those who have a history of survival in adverse conditions.

There continue to be threats to indigenous knowledge and the value they have to us in disaster management. In some early work in this area, Grenier (1998) warned that indigenous knowledge, as well as biodiversity and cultural diversity, were threatened with extinction because of pressures of rapid modernization and cultural homogenization. Traditional channels of oral communication were failing. In 2005 (Ellemor), it was noted with interest that Australia was moving toward a prevention-oriented focus that involved working with, rather than on, local communities. The importance of existing capacities in indigenous communities was emphasized, along with the need for local understandings of risk and local knowledge of hazards and coping strategies. In the National Emergency Management Strategy for Remote Indigenous Cultures (Attorney-General's Department, Emergency Australia, 2007), there was emphasis placed on creating a framework for a coordinated and cooperative approach to assessment of risk, on decision-making and on allocation of resources.

Western scientists have begun to recognize the importance of understanding and valuing indigenous Native knowledge systems (Baumwall, 2008). It is not surprising that it was originally thought that others needed to impose modern western methodologies on how they handled disasters. Barnhardt and Kawagley (2005) maintain that through external relationships, the sixteen distinct indigenous cultures of Alaska have had their knowledge systems marginalized and their cultural integrity eroded. However, these knowledge systems have not disappeared. Hagen (2008) examined the structure of the emergency management system in the Alaska Indigenous peoples and found that special attention needed to be paid to the unique situation of the Native elderly in the family structure during times of disaster. There was great value in respect for indigenous knowledge and cultural belief systems. In 2000, Stephens developed a visual representation to assist in understanding the overlap between traditional native knowledge and Western science. In the Policy Note concerning Indigenous Knowledge: Disaster Risk Reduction (ISDR, 2008), it was recognized that policies pertaining to disaster management most often came from governance rather than the affected population. In fact, management models from the west often over - shadowed indigenous knowledge that existed. This work, published in late 2008 prior to the Wenchuan earthquake, noted the high risk of some areas of China, especially to the megacities. There has been a great deal of work more recently to produce a database of Transferable Indigenous Knowledge (TIK) that could be a source of extremely valuable information. This Disaster Reduction Hyperbase – Asian Application (2010) information can be found at http://drh.edm.bosai.go.jp. This database is a "webbased facility to compile appropriate disaster reduction technologies and knowledge that incorporates regional characteristics of Asian countries and has solid implementation strategy."

For centuries, indigenous peoples have used strategies to help survive and recover from natural disasters. It is vital that we seek out that knowledge and incorporate it into our disaster management systems. This is especially true is rural communities, where residents must often be self-sufficient for prolonged time periods. The ancient land of China is known for its large number of tribal and indigenous peoples, especially in the southern mountainous regions. There has also been much work in Papua, New Guinea

(Mercer et al., 2007,2009), the Himalayas (Rautela, 2005), South Africa (Vermaak and Niekerk, 2004), and Washington State, USA (Becker et al., 2008), concerning emergency management and effective disaster management, as well as practical information concerning how indigenous knowledge can be incorporated.

Results

There has been a great deal of discussion and consideration of the concept of core competencies for emergency managers in the United States. The term “core competency” was first used an article by Prahlad and Hamel (1990), and then elaborated in their book *Competing for the Future* (1996).

Originally, it was used in the business world to describe strategies based on unique market strengths. In other words, the term defined those characteristics that would lead to successful completion of defined goals. Although universally used today, the basic definition still holds true. When applied to the field of emergency management, these competencies take the form of both knowledge and skills/actions. Since there is no one definition of these core competencies, a method of creating a composite list would be to ask those involved in the practical field of emergency management, as well as to look at the training and education programs around the country to glean the commonalities and consistencies that stand out. The literature is replete with articles concerning the search for core competencies in a multitude of areas. In the United States from a national, there has been a periodic search for such competencies for many years, at least from a national perspective. This search intensified following problems with the 9/11 response, the spectacular failure of the Katrina response and other issues pertaining to national security.

There is no absolute standard for what makes a good emergency manager. It truly a mixture of art and science that creates an optimal response. Hindsight always reveals how the response could have been made better. This is not a function of lack of ability or preparedness. There have been several studies considering the identification of core competencies in emergency management (Chhabra, 2009; Barbera, 2005; Etkins, 2006; European Commission, 2010; Green, 1999; O’Connor, 2005) However, the two major sources of data cited concerning core competencies and core curriculum are a study performed by the International Association of Emergency Managers (IAEM), and another comprehensive study by the Federal Emergency Management Agency Emergency Management Institute (FEMA EMI).

It is interesting to compare the top 10 core competencies as defined by IAEM (Swiewak, 2005)with the top ten professional competency list created from two FEMA Higher Education Conferences in 2003 and 2005 (Blanchard, 2005). IAEM performed an extensive study to identify core emergency management competencies. The top 10 core competencies were identified as (in priority order):

Planning
Hazard identification, risk management, and impact analysis
Direction, Control, and Coordination
Laws and authorities
Exercise, evaluations, and corrective actions
Communications and warnings
Hazard mitigation
Resource management
Continuity of operations/continuity of management
Mutual aid

The second major source of data was FEMA's EMI. EMI is a major player in the education, training, and certification of emergency management professionals in the United States. The roots of the Emergency Management Institute are in the former Civil Defense Staff College created in response to training needs during the cold war. In 1980, the college was renamed the Emergency Management Institute and moved to its current location in Maryland, and gave its first course in 1981. In part, EMI acts to develop and implement training curriculum for FEMA disaster workers. In 1994, the Emergency Management Institute in Emmitsburg, Maryland developed the Emergency Management Higher Education Program, with the aim of promoting college-based emergency management education for future emergency managers and other interested personnel. By definition, the program is to "work with colleges and universities, emergency management professionals, and stakeholder organizations to help create an emergency management system of sustained, replicable capability and disaster loss reduction through formal education, experiential learning, practice, and experience centered on mitigation, preparedness, response and recovery from the full range of natural, technological and intentional hazards which confront communities, States and the Nation". (http://training.fema.gov/EMIWeb/edu/)

The FEMA Higher Education Program has now become the premier site for accessing a multitude of educational programs, as well as course syllabi, and materials for entire courses. References, resources, and job market information can be found on this site. A section of Emergency Management Competencies and Curriculum provide insight into core curriculum issues. From the FEMA Conference, the following competencies emerged (in no priority order):

Comprehensive emergency management framework or philosophy
Leadership and team building
Management
Networking and coordination\
Integrated emergency management
Emergency management functions
Political, bureaucratic, social contexts
Technical systems and standards
Social vulnerability reduction approach
Experience

The 2005 Hyogo Framework for Action 2005 – 2015: Building the Resilience for Nations and Communities to Disasters (World Conference on Disaster Reduction, 2005) and subsequent Disaster Risk Reduction in the United Nations: Roles, mandates and work of key United Nations entities (United Nations, 2009) clearly outlined the multitude of areas in which work needed to continue in preparing for national and global disasters. The World Economic Forum (2008), World Bank and the International Strategy for Disaster Reduction (2009) stated that the unprecedented increase in numbers of disasters around the world has been accompanied by concomitant financial losses from earthquakes, wildfires and floods. In those undeveloped and developing countries, there is no way of measuring undocumented and uninsured losses. However, in all of the risk reduction and preparedness activities, little is said of standardized training or global competencies that are required by all of those in emergency management.

The basic design of the pilot course for education and certification was created taking into account current and former activities in the area of disaster management education and training. It was determined that there were 10 modules that needed to be created to address necessary global competencies and be taught over a four course series. Material to be included should not be considered as all-inclusive or comprehensive. Rather, it is a foundation on which the TIEMS advisory boards can build and refine over time. Once the pilot program has been developed and created in conjunction with the TIEMS China Chapter Development Board, the pilot will be taught in China and critically evaluated. The TIEMS International Advisory Board of Experts and the TIEMS Chapter's Advisory Board will then have an opportunity to provide input concerning alteration and modification of the material presented as the program evolves.

In December of 2010, the European Commission produced a working paper on risk assessment and mapping guidelines for disaster management. It set out an overall disaster prevention framework to minimize the impact of disasters. It was a giant stride to standardize risk assessment methodology, provide information for a assets database, and contribute information to knowledge-based disaster prevention policies. Again, however, little was addressed in the way of standardizing training and seduction and to serve as a platform for needs on a country or nation-specific basis.

The Role of TIEMS in Core Competency Education and Certification

The International Emergency Management Society has taken on the task of creating a program to provide education and certification of emergency management personnel in counties in need of such a platform. After considering available literature, speaking to emergency managers, consulting those involved in academic training of emergency managers, and involvement with members of the International Emergency Management Society, a curriculum was designed for the basic training of emergency managers on a global scale. There have been eight points highlighted pertaining to the concept of international training. They are:

1. An Education and Training Program with Concluding Certification Examination will be developed to be used in Education and Training of Emergency and Disaster Personnel on all levels, search and rescue personnel, emergency managers, first responders, including local Management level, Volunteers and Military as well as the future Trainers
2. All Course material will be Developed in English and the National language of the countries which take part in national pilot projects
3. The Program will cover Education and Training in all Emergency Phases; Preparedness, Mitigation, Response and Recovery
4. The Program will comprise Courses, Group Work, Table Top Exercises, and Practical Training with a Final Certification Examination
5. The Certification will contain an international and local part specific for the country in question
6. Universities and training centres will be certified for teaching courses and training
7. Student should be able to be trained and the exam within 6 months of studying/practical training
8. Experienced personnel in emergency and disaster management will need to do the same examination to be certified, but courses and training sessions are voluntary

Qualified individuals, as recommended by the appropriate governmental agency or level will be provided with the opportunity to receive specific courses designed to core competency education and certification. The TIEMS Education and Certification program maintains that there is a set of competencies that are common among both nations and disaster types. One of the main goals of the program is to systematize these learnings into a course series to aid and assist in initiating, or standardizing and improving disaster management education. It would serve not to replace current programs, but to provide common ground in which to base education and training where needed.

Discussion of the TIEMS Program and Course Design Overview

After much investigation and study, it was decided that a five course series would be created to serve the international community, and would be based on those core concepts that transcended international boundaries. Their purpose is to build a common foundation on which specific national needs and concepts might be built.

The series of courses will open with an introduction to the TIEMS and other international organizations, and their involvement in emergency and disaster management. The specific role TIEMS has played in international cooperation, conferences and workshops, and research programs will be highlighted. The Planning course will focus on the following topics:

- Global Realities in the Rising Number and Severity of Disasters
- Classification of Disasters – Compare and Contrast Disaster Management
  - Natural, Man-made, Technologic
- The Planning Process
- Comprehensive Emergency Management – Concept and Reality
- Hazard Analysis
  - Data development, hazardous materials, Hazard Vulnerability Assessment, Risk analysis
- Describe, Explain, and Apply the Four Phases of Disaster Management
- Introduction to the Ten Basic Functions of the Emergency Manager

The second course will focus on areas of command and control and will focus on the following topics:

- Natural Disasters versus Civil Security
- Environmental Consequences of Disaster
- Inter-Sectoral Cooperation
- Creation of the Emergency Operations Plan (EOP)
- Setting Up the Emergency Operations Center (EOC)
- The First Operational Period – The Planning "P"
- Complex Operations – Multi-Site, Multi-jurisdictional, Multi-Sectoral
- Resilience and Recovery
- Tools of Emergency Management
- Role of Volunteers and Local Resources
- Compare and Contrast Management and Emergency Management – Leadership During Crisis
- Use of Simulations and Technology
- Integration of Decision Support Systems

The third course will deal with human parameters of the disaster response and will focus on:

- Evaluation of Physical and Emotional Damage
- Health System Response to Disaster
- Vulnerable Populations
- Surge Capacity and Initial Response to Large Scale Casualties
- Emergency Communications
- Improving Public Response
- Emotional Response to Disaster
- Impact of Disaster Trauma/Secondary Trauma
- Mental Health Disaster Response
- Normative and Extreme Reactions of Disaster Responder
- Psychological First aid

In the final course, time will be spent on exploring the methodologies associated with exercise design and evaluation, with focus on student's ability to design, participate in, and evaluate exercises. The program will then culminate in a program evaluation component consisting of written and oral examinations using primarily scenario-based tools.

Conclusion

As disasters increase in number, size, complexity, destructive power, and financial devastation, all nations need to continue work in educating and training emergency managers to effectively prepare, respond and recover. This is especially true in developing nations and those unable to current respond effectively. TIEMS has a major role to play in the education and preparedness of nations. As described in the body of this work, the search for a set of acceptable global competencies in disaster management continues. Although nation and area-specific training must be developed due to the myriad of ideologies, governmental structures, and range of disasters encountered/expected, commonality in disaster management knowledge exists among all who work in emergency management. One set of such competencies has been proposed in this paper, and will serve as the foundation for a pilot course for emergency managers. TIEMS leadership has established a broad base of international members, chapters, and extensive expertise on which to build a pyramid of readiness based on competencies. All TIEMS Education and Training Development and Certification components are mobilized to continue evolution of its program at TIEMS 2011 in Bucharest, Romania.

Three conclusions are drawn from this paper:

1. There is an international set of competencies common to all emergency management that can serve as the base to a pyramid of more specific nation and disaster-specific training.
2. The competency base should be drawn from the topic areas described.
3. The base competencies described will evolve as the panel of experts grows, as chapters and members provide further input, and as TIEMS Education and Training Development and Certification components evolve.

The TIEMS Education, Training, and Certification Program in Emergency and Disaster Management provides a mechanism to acquire necessary knowledge and skill sets for times of disaster.

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Romanian Emergency Management Information System Architecture

Victor Gradinescu, Gabriel Waspusch, S&T Romania

Introduction

Romanian Emergency Management Information System (EMIS) is a fully integrated information system within the National Emergency Management System (NEMS) connecting all the Emergency Operations Centers (EOC), and other stakeholders for streamlining information sharing and decision support for both daily routine and emergency situations response operations, supporting all phases of emergency management*:* mitigation, preparedness, response, and recovery. EMIS selects and organizes the various data collected and disseminated by a multitude of authorities involved in emergency management and process that data to enable the development and implementation of a clear plan of actions in response to the emergency.

EMIS is deployed in the Emergency Operational Centers **-** EOC's of the NEMS: primary National EOC – NEOC1, secondary National EOC – NEOC2, County EOC **-** CEOC, Bucharest EOC **-** BEOC and Ministry Emergency Operative Centers – MEOC. National, Bucharest and County EOCs are operational structures of the General and County Inspectorates for Emergency Situations, whilst Ministry EOCs are operational structure belonging to the respective organisations. EMIS covers the national level (NEOCs and MEOCs) and the county level (CEOCs). An extension of the system to the local level can be taken into consideration in the future.

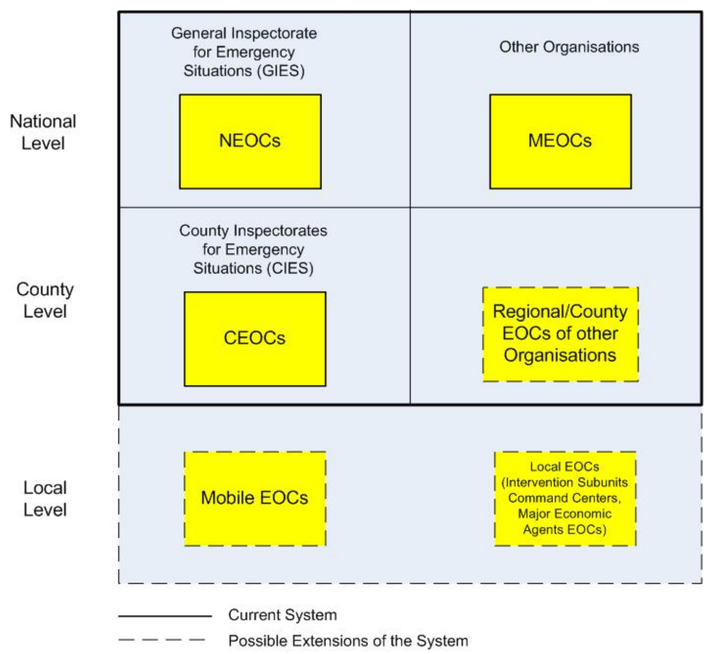


Figure 1 – EMIS Operational Centres

System Architecture Overview

The architectural model of EMIS maps exactly on the current Romanian organization model of emergency management. In this model (combined centralized-distributed model) county EOCs (CEOCs) coordinate emergency management activities at county level. During normal operations, only a limited number of operators are available at the county EOCs. In case of major emergencies, the CEOC is staffed with CIES emergency management personnel and experts belonging to various other independent emergency actor organizations .In this model independent emergency actors, while still maintaining their operation centers, use the county EOC primarily and decisions are made there. NEOC1 plays a high-level coordinator role during emergency situations, and NEOC2 is activated in cases of nation-wide emergency situations.

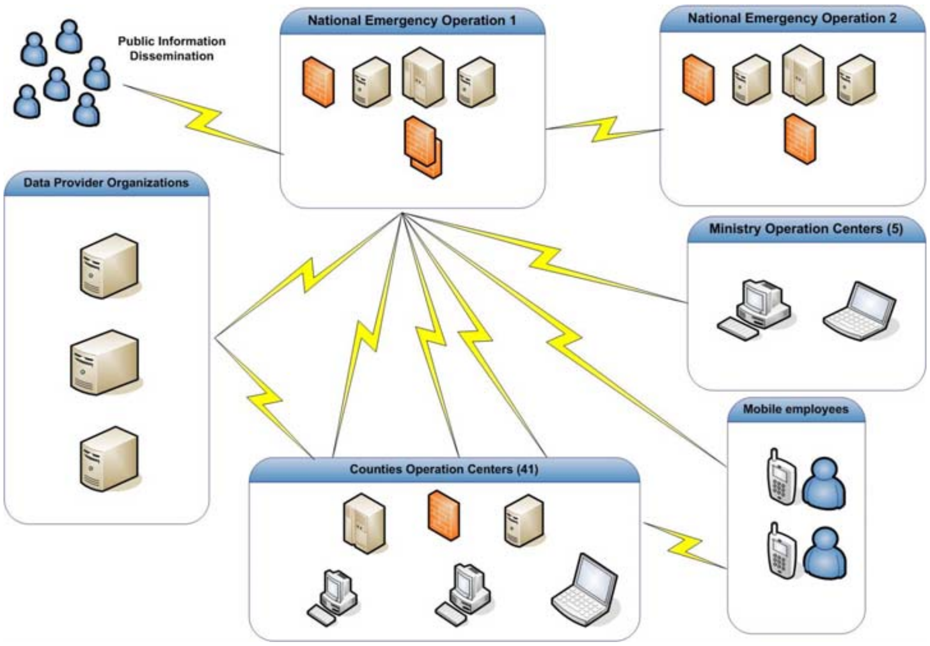


Figure 2 - EMIS Conceptual Model

According to the NEMS provisions, within EMIS, the EOC's are acting as information hubs. The information centralized at county level (County EOC - CEOC) or ministry level (Ministerial EOC - MEOC) is replicated at the national level (National EOC - NEOC). These locations are interconnected by means of a WAN, built on the existing infrastructure of Special Telecommunications Services and Ministry of Administration and Interior networks.

EMIS Applications

Following is a detailed description of the Applications level (see EMIS System Architecture for details regarding EMIS system conceptual levels). The Applications level is the level which implements the business processes in the system.

Software application level contains three main parts:

- **EMIS Application** which contains all the modules used in the management of emergency situations, back office activities and interoperability. Deployed in every EOC in the system.
- **Public Information Dissemination Application** - deployed at NEOCs, it offers all needed mechanisms to provide timely public information and instructions in case of an emergency situations
- **Cortex** - communications solution that gives operators a unified access to telephone systems, radio and CCTV

The EMIS Application is the core application of the system. The application implements the business processes specific to the planning, response and recovery emergency management phases.

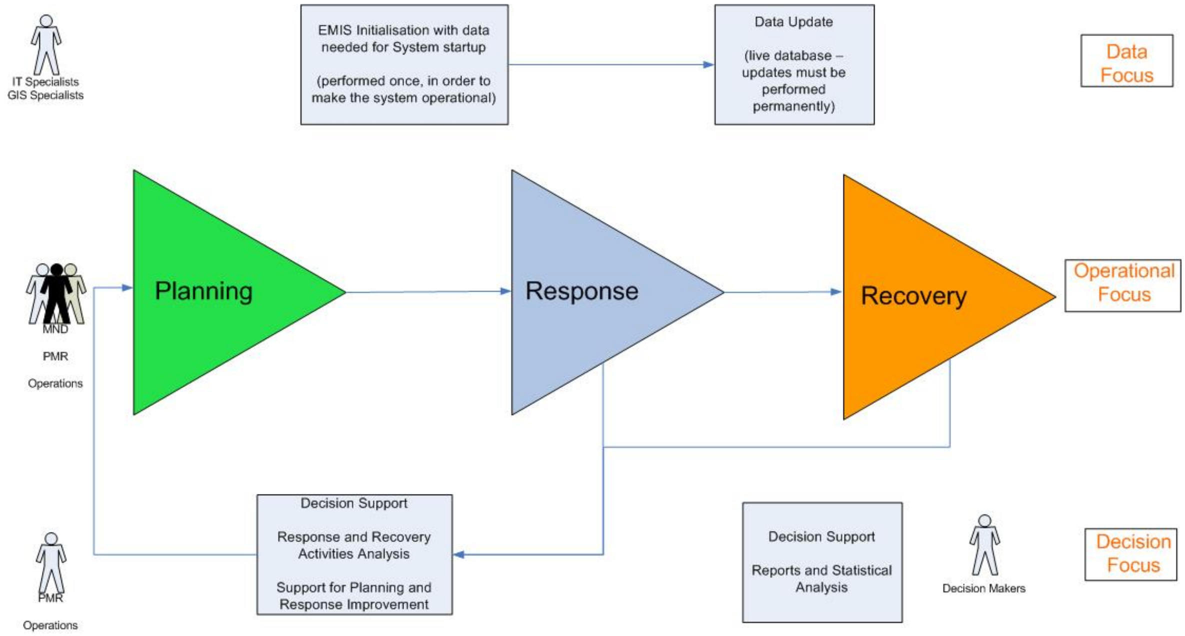


Figure 3 – EMIS Operational Processes

The application has a modular structure. Some modules are core modules used in a specific phase, some modules are to be used in multiple phases, whilst others are only support modules.

Following is the mapping between business processes / major functionalities of the application and functional modules.

- **Response and Recovery:**
  - Emergency Situation Management Module with support from the others modules
  - WebGIS Module (Emergency Situations Management module)
  - Task Force Creation
  - Evacuation Module
  - Casualties, Damages and Material Loses Module
- **Planning:**
  - Planning Module with support from the others modules
  - WebGIS Module (Planning Mode)
  - Task Force Creation Module
  - Finance and Budgeting Module
- **Alerting and Notification**
  - Notification Module alone or integrated in Emergency Situation Management

- **Reporting:**
  - Situations and Reporting Module
  - Intervention Reporting Module
  - Budgeting and Financing Module
- **Creating, management and maintaning EMIS database (**must be a live database):
  - Organization Management Module
  - Human Resource Management Module
  - Logistics, Material Resources and Supply Chain Module
  - Risk Management Module
  - Hazardous Materials Management Module
  - Evacuation Module (Hosting Spaces)
  - WebGIS Module (Reference Components Management Mode)
  - External Interfaces Module
  - Media and Communication Experts

– Administration Module, Nomenclatures Administration Module

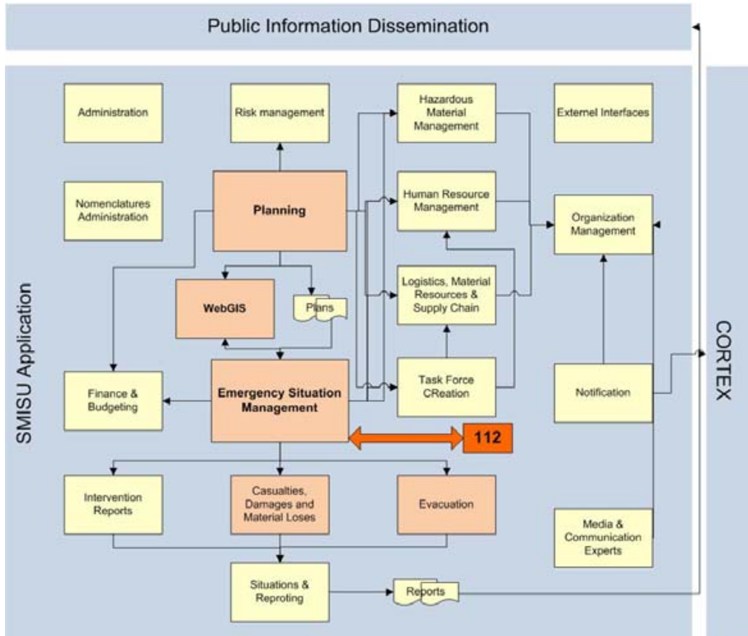


Figure 4 – The three applications in the application level and the modular structure of the EMIS Application

Emergency Situation Management Module is one of the core modules of the EMIS application, integrating features that enable real-time operational management of emergency situations. An emergency situation can be treated as "real" or "exercise". This module integrates functionalities providing emergency situation registration, intervention forces and material resources assignment, visual management of emergency situation intervention (by means of integration with the GIS module), availability of scenario based pre-planned emergency management information, workflow based EOC activities management, recording of emergency situation effects data (casualties and damages, evacuated persons) and intervention reports data, integrated notification and alerting and recording of communications.

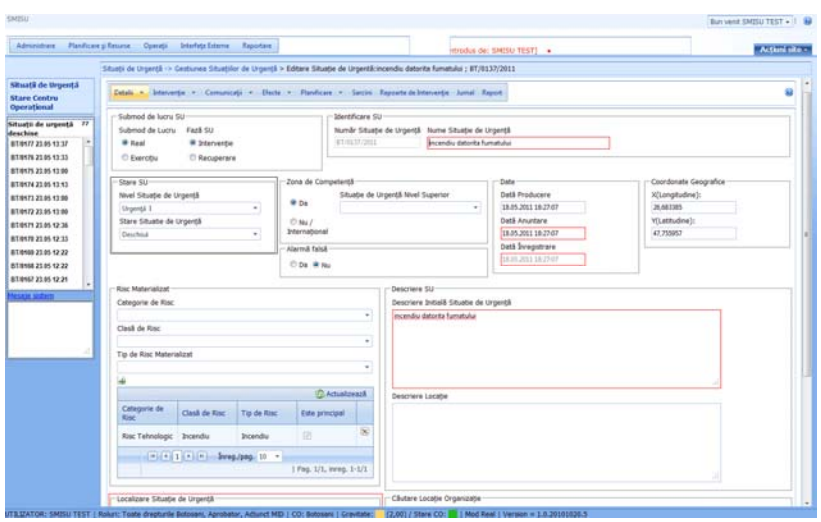


Figure 5 – The Emergency Management Situation Registration Screen

Planning Module provides tools for the development in the preparation phase of plans and procedures which can later be used in the response and recovery phases.

Plans have various types (e.g.: intervention, evacuation), address certain risk types and have a geographical context (address certain locations).

Plans may contain three types of information:

- structured data
    - which was input in other modules and is displayed filtered according to plan context (organisations to be contacted, risks, hazardous materials, available hosting spaces to be used in case of evacuation, available experts)
    - scenario based data (intervention forces to be tasked, human resource capabilities and material resource types to be allocated, alerting lists to be used)
- GIS data providing a visual depiction of the geographical area addressed by the plan context and planning elements which can be represented visually (evacuation routes, rally points, command points, etc.)
- Unstructured data (documents, images, movies, etc.)

EOC procedures can be input in the planning module. Procedures are modeled as task template libraries. When activated in the emergency management module, procedures turn into workflows, which allow the tasking and tracking of activities performed by the various operational roles in the EOC.

WebGIS Module provides to EMIS the GIS functionalities required to visually manage an emergency situation from the operational point of view. It integrates with the emergency management and planning modules, providing functionalities allowing users to represent on the map various emergency situation related entities (emergency situations, intervention forces, points of interest – organisations' locations, hosting spaces, etc) and takeover the data input in the other modules for usage in GIS context, automation features like automatic emergency situation or plan context placement.

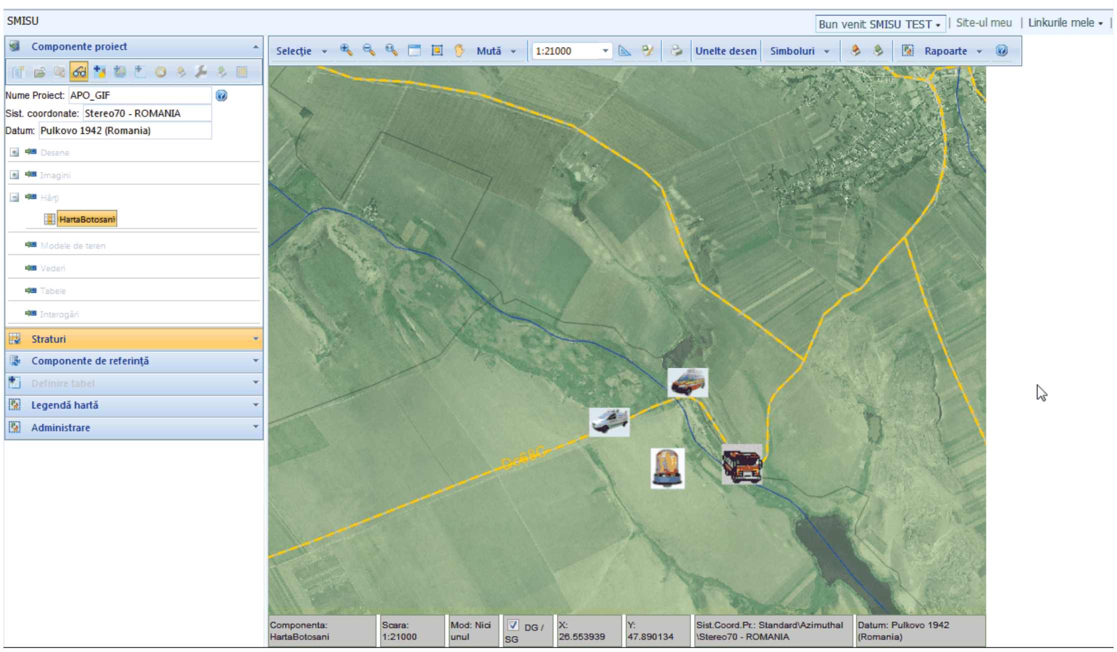


Figure 6 – WebGIS Module Screen

Task Force Creation module registers the intervention forces that can be actively used in each EOC for managing emergencies. Task Forces can belong either to organisations having intervention attributions for emergency situations pertaining to various risk types (e.g.: professional emergency situation management services like General and County Inspectorates for Emergency Situations, Police, Ambulance, other institutions), or to organisations having a support role for interventions (e.g.: private or voluntary emergency management services, Economic Agents)

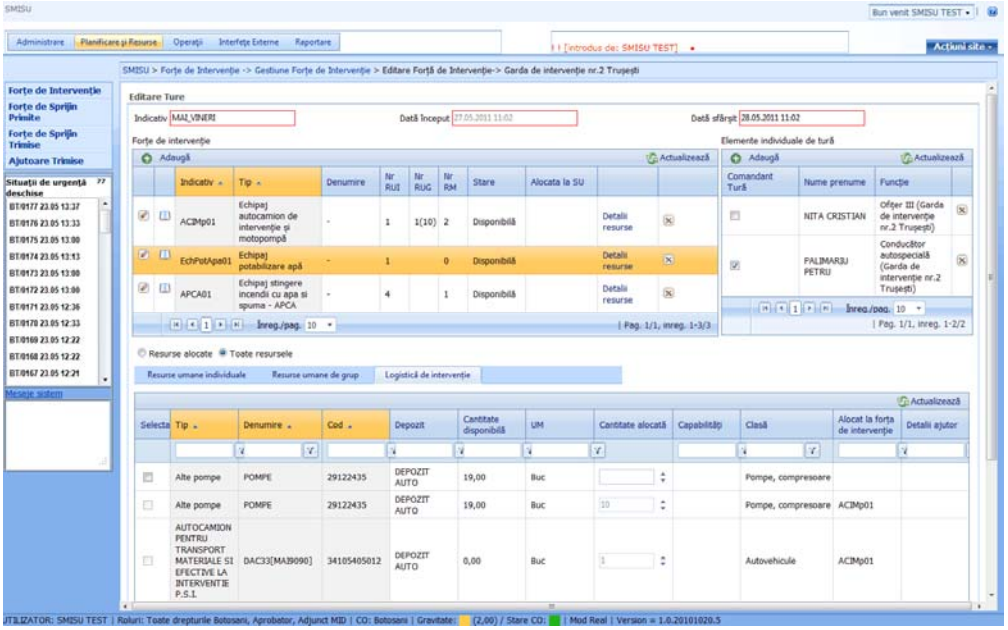


Figure 7 Task Force Creation Screen

Casualties, Damages and Material Loses Module records information about victims and material damages caused by emergency situations.

Evacuation Module assures the management of evacuated persons and the management of evacuation areas.

Interventions Reports Module allows the registration of intervention reports

Notification Module is intended to notify people regarding important events and emergencies. The system implements the following methods of communication: SMS, Fax, Voice, and Email. This module provides facilities to create list of contacts belonging to organisations of persons. Alerting lists can then be used to provide targeted and structured notification of certain target groups, according to various notification schemes.

Risk Management Module ensures local and national management of risks catalogs of territorial administrative units, public institutions and economic operators. Local system catalogs are managed by the Counties Emergency Operational Centres of the Counties Inspectorates for Emergency Situations and the Bucharest Inspectorate for Emergency Situations. National Catalogue is constituted according to law, by centralization of the information from local catalogs in the National Emergency Operational Centre.

Hazardous Materials Management Module records in the hazardous substances database of EMIS the inventory of hazardous substances for each location of each economic agent.

Human Resource Management allows the management of individual and group human resources.

Logistics, Material Resources and Supply Chain Module allows the management of material resources used in the emergency situations.

Media and Experts Module provides emergency management experts contact information and supports public relations communication structures within the Operational Centres, enabling them to manage information about media.

Organization Management Module allows the management of the organizations which can play a role (active or passive) in emergency situations and their management. Organizational entity concept is one of the central concepts of EMIS. The EMIS application allows the modelling of organizations or structures within them. The module allows management of all corporate entities that are defined in the Organizational Entity Registry in EOCs.

Financial and Budgeting Module allows the calculation of the budget for exercises and the costs of interventions

Situation and Reports Module generates reports based on information recorded in the Emergency Management (or other modules integrated in it) or Intervention Reports modules. The set of reports can be expanded to include ad-hoc reports.

External Interfaces Module allows external information originating from data sources belonging to different institutions and organizations which have responsibilities in NEMS to be imported into EMIS. The data sources supported are electronic documents (MS Office, pdfs, images, videos, paper documents), tabular data(.XLS, .DBF files), digital maps (ESRI shape files, images) or user interface forms.

Administration Module allows management of user accounts, user groups and roles. This module also allows auditing of all operations performed in the system.

Nomenclatures Administration Module registers and modifies the data model entities of the EMIS application whose values are common to the whole system: common lists, SIRUTA register, libraries of symbols, patterns and printing entities which can be represented on a map. In order to ensure the consistency of information in the EMIS, these nomenclatures are managed centrally (NEOCs) by users with appropriate rights and disseminated in the whole system.

Information Workflows in EMIS

At the national level, EMIS is installed in primary National EOC (NEOC1) and in secondary National EOC (NEOC2. The two national centers are configured so that the NEOC2 in case of force majeure can take over all the functions of NEOC1. The take over solution is ensured by mirroring and log shipping database mechanisms.

National level has a major role in system architecture, at this level being updated common system nomenclatures and other common information which are then disseminated to all EOCs through the mechanisms of database replication.

County Level represented by the CEOC and the Bucharest EOC. The county is fully operational and the data consistency is assured in all CEOC through information dissemination from the national level, and through centralizing information on emergencies of all counties EOC to the national centers. At this level EMIS application is installed so that it can also be used in case of lack of communication channels with the national level. The system architecture allows the backup mechanism and log shipping made from the county level to national level, and also allows operational county re-creation of an EOC, in case of force majeure, in the secondary location and takes over of all operational activities with all data and information of the affected location.

Ministerial level is represented by ministries and central government responsible for management of those risk type which can generate emergency situations. EMIS MEOC has implemented special information workflows to all counties EOC or just to specific operational county centers.

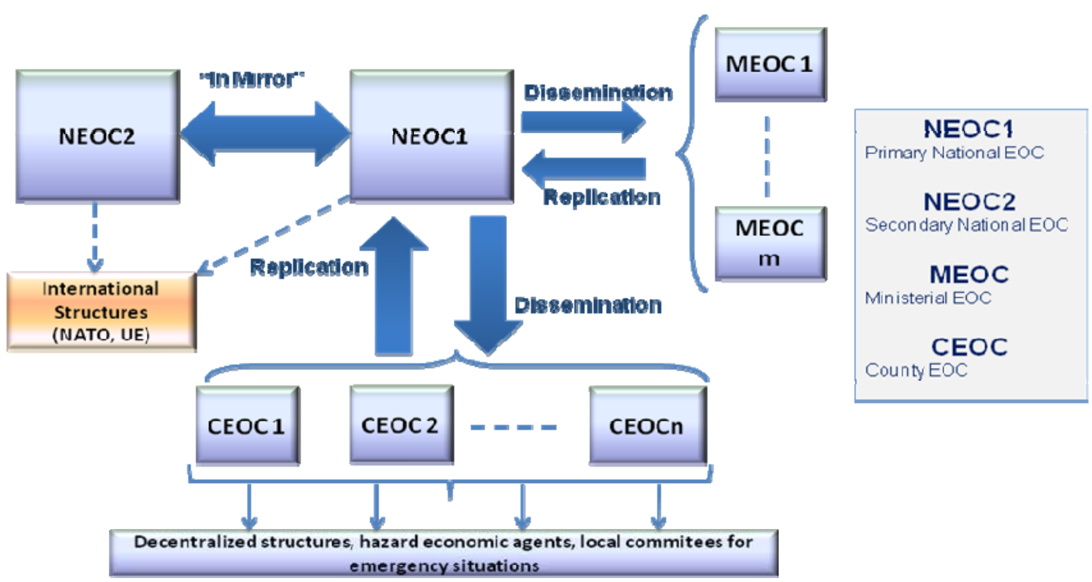


Figure 8 EMIS information workflows

The central part of EMIS is located at NEOC1 with a complete backup system at NEOC2, the two locations being connected by a gigabit link. During normal situations, routine operations management is carried on at CEOCs/BEOC supervised by NEOC1, NEOC2 having backup role; during emergency situation, NEOC2 will take over the role of managing the situation.
The EMIS system architecture has three conceptual basic levels:

- Hardware and communications infrastructure level
- System software infrastructure level
- Software Application level

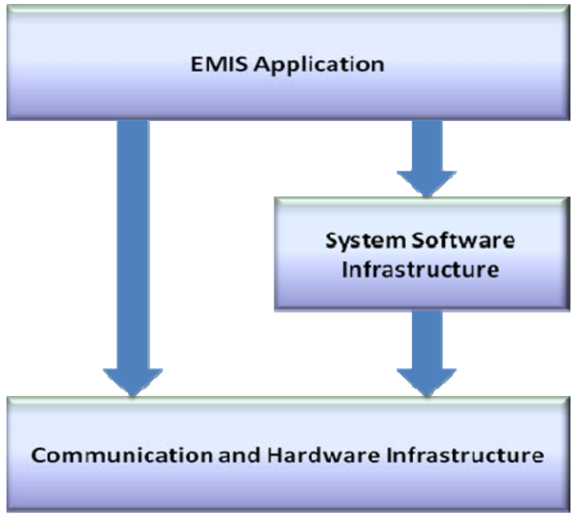


Figure 9 EMIS Architecture Conceptual levels

Hardware and communications infrastructure contains servers, workstations, peripheral equipment, network and communications equipment.

System software infrastructure level contains system software components which assure the support for software application level: operating systems, database management systems, application servers, portal, content and document management systems, email management systems, infrastructure management software, directory services, etc. The platform used is Microsoft platform.

Application software level implements the software applications specific for management of emergency situations. All the software applications were developed on Microsoft .NET technology having an interface accesible by web browser.

Conclusions

- Covers all phases of emergency management: preparation, mitigation, response, recovery
- Covers routine situations / major emergencies situation
- Allows management and coordination of response to emergencies situations
- Allows sharing of information among participating actors to solve an emergency situation
- Ensure traceability of emergency management
- Supports the achievement of high efficiency and performance indicators for emergency situation interventions
- Provides two working modes – real and simulation. The latter can be used for training activities. Data separation between the two modes is complete.
- Manages activities related to evacuation operations
- Keep track of victims and material damages

- Keeps track of plans and procedures
- Allows planning activities related to intervention
- Provides structured and tiered notification for various target groups: operational centers and professional intervention structures staff, emergency committee members
- Allows recording of information in the national catalog of risks
- Provides management of organizations and individuals, human and material resources management, management of hazardous substances
- Consolidation of national emergency-related information
- It allows real-time synthetic NEOC information on active emergency situations
- It provides a nationally consistent approach to emergency management
- Provides interface between the component institutions of the National Emergency Management Situations
- Provides various statistical and consolidated reports, both at county and national level

Technologies and concepts for urban safety

Dragos Basmaluta, MIRA Telecom, Romania

Abstract

By 2050, nearly three quarters of our planet will live in cities. The increment of inhabitants in the cities implies an increasing demand in vital services as transport, health, education or personal security. For all cities and regions competing in the global market place, safety and security are crucial factors in determining overall quality of life. Moreover, protecting citizens is the first duty of a state and also a priority for the success of businesses, communities and civil society at large.

In recent years, several cities' Town hall authorities, police and fire brigade managers have made a great effort in applying innovative approaches and new technologies to help reduce emergency response time and urban crime. However, there is still a need to enhance technologies already applied in the public safety area.

New capabilities could help make urban public safety systems not just more connected and efficient, but smarter. Instead of merely responding to crimes and emergencies after the fact, smart new systems should analyze, anticipate and actually working to prevent them.

Cities framework for urban safety is devided in four main groups depending on their functionality.

Situational awareness – sensors classification based on their functionality.

Command Centers – defines how the input data is processed and how to detect anomalous behaviour.

Ad-Hoc networks – deploy an array of sensors in strategic points.

Alerting technologies to citizens – send emergency messages through telecommunication networks.

Introducere

Aceasta este o scurta descriere a proiectului SafeCity, finantat de Uniunea Europeana prin programul FP7 (Seventh Framework Programme for Research and Technological Development) pe care Mira Telecom il implementeaza alaturi de alti participanti la consortiu.

In ultimii ani, mai multe autoritati locale de la nivelul orasului, din Politie, Jandarmerie, au investit mai mult efort in adoptarea unor solutii inovative si noi tehnologii pentru a reduce timpul de raspuns in cazul unei urgente sau a unei crime „urbane". Totusi, este nevoie de a imbunatati tehnologiile deja aplicate in cadrul sigurantei locurilor publice. De exemplu, sistemele actuale de securitate de CCTV colecteaza si transmit informatii vitale folosind reteaua de fibra optica instalata la nivelul orasului catre camere de control in care membrii departamentelor ce se ocupa cu securitatea unui oras supravegheaza zonele de siguranta. Totusi, volumul mare de informatii transmise de camere ora de ora, zi de zi obosesc operatorii conducand astfel la o eficienta scazuta a sistemului. Numai 3% din incidentele din Londra au fost rezolvate folosind camerele CCTV amplasate in Londra in conditiile in care sunt instalate peste 10 000 camere.

Noi capabilitati ar putea sa imbunatateasca capabilitatile instalate la nivelul oraselor. In loc ca autoritatile sa raspunda la un incident dupa ce acesta a avut loc, noile sisteme inteligente ar trebui sa analizeze, anticipeze si sa incerce sa previna aceste evenimente.Dupa atacul terorist din Madrid in 2004, primaria orasului a dezvoltat un sistem integrat „Emergency Response Center" astfel incat daca se primeste un apel de urgenta de catre un serviciu acesta este rutat imediat catre politie, ambulanta si/sau pompieri. Sistemul poate recunoaste daca o alerta corespunde unui singur sau mai multor incidente si sa aloce resursele luand in considerare cerintele din teren. Timpul de raspuns a fost redus cu 25%.

Mai mult, in loc ca centrele de comanda si control sa raspunda dupa ce incidentele au avut loc, acestea ar trebui sa poata analiza, anticipa si preveni astfel de evenimente. Entitatile responsabile cu siguranta publica ar trebui sa fie alertate despre un incident inainte ca acesta sa aiba loc, iar cei care intervin in faza initiala, precum si populatia afectata ar trebui informata.

Tematica

Termenul de „SafeCity" se aplica sigurantei urbane in orasele inteligente (Smart Cities). Obiectivul principal este de a imbunatati rolul sistemelor de supraveghere pentru a asigura cetatenilor protectia in zonele in care este instalata infrastructura de supraveghere. Conform DG INFSO un oras SmartCity face un efort constient de a folosi solutii IT&C pentru a imbunatati conditiile de viata si munca si pentru a sprijini un mediu urban sustenabil.

Economie inteligenta (Competitivitate)	Oameni inteligenti (Capitalul uman si social)
Spirit inovativ Spirit antreprenorial Imaginea economiei Flexibilitatea fortei de munca Participarea la economia globala Abilitatea de a se transforma	Nivelul calificarii Long Live Learning Pluralitate sociala si etnica Flexibilitate Creativitate Cosmopolitan / deschidere Participarea la viata publica
Guvernanta inteligenta (Participatie)	Mobilitate inteligenta (Transport & ITC)
Participarea la luarea deciziilor Servicii publice si sociale Transparenta guvernarii Strategii politice si perspective	Accesibilitate locala Accesibilitate (inter)nationala Infrastructura IT&C Sistem de transport sustenabil, sigur si inovativ
Mediu inteligent (Resurse naturale)	Viata inteligenta (Calitatea vietii)
Atractivitatea conditiilor naturale Poluarea Protectia mediului Managementul sustenabil al resurselor	Posibilitati culturale Conditii de sanatate Siguranta individuala Siguranta locuintei Posibilitati de educatie Atractivitate turistica Coesiune sociala

Dupa definitia Wikipedia, Orasele Inteligente pot fi definite (si clasificate) dupa 6 arii sau dimensiuni. Acestea sunt: economie inteligenta, mobilitate inteligenta, mediu inteligent, oameni inteligenti, viata inteligenta si in final guvernanta inteligenta. Aceste 6 arii conecteaza abordarea traditionala cu teoriile noi despre dezvoltarea si cresterea oraselor.

Un oras poate fi definit ca Inteligent cand investitiile in capitalul uman si social, in transport si infrastructura de comunicatii IT&C alimenteaza cresterea economica sustenabila si o calitate ridicata a vietii, cu un intelept management al resurselor naturale prin guvernanta participatorie.

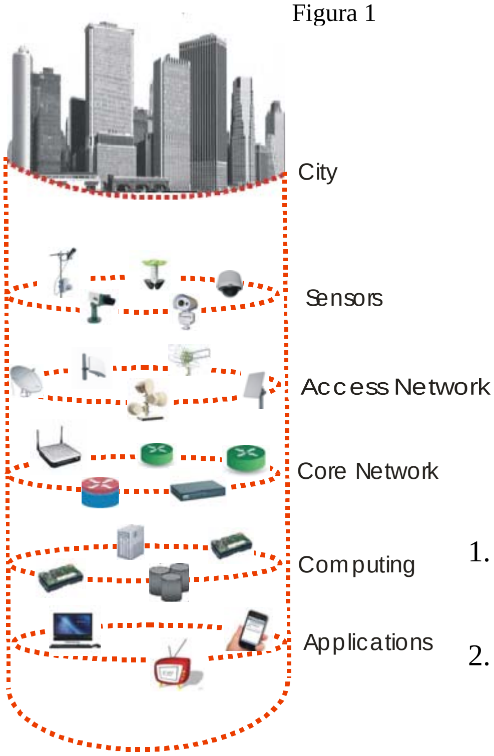
Conform unui studiu de piata intitulat „Wireless Sensor Networks for Smart Cities”, Iulie 2007, in zona de siguranta urbana:

1. 62% din municipalitatile chestionate indica ca siguranta urbana este motivul numarul unu pentru adoptarea unor tehnologii wireless cum ar fi wireless broadband sau WSN.
2. Cei implicati in siguranta publica sunt foarte inclinati in a adopta o varietate de solutii WSN in urmatoarele 18 luni pentru serviciile de localizare, monitorizarea semnelor vitale si monitorizarea mediului inconjurator.
3. Cheltuielile cu siguranta publica sunt deja la un nivel de 18% si cresc mai rapid decat alte tipuri de cheltuieli.

Aplicatia

Scopul proiectul SafeCity este de a imbunatati serviciile de siguranta publica prin integrarea mai buna cu infrastructura de Internet din interiorul oraselor. SafeCity is creat pentru a ajuta organizatiile implicate in siguranta publica in a colecta, distribui si analiza datele mai eficient pentru a ajunge la decizii inteligente in timp real, in timp ce planifica si se raspunde la incidente si urgente. Ajutand agentiile implicate in pastrarea sigurantei urbane sa obtina o imagine de ansamblu comuna prin distributia informatiei rapid si sigur folosind sisteme multiple este scopul acestui proiect. Concret, SafeCity isi propune sa imbunatateasca perceptia situatiei (Situational Awarness) si prima faza a raspunsului la incidentul sau urgenta care a aparut in oras. Proiectul SafeCity poate fi vazut pe 6 nivele, depinzand de infrastructura analizata.

Figura 1



Nivelele sunt:

1. Infrastructura orasului: drumuri, strazi, parcuri, cladiri emblematice
2. Senzori / sisteme de alertare a cetatenilor: senzorii sunt compusi din camere, senzori de mediu, senzori biometrici, retele wireless de senzori, care

genereaza date ce vor fi preluate de nivelul superior. Sistemele de alertare a cetatenilor sunt compuse din telefoane, panouri de trafic, etc care primesc comanda din unitatile de procesare.

3. Retele de access si gateways: puncte de access wireless bazate pe tehnologia WiMax/Wi-fi sau relete de calculatoare cuplate la reteaua de baza („backbone”)

4. Retele de baza („Backbone”): rutere de internet, fibra optica care formeaza reteaua de baza a unui oras.

5. Unitati de procesare: unitati care proceseaza datele, centralizat sau distribuit, responsabile pentru managementul datelor colectate de la senzorii subordonati, controleaza sistemele de alertare a cetatenilor asignati si transmit alarme catre centrele de procesare ierarhic superioare daca este necesar.

6. Aplicatii: alertele sunt distribuite prin web, reteaua telefonica, etc.

Deasupra acestor nivele vor fi elementele componente ale orasului compusa din cetateni, strazi, cladiri si altele. In plus, sunt disponibile o retea larga de senzori si sisteme de alertare a cetatenilor distribuite in oras. Desi SafeCity este bazat pe o noua generatie de senzori, integrarea cu sistemele existente este posibila. Toate informatiile generate de sistemele existente vor fi transmise centrelor de procesare folosind doua tipuri de retele: de acces si de comunicatii. Modele de procesare centrale sau distribuite vor fi analizate pentru a prelucra informatiile in puncte specifice din cadrul unui oras. Pentru mecanismele de actualizare, unitatile de procesare a informatiilor pot trimite comenzi catre sistemele subordonate sau pot alerta unitati de procesare situate mai sus pe o scara ierarhica.In cazul unor schimbari de situatie, primul nivel de procesare furnizeaza centrelor superioare ultimele date si le alerteaza atunci cand apare o astfel de situatie. In acelasi timp centrele de comanda si control sunt unitati de prelucrare independente, capabile sa colecteze si sa proceseze informatiile de intrare, generand comenzi pentru a subordona alte centre de procesare sau pentru a alerta centre de comanda si control superior ierarhice din alte orase sau regiuni.

Structura sistemului

Structura sistemului SafeCity poate fi impartita in 4 grupuri, depinzand de functionalitatea lor: Perceptia situatiei, Centre de comanda, retele Ad-hoc si Tehnologii de alertare ale cetatenilor. Figura 2 descrie structura sistemului.

a) Perceptia situatiei: Depinzand de aspectele monitorizate, senzorii pot fi clasificati in senzori pentru cetateni, senzori pentru drumuri, senzori de mediu si senzori mobili.

Senzorii pentru cetateni sunt senzorii care sunt capabili de a detecta o situatie cauzata de cetateni. Exemple de aplicatii inovative acoperite de aceste tipuri de senzori sunt detectia comportamentului uman anormal, in interiorul sau exteriorul cladirilor, folosind sistemele CCTV pentru a detecta persoanele suspecte, bazandu-se pe recunoasterea amprentei, a trasaturilor faciala sau a irisului.

Senzorii pentru dumuri detecteaza situatiile de alerta cauzate de autovehicule. Un exemplu de aplicatie este detectia unei probleme de trafic, bazata pe sisteme de CCTV si algoritmi de prelucrare a imaginii.

Senzorii pentru mediu detecteaza situatiile de alerta cauzate de conditiile de mediu. Un exemplu de aplicatie poate fi detectia incendiului, gaze nocive, apa contaminata, etc.

Senzorii mobili pot detecta situatiile de alerta in timpul deplasarii. Exemplu de astdel de aplicatii poate fi detectia de autovehicule furate sau implicate in crime, folosind tehnologiile de recunoastere a numerelor de inmatriculare, folosind sisteme incorporate autovehiculele de patrulare.

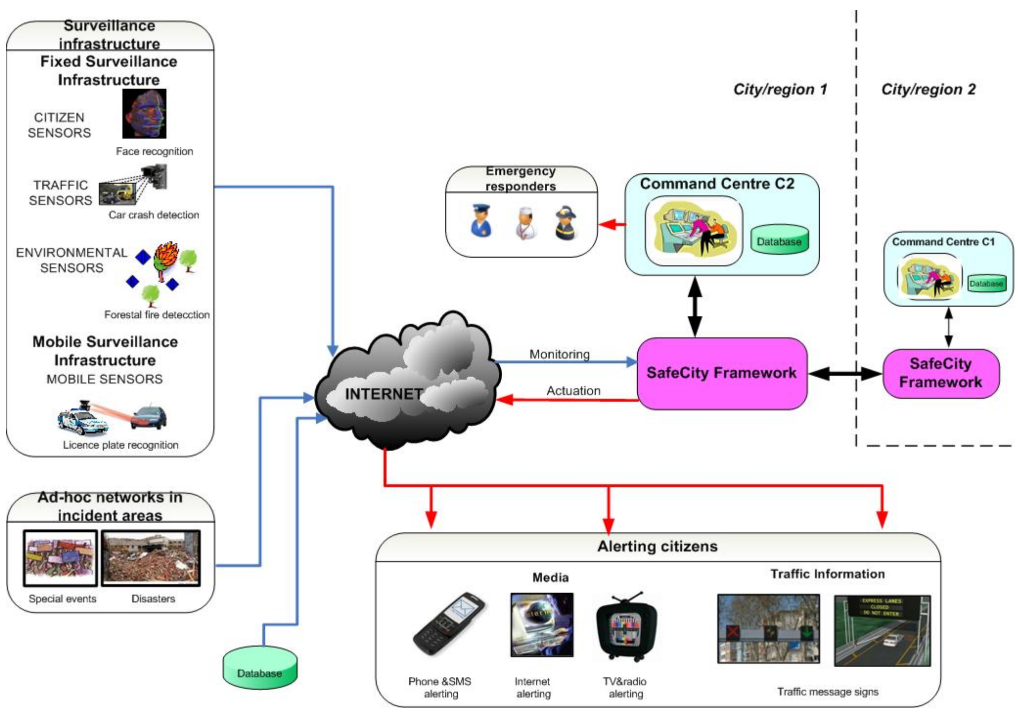


Figura 2 Structura sistemului SafeCity

b) Centre de comanda: Structura SafeCity este bazata pe algoritmi de decizie care permite unui sistem sa colecteze si sa proceseze datele de intrare si sa ia decizii in timp real. Este capabil sa detecteze comportamentul anormal folosind date in diferite formate provenite de la senzori diversi si sa genereze alerte ce vor fi analizare de operatori.

c) Retele ad-hoc: Structura SafeCity poate fi extinsa pentru a permite adaugarea unui numar mai mare de dispozitive si senzori, dispozitive de management si de stocare a informatiei. Mai mult, sistemul este conceput sa include retele de comunicatii mobile care pot fi desfasurate in punctele strategice unde a aparut un incident, in special atunci cand infrastructura de comunicatii este afectata sau atunci cand are loc un eveniment special (greva, manifestari sportive, etc).

d) Tehnologii de alertare a cetatenilor: Centrele de procesare a informatiilor ajuta in reducerea timpului de raspuns la stagiile primare de analiza, putand actualiza sistemele de informare ale cetatenilor sau alerta alte centre de comanda. Structura SafeCity doreste sa ofere un mechanism pentru a scrie si trimite un numar mare de mesaje personalizate de alerta catre cetateni, serviciu foarte apreciat de utilizatorii finali. Centrele de comanda si control vor trimite informatia oportuna folosind retele de comunicatii precum 3G, 4G, LTE, TV, chiar internet.

Rezultate si concluzii

Scenariile implementate de SafeCity tin de siguranta public in orasele inteligente (Smart Cities). Pentru prima faza a proiectului au fost alese cateva orase europene representative, luand in considerare mai multi factori, cum ar fi:

- Marimea orasului: mare, mediu
- Asezarea geografica
- Demografie
- Standardul de viata
- Gradul de dezvoltare IT&C si Securitate
- Aspecte sociale si culturale

Orasele considerate au fost alese cu atentie dupa ce autoritatile respective si-au manifestat interesul in acest proiect. Noi orase vor fi contactate in cadrul acestui proiect pentru a organiza proiecte pilot la scara mai mare in timpul derularii acestui proiect. Orasele candidate pentru prima faza sunt urmatoarele:

Orase candidat pentru prima faza a proiectului SafeCity

	**a.** **Madrid*:*** este al treilea oras ca marime din Europa. A inceput dezvoltarea unui system inovativ de siguranta publica dupa atacul terorist din Martie, 2004. **Authoritatea implicata:** Consiliul Orasului Madrid, ca partener.
	**b.** **Stockholm*:*** Capitala si cel mai mare oras din Suedia, avand aproximativ 22% din populatia Suediei. Stockholm are un sistem de transport foarte dezvoltat. **Autoritatea implicata:** Brigada de prevenire si stingere a incendiilor, Attunda
	***c.*** **Bucuresti*:*** Este cel mai mare oras din Romania, localizat in partea de sud est a tarii. Este unul din centrele principale de industrie si transport din Europa de Est. **Autoritatea implicata:** Consiliul General Bucuresti
	**d.** **Atena:** Unul din cele mai vechi orase din lume. **Autoritatea implicata:** Politia din Atena

	**e. Helsinki:** Este un important oras, plasat pe malul marii Baltice. **Autoritatea implicata:** Consiliul Orasului Helsinki
	**f. Obidos:** Este un oras mic, in sudul Europei, Portugalia. Au cateva proiecte ce instra in categoria “smart safety” **Autoritatea implicata:** Consiliul orasului Obidos

NATURAL RISK ASSESSMENT AND MANAGEMENT WITH INFORMATION TECHNOLOGY APPLICATION

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Keywords: natural risk assessment, earthquakes, landslides, mud flows, floods, storms, avalanches, information technology

Abstract

The paper addresses integrated natural risk assessment and management. It contains the results of a five-year study that was conducted by Seismological Center of IGE, Russian Academy of Sciences and Extreme Situations Research Center for EMERCOM of Russian Federation in natural risk estimation and mapping. Within the study, methodological recommendations have been developed for estimating and mapping natural hazard and risk at local, regional and federal levels. A special GIS environment has been especially created which contains information about earthquakes, landslides, mud flows, floods, storms and avalanches, as well as information about their consequences for the last 20 years in the Russian Federation. Mathematical models and the special GIS have been used to estimate the level of integrated natural risk for administrative regions of the Russian Federation territory, as well as for constructing maps of individual and collective risk zoning for the country territory.

Introduction

Natural disasters are becoming more frequent and devastating. Social and economic losses due to those events increase annually, which is definitely in relation with evolution of society. Natural hazards identification and analysis, as well natural risk assessment and mapping, are the first steps in prevention strategy aimed at saving lives and protecting property against future events. The paper addresses methodological issues of natural integrated risk assessment

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and mapping at different levels. The most hazardous natural processes, which may results in fatalities, injuries and economic loss in the Russian Federation, are considered. They are earthquakes, landslides, mud flows, floods, storms, avalanches. The special GIS environment was developed which includes information about hazards' level and reoccurrence, an impact databases for the last 20 years, as well as models for estimating damage and casualties caused by these hazards. Examples of seismic and integrated natural risk estimations and mapping at different scales are given. The results of integrated natural risk assessment are essential (practical) input for planning and implementing preventive measures at national and local authority levels, as well as actions to be taken by EMERCOM of Russian Federation.

Methodological issues of natural risk assessment

The section describes the procedures for individual and collective risk assessment created by earthquakes and other natural hazards, such as landslides, mud flows, floods, storms, avalanches, as well as integrated natural risk assessment. For estimation risk indexes and risk mapping the probabilistic approach was used.

Individual risk due to natural hazards is determined as the probability of death and/or injuries and/or economic loss for persons due to possible natural hazards within one year at a given place. Individual seismic risk R_s is the product of hazard and seismic vulnerability V_s. Vulnerability of population to seismic action of a given intensity is understood here as the ratio between the expected fatalities, injuries, those lost their property and the total number of persons living in a certain type of buildings (Larionov et al., 2003a). Individual seismic risk R_s (Methods..., 2000; Bonnin et al, 2002; Bonnin et al.,2004; Frolova et al., 2003; Larionov et al., 2003b) may be determined through mathematical expectation of social losses, which include fatalities, injuries and persons who lost their property $M(N)$ taking into account the number of inhabitants N in the considered settlement and probability of seismic event H

$$R_s = H \cdot V_s\ (I) = H \cdot M(N\ )\ /\ N \tag{1}$$

where - $V_s(I)$ is the vulnerability of population for the considered settlement;
- H is the probability of seismic event *per* one year;
- N is the number of inhabitants in the considered settlement.

The mathematical expectation of social losses $M(Nj)$ in certain j type of buildings for the considered settlement taking into account inhabitant migration in the buildings of j type during the day and night is determined by equation

$$M(N_j) = \iint\limits_{S_c} \int_{I_{\min}}^{I_{\max}} P_{C_j}(I\ ) \cdot f(x, y, I) \cdot \Psi_j(x, y) \cdot f(t) dIdtdxdy \tag{2}$$

where - $I_{\min}$ and $I_{\max}$ are the maximum and minimum possible earthquake intensities;
- S_c is the settlement area;
- $P_{Cj}(I)$ is the probability of fatalities, injuries and persons lost their property under the condition of damage to buildings of j type due to earthquake with intensity I;
- $\psi_j(x,y)$ is the density of population distribution within the considered area in buildings of j-type;
- $f\ (x,y,I)$ is the density function of earthq0uakes' intensity probabilities within the unit area with coordinates x , y;
- $f(t)$ – function obtained on the basis of statistical analysis of data on population migration during 24 hours.

The computations of $P_{Cj}\ (I)$ are carried out by formula

$$P_{Cj}(I) = \sum_{i=1}^{5} P_{Bi}(I) \cdot P\ (C_j | B_i) \tag{3}$$

where - P_{Cj} (I) is the probability of people to be impacted during the earthquake with intensity I;
- $P_{Bi}(I)$ is the probability of definite i damage state of buildings providing the given value of earthquake intensity;
- $P(C_j|B_i)$ is the probability of people to survive j level of impact under the condition that the building survived the damage state i.

The computations of P_{Cj} (I) are usually done for buildings and structures types classified according to MMSK-86 scale (Shebalin et al., 1986):

- buildings' type A (from local materials);
- buildings' type B (brick, hewn stone or concrete blocks);
- buildings' type C (reinforced concrete, frame, large panel and wooden);
- buildings' types E7, E8, E9 (earthquake resistant which are designed and constructed to withstand the earthquakes with intensity 7, 8, 9).

The mathematical expectation of social losses $M(N)$ for the whole considered settlement taking into account inhabitant migration in the buildings of all types during the day and night is determined by equation

$$M(N) = \sum_{j=1}^{n} \iint_{S_c} \int_0^{24} \int_{I_{\min}}^{I_{\max}} P_{Cj}(I) \cdot f(x, y, I) \cdot \Psi_j(x, y) \cdot f(t) dIdtdxdy \qquad (4)$$

where - n is the number of considered building types according to MMSK-86 scale.

Individual risk due to landslides, mud flows, floods, storms, avalanches may be determined using statistical data on consequences due to these processes for the area under study, using formula

$$R_{ei} = H \cdot P, \qquad (5)$$

where - R_{ei} is the individual risk due to i-th emergency situation caused by natural hazard;
- H is the probability of natural hazards *per* one year;
- P is the probability of unfavorable event under the condition that natural hazard occurred. Dimension of individual risk is 1/year.

Integrated natural individual risk (R_e) may be determined (Methods…, 2002; Frolova et al., 2007) taking into account the probability of death and/or injuries and/or economic loss for population, due to all possible natural hazards within one year in the area under consideration applying formula

$$R_e = 1 - \prod_{i=1}^{n} (1 - R_{ei}), \qquad (6)$$

where - n is the number of considered natural hazards;
- R_{ei} is the individual risk due to i-th natural hazard.

In the present study, for estimating integrated individual and collective natural risks from earthquakes, landslides, mud flows, floods, storms, avalanches, assumption is made that all these events are independent.

Collective risk due to natural hazards R_{ec} is determined as the expected number of casualties, both fatalities and injuries, as well as the number of people who lost their property as a result of natural hazards' occurrence *per* year.

$$R_{ec} = R_e \cdot N, \qquad (7)$$

where - R_e is the integrated individual risk due to natural hazards under consideration,
- N is the number of inhabitants in the area under study.

The estimations of collective seismic and integrated risks were made for the administrative areas of the Russian Federation.

Special GIS project for risk assessment and mapping

In order to estimate risks and construct maps for the Russian Federation territory, special GIS environment was developed (Frolova et al., 2010). It includes data bases with information describing the Russian Federation territory, software assigned for hazard and risk indexes' assessment, interface which allows to create thematic maps and text report according to specified forms.

The databases contain information describing the geographical situation of the territory, its structure, main landmarks and boundaries' shape. The main sources of information are digital and paper maps of average scales, thematic maps with description of zones characterized by different levels of natural hazards, statistical data about natural hazards' impact.

Thematic information about landslides, mud flows, floods, storms, avalanches is presented as vector digital maps, with detailed description of zones characterized by different hazard levels and recurrence period. Information is developed by the laboratories of geological risk and geoinformatics and computer mapping of IGE RAS. Maps of review seismic zoning of Russian Federation RSZ-97, scale 1:8000000, developed by Institute of Physics of the Earth RAS (http://seismos-u.ifz.ru/zoning.htm) were used as source of information about seismic hazard levels. Fig.1 shows the special GIS screen used to visualize different natural hazards; fig.2 shows integrated indexes of natural hazards for the Russian Federation territory.

Fig. 1. Screenshot of the special GIS for natural hazards visualization

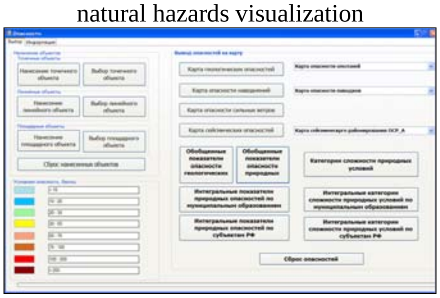


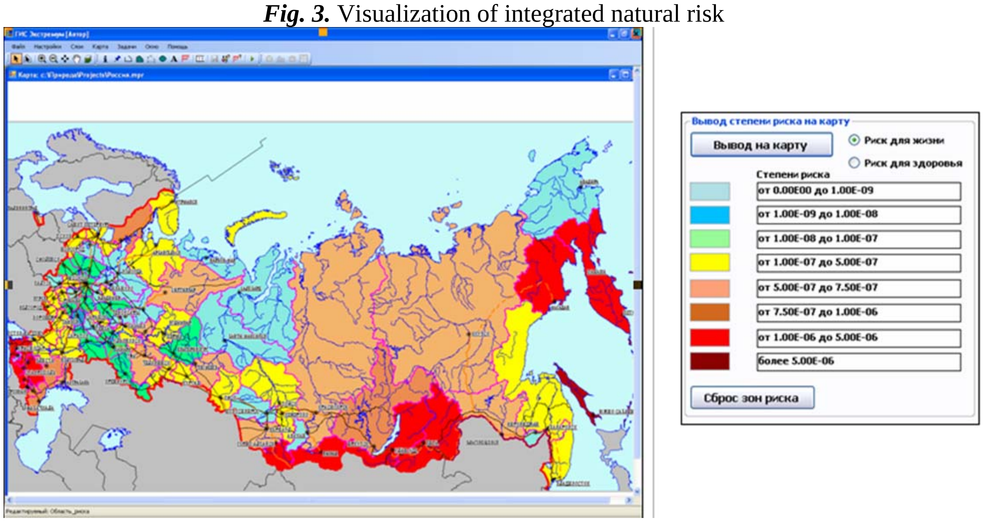
Fig.2. Map of integrated natural hazard for the territory of the Russian Federation

The GIS project includes also an impact database which was developed by the laboratory of seismic risk of IGE RAS. It contains brief descriptions of consequences of emergencies caused by natural hazards during the last 20 years, from 1991 up to 2010, in the Russian Federation.

GIS project software includes three blocks used for data management, computation of risk indexes and visualization of space information, on the screen, as thematic maps fixed scales.

The software allows integrated natural risk to be estimated at national level, on the basis of statistical information about past events over the last 20 years, as well as separate and integrated natural hazards risk indexes to be evaluated. It allows natural risk evaluations to be visualized for administrative areas and regions of the country. Fig. 3 shows visualization of zones characterized by different integrated individual natural risk levels computed using empirical data on past events' consequences.

Fig. 3. Visualization of integrated natural risk



Zones with level of individual integrated risk from earthquakes, landslides, mud flows, floods, storms, avalanches above $1.0\bullet10^{-6}$ are shown by red and dark brown colors.

Seismic risk assessment and mapping

Simulation models were used for computation of individual and collective seismic risks for the territory of the Russian Federation. Values of seismic risk obtained for separate cities and settlements were averaged within the administrative regions of the country. Three maps of individual seismic risk were constructed: R_s1 – probability of fatalities; R_s2 – probability of fatalities and injuries; R_s3 **-** probability of fatalities and injuries, economic loss for population due to earthquakes within one year. Three maps of collective seismic risk were constructed as well: $R_{sc}1$ – expected number of fatalities due to earthquakes *per* year; $R_{sc}2$ – expected number of fatalities and injuries due to earthquakes *per* year; $R_{sc}3$ – expected number of fatalities and injuries, as well as those who lost their property due to earthquakes *per* year. Fig. 4 shows the map of individual seismic risk zoning R_s2: probability of fatalities and injuries.

Fig. 4. Map of individual seismic risk for the territory of Russian Federation

Obtained values for individual seismic risk vary from negligible, close to zero, up to rather high values: more than $300\cdot10^{-6}$ for the probability of fatalities (map R_s1); more than

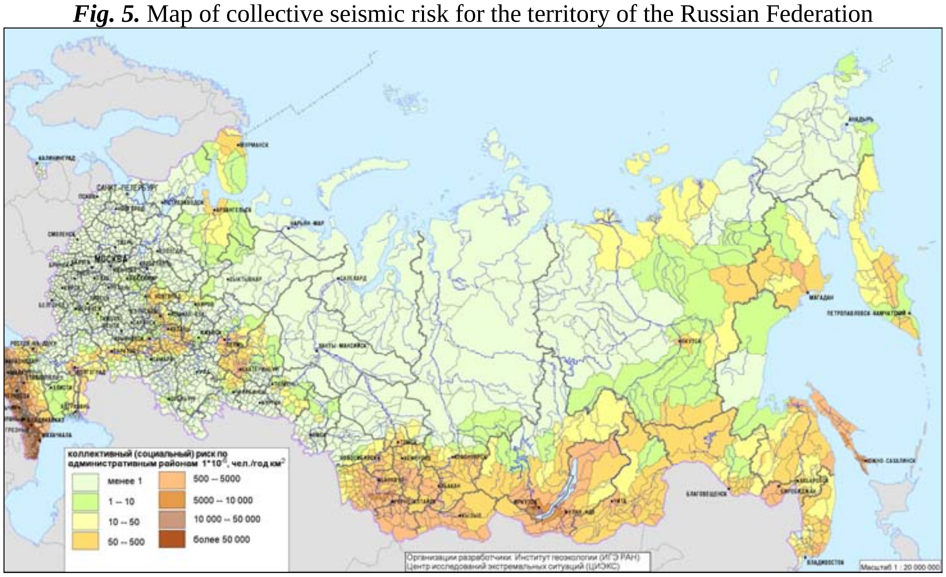
$1{,}000 \cdot 10^{-6}$ for the probability of fatalities and injuries (map R_s2); more than $1{,}500 \cdot 10^{-6}$ for the probability of fatalities, injuries and economic loss to population caused by earthquakes *per* year (map R_s3). Table 1 shows extent of zones with different levels of individual seismic risk according to maps R_s1, R_s2 and R_s3.

Table 1. Values of individual seismic risk and extent of zones with different risk levels

Risk ranges, 10^{-6}/year	Qualitative risk characteristics	Extent of zones, map R_s1		Extent of zones, map R_s2		Extent of zones, map R_s3	
		10^6 km^2	%	10^6 km^2	%	10^6 km^2	%
Less than 1	small	8.8	53	8.1	49	7.6	46
1 – 10	moderate	2.5	15	2.9	17	2.2	13
10 – 50	average	2.4	14	1.5	9	1.9	11
50 – 100	high	1.2	7	1.4	8	0.9	5
100 – 300	rather high	1.2	7	1.5	9	1.8	11
300 – 1000	extremely high	0.5	3	1.1	7	1.6	10
1,000 – 1,500		-	-	0.1	1	0.2	1
More than 1,500		-	-	-	-	0.4	2

Fig. 5 shows the map of collective seismic risk zoning $R_{sc}2$: expected number of fatalities and injuries due to earthquakes *per* one year.

Fig. 5. Map of collective seismic risk for the territory of the Russian Federation



Obtained values of collective seismic risk vary from negligible, less than $1 \cdot 10^{-6}$, up to rather high values – more than $10{,}000 \cdot 10^{-6}$ for expected number of fatalities (map $R_{sc}1$); more than $50{,}000 \cdot 10^{-6}$ for expected number of fatalities and injuries (map $R_{sc}2$) and for expected number of fatalities, injuries and number of persons who lost their property (map $R_{sc}3$). Table 2 shows extent of zones with different levels of collective seismic risk, according to maps $R_{sc}1$, $R_{sc}2$ and $R_{sc}3$.

Table 2. Values of collective seismic risk and size of zones with different risk levels

Risk ranges, 10^{-6} persons/year·km^2	Qualitative risk characteristics	Extent of zones, map $R_{sc}1$		Extent of zones, map $R_{sc}2$		Extent of zones, map $R_{sc}3$	
		10^6 km^2	%	10^6 km^2	%	10^6 km^2	%
1	2	3	4	5	6	7	8
Less than 1	small	9.7	58.4	8.9	53.6	8.1	48.8
1 – 10	moderate	2.5	15.1	2.4	14.5	2.8	16.9

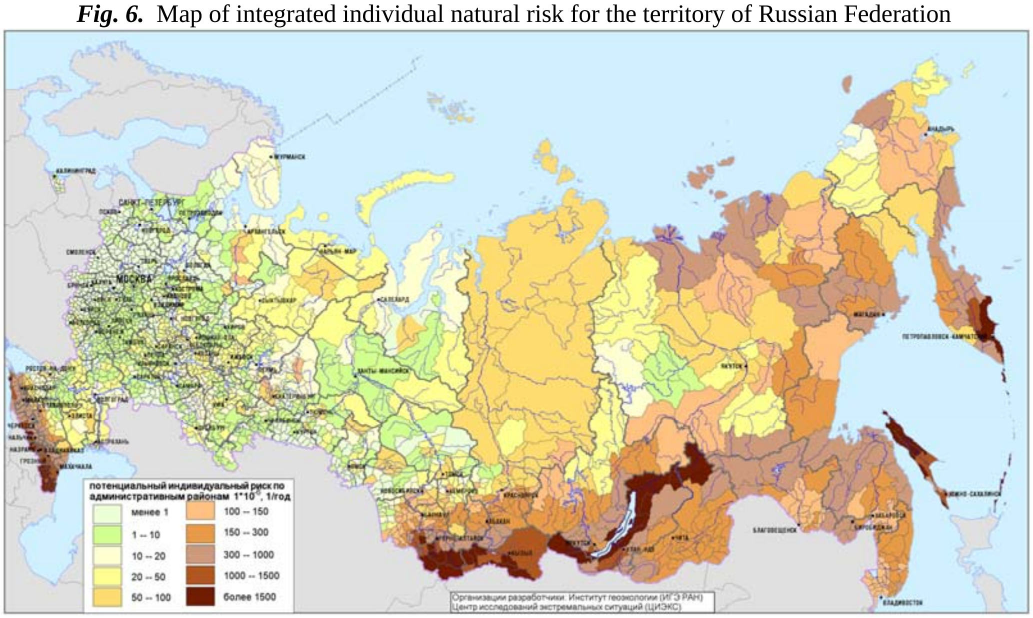
1	2	3	4	5	6	7	8
10 – 50	average	2.1	12.7	2.0	12.0	1.6	9.6
50 – 500	high	1.7	10.2	2.2	13.3	2.6	15.7
500 – 5000	rather high	0.5	3.0	0.9	5.4	1.2	7.2
5000 – 10000	extremely high	0.06	0.4	0.08	0.5	0.1	0.6
10000 – 50000		0.06	0.4	0.08	0.5	0.1	0.6
More than50000		-	-	0.04	0.2	0.1	0.6

The computed values of individual seismic risk R_s1 are more than $300 \cdot 10^{-6}$,1/year for all administrative divisions within Sakhalin area, Republic of Altay, Tuva, Dagestan and Northern Osetia. The highest values of individual seismic risk R_s3 are obtained for Kamchatka, near lake Baikal, Republic of Buryatia, Irkutsk region, Altay kray, as well as for Krasnodar region and Chechen Republic.

Integrated risk assessment and mapping

Individual risks from separate natural hazards (landslides, mud flows, floods, storms, avalanches) were computed according to equation (5) using regional empirical data about each hazard consequences over the last 20 years. Integrated individual risk from all considered six hazards (earthquakes, landslides, mud flows, floods, storms, avalanches) was computed according to equation (6). Three maps of integrated individual natural risk were constructed: R_e1 – probability of fatalities; R_e2 – probability of fatalities and injuries; R_e3 - probability of fatalities and injuries, economic loss for population due to six hazards within one year. Three maps of integrated collective natural risk were constructed as well: $R_{ec}1$ – expected number of fatalities due to six hazards *per* year; $R_{ec}2$ – expected number of fatalities and injuries due to six hazards *per* year; $R_{ec}3$ – expected number of fatalities and injuries, as well as those who lost their property due to six hazards *per* year. Fig. 6 shows the map of integrated individual natural risk zoning R_e3: probability of fatalities, injuries and economic loss to population due to six hazards within one year.

Fig. 6. Map of integrated individual natural risk for the territory of Russian Federation



Obtained values of integrated individual natural risk vary from negligible, close to zer, up to rather high values – more than $300 \cdot 10^{-6}$ for the probability of fatalities (map R_e1); more than $1{,}000 \cdot 10^{-6}$ for the probability of fatalities and injuries (map R_e2); more than $1{,}500 \cdot 10^{-6}$ for the probability of fatalities, injuries and economic loss for population caused by six hazards *per* year (map R_e3). Table 3 shows extent of zones with different levels of integrated individual natural risk according to maps R_e1, R_e2 and R_e3.

Table 3. Values of integrated natural risk and extent of zones with different risk levels

Risk ranges, 10^{-6}/year	Qualitative risk characteristics	Extent of zones, map R_e1		Extent of zones, map R_e2		Extent of zones, map R_e3	
		10^6 km^2	%	10^6 km^2	%	10^6 km^2	%
Less than 1	small	7.9	48	5.7	34	1	6
1 – 10	moderate	3.3	20	5	30	1.9	11
10 – 20	average	0.9	5	0.5	3	1.6	10
20 – 50		1.6	10	1.2	7	2.6	16
50 – 100	high	1.1	7	1.4	8	3.5	21
100 – 150	rather high	0.5	3	0.4	2	1.6	10
150 – 300		0.7	4	1.1	7	1.6	10
300 – 1,000	extremely high	0.6	4	1.2	7	2.1	13
1,000 – 1,500		-	-	0.1	1	0.2	1
More than 1,500		-	-	-	-	0.5	3

Table 4 shows the number of Russian Federation inhabitants in the zones with different levels of integrated natural risk.

Table 4. Number of inhabitants in zones with different risk levels

Risk ranges, 10^{-6} /year	Number of inhabitants, map R_e1		Number of inhabitants, map R_e2		Number of inhabitants, map R_e3	
	1,000 pers.	%	1,000 pers.	%	1,000 pers.	%
Less than 1	91,452	61	73,370	49	22,566	15
1 – 10	30,114	20	46,440	31	45,957	31
10 – 20	5,345	4	1,254	1	18,514	12
20 – 50	7,393	5	8,396	6	21,940	15
50 – 100	2,580	2	4,844	3	8,496	6
100 – 150	3,456	2	737	0	9,776	6
150 – 300	5,861	4	5,299	4	7,239	5
300 – 1,000	4,786	3	10,616	7	9,884	7
1,000 – 1,500	-	-	30	0.02	3,941	3
More than 1,500	-	-	-	-	2,194	1

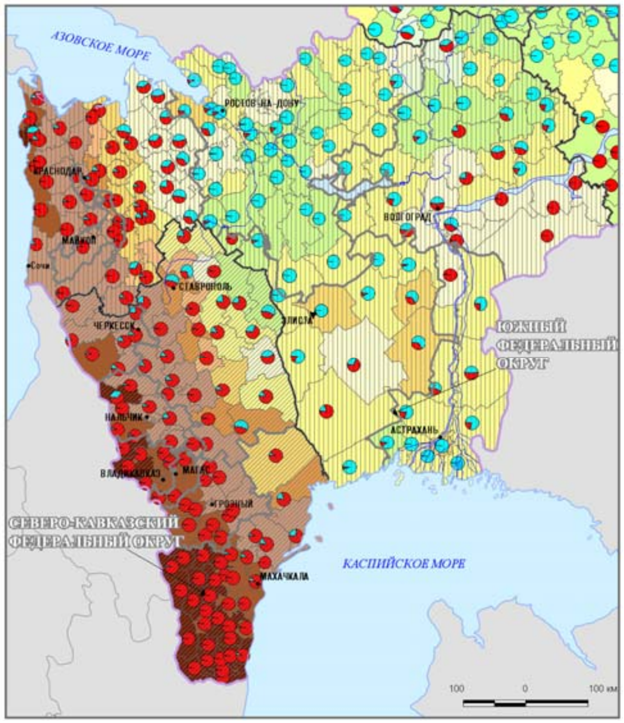
The highest values of integrated individual natural risk R_e1 are obtained for the same areas than for individual seismic risk: Kamchatka, near lake Baikal, Republic of Buryatia, Irkutsk region, Altay kray, as well as for Krasnodar region and Chechen Republic. It could be explained by the fact that among the six natural hazards considered, earthquakes more often result in fatalities in comparison with landslides, mud flows, floods, storms, avalanches. In other words, seismic risk is dominant.

In Sakhalin, Republic of Altay, Tuva, Dagestan, Northern Ossetia computed values of R_e1 exceed $300\text{-}400 \cdot 10^{-6}$/year for 70% of the territory of their administrative divisions.

The highest values of integrated individual natural risk R_e3 are obtained for Kamchatka, Republic of Altay, Krasnodar area, Baikal area, Republics of Buryatia and Tuva, Sakhalin and Northern Ossetia.

Fig. 7 illustrates the contribution of earthquakes to the integrated individual natural risk in northern Caucasus. Contribution of hazards to integrated risk R_e3 is shown at the centres of administrative divisions by circles: red color –, contribution of earthquakes; blue color –, contribution of landslides, mud flows, floods, storms, avalanches.

Fig. 7. Map of integrated individual natural risk R_e3 for the Northern Caucasus



Conclusions

The present paper describes the methodological procedure and databases used for the assessment of integrated natural risk assessment with application of information technology.

Examples of application of the special GIS for integrated individual and collective natural risk assessment for the Russian Federation are given.

The obtained estimations of integrated individual and collective natural risk from earthquakes, landslides, mud flows, floods, storms, avalanches are used by EMERCOM of the Russian Federation, as well as by other federal and local authorities, for planning and implementing preventive measures aimed at saving lives and protecting property against future disastrous events..

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ROMANIA'S ENERGY SECTOR SEISMIC RISK ASSESSMENT

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Keywords

Assessment, seismic risk, energy industry

Abstract

Romania is one of the most seismically active countries in Europe; in the Vrancea seismic zone are occurring 2-3 earthquakes of magnitude M> 7.0 per century, affecting about 2/3 of the Romanian territory. While considerable effort has been expended to assess the buildings in the Vrancea earthquake zone, no comparable assessment was made for critical facilities and equipment in the energy production and distribution systems.

The paper presents the approach of Ministry of Regional Development and Tourism as main authority responsible for implementation of the Hazard Risk Mitigation and Emergency Preparation Project (HRMEPP) - Component B: Seismic Risk Reduction. The HRMEP Project Component B developed with International support – World Bank financing – has the overall objective to reduce the seismic vulnerability of high priority technical and social infrastructure through structural strengthening of critical public facilities and lifelines. As a part of the Component B, the Subcomponent B3 will provide the Energy Sector Risk Assessment, a comprehensive evaluation of the risk and vulnerability of electricity, gas and oil lifelines facilities located in the Vrancea earthquake zone.

The Energy Sector Risk Assessment Study will lay the foundation for analysis of investment projects to reduce the vulnerability of the energy sector and the main outcomes will be:

- An analysis of the Vrancea earthquake impact on the energy industry for two scenarios: the most probable earthquake and the maximum credible earthquake.
- An inventory of energy infrastructure at risk and determination of the spatial distribution of structures and population exposed.
- A risk management plan that will identify the vulnerabilities and risks in the energy fields, and will provide technical guidance to the governmental authorities to develop appropriate mitigation measures.
- Setting of performance standards and recommendations for cost-efficiency implementation of the risk mitigation measures on energy sector essential facilities.

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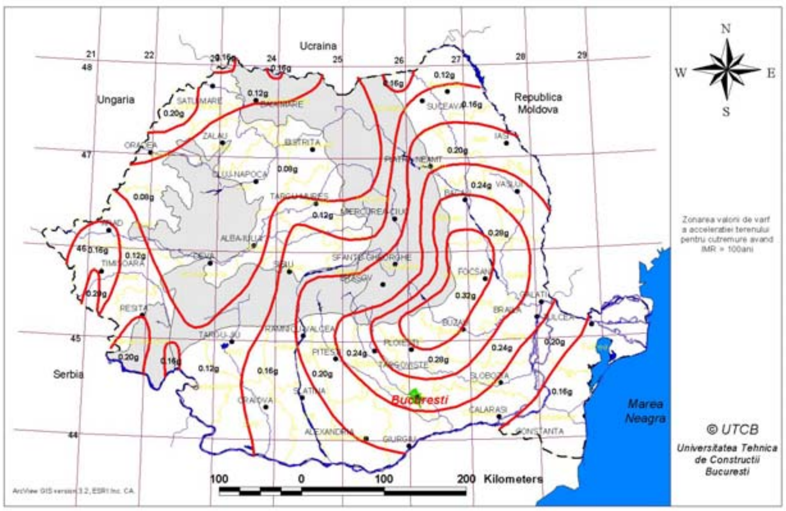
Introduction

Romania's hazards portfolio consists of earthquakes, landslides, floods and other meteorological phenomena as well as various technological hazards. Romania is regarded as one of the most seismically active countries in Europe. Vulnerability to the seismic risk is due to Romania's geographical location on the Vrancea zone, situated along the south-eastern Carpathian arch, which form an ellipse stretching from the North East to the South West of Romanian territory, including the capital city of Bucharest.

In the Vrancea seismic zone are occurring 2-3 earthquakes of magnitude M> 7.0 per century, affecting about 2/3 of the Romanian territory. The vulnerability of the Romanian economy to earthquakes is further exemplified by the following facts:
- over 35 percent of Romanians and 65 percent of all urban population is exposed to seismic hazard;
- 60-75 percent of fixed assets are located in seismic zones;
- 70-80 percent of GDP is produced in highly seismically prone areas.

Fig. 1 Seismic zoning of Romania's territory



Since 1908, 14 earthquakes of magnitude 7 or greater were recorded affecting almost 2 million people and causing massive economic loss.

The 4 March 1977 earthquake incurred significant losses:

- Human lives:
  - 1578 fatalities of which: 1424 in Bucharest and 154 in other areas;
  - Injuries: over 11000;
- Damages/ collapsed buildings:
  - 33000 housing units destroyed or seriously damaged with 200000 residents homeless;
  - 400 schools destroyed and 2000 seriously damaged;
  - 11 hospitals destroyed;
  - 448 hospitals and health care clinics damaged;
  - 29 tall buildings, over 4 stories, collapsed in the centre of Bucharest;
- Economical losses: over US$2 Billion direct losses.

Thesis – Strategy of Ministry of Regional Development and Tourism

The 1977 earthquake served as a catalyst for Romania to begin implementation of seismic risk reduction measures. Ministry of Regional Development and Tourism (MRDT) is the main authority in the seismic risk reduction field, and coordinates major actions and measures associated with this field. An important development of seismic risk reduction measures were motivated by the consequences of the 1977 earthquake:

- Strengthening of the existing vulnerable buildings;
- Improving the legal framework in seismic risk reduction domain;
- Development of engineering studies and revision of several norms and regulations (including harmonization with Eurocode);
- Permanent upgrading of the seismic monitoring system and increasing the number of stations and sensors;
- Sustained professional training in the risk reduction field.

While considerable effort has been expended to make an inventory and asses the buildings in the Vrancea earthquake zone, there is no comparable assessment for critical facilities and equipment in the Romania's energy sector including production and distribution facilities and systems. The function of energy production and distribution systems is essential after a disaster, and the Romanian energy systems are vulnerable to seismic disruption.

<u>General Presentation of Hazard Risk Mitigation and Emergency Preparedness Project</u>

For preventing the consequences of occurring disasters, the Government of Romania sought for assistance at the World Bank for the preparation of a comprehensive hazard risk management project on an ex-ante basis. The Loan Agreement was approved and signed in May 2004 and Romania became the first country in Europe-Central Asia region requesting WB assistance in preparation of a multi-sector hazard risk mitigation project.

The overall objective of the Project is to assist the Government of Romania in reducing the financial, social, environmental and economic vulnerability to natural disasters and water pollution accidents from mining activities. The Project has 4 Components:

- Component A - Strengthening of Emergency Management and Risk Financing Capacity.
- Component B - Earthquake Risk Reduction.
- Component C - Flood and Landslide Risk Reduction.
- Component D - Mining Accident Risk Reduction in the Tisza Basin.

HRMEP Project Component B - Earthquake Risk Reduction

Objective of Component B: to reduce the seismic vulnerability of priority technical and social infrastructure through the retrofitting of key structures and institutional strengthening.

The objective of Component B, is achieved through two directions (5 Sub-components):

A. Capacity Building:
- Sub-component B3: Energy Sector Risk Assessment
- Sub-component B4: Building Code Review
- Sub-component B5: Professional Training in Cost-effective Retrofitting Methods

B. Implementation - Strengthening of High Priority Public Facilities:
- Sub-component B1: Retrofitting Works for High Priority Public Facilities
- Sub-component B2: Design and Supervision

Financial support was assured as follows:
- World Bank Loan: $ 56.928 million US$;
- Government of Romania Co-financing: $ 16.830 million US$
- Total Component B - Earthquake Risk Reduction 73.758 million US$;

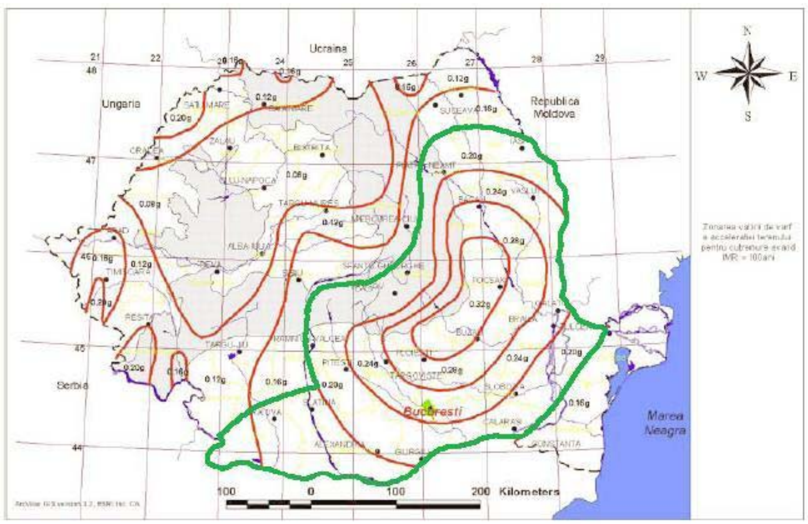
- Beneficiary Contribution: over $ 100 million US$.

Energy Sector Risk Assessment Study

MRDT selected an international company to undertake the preparation of the Energy Sector Risk Assessment (ESRA) Study. The first phase of the assessment was undertaken over approximately five months in the second half of 2010. The final phase will be complete in the first half of 2011; the assessment will be integrated in the overall regional earthquake scenario and will lay the foundation for follow-up work on promoting the investments needed to address the vulnerabilities in the energy sector.

The ESRA Study is defining Vrancea earthquake zone as area of Romania in which significant damage of the energy sector facilities could be expected from very large earthquakes emanating from the Vrancea Source. The area comprises more than one-third of Romania, and includes Cernavodă where Romania's only nuclear power station is located.

Fig. 2 Extent of Vrancea Earthquake Zone defined for ESRA Study



Seismic Hazard from Vrancea Source Earthquakes

The scenarios for two earthquakes from the Vrancea Source Zone have been investigated:
- The most probable earthquake (1000-years return period), and
- The maximum credible earthquake (Magnitude 8.1).

Most Probable Earthquake

The term "most probable earthquake" refers to an earthquake of such a size that it would have the potential to cause damage to structures in Romania, but not so large that it would be considered highly unusual. The Eurocode 8 requires structures of normal importance to society to be designed to withstand without collapsing ground shaking that has a probability of being exceeded of 10 % in 50 years (i.e., it has an average return period over a long time of 475 years). The Romanian seismic code P100-2006 sets a much lower normal level of shaking - that with an average return period of 100 years.

The Romanian code assigns special importance to facilities for the energy sector. The code requires the earthquake design loads of energy sector facilities to be 1.4 times those for similar ordinary-importance facilities/buildings. The assignment of *importance factors* internationally is considered to have a two-fold purpose. Firstly, they are used to increase the reliability of the seismic resistance of more important facilities and, secondly, they increase the intensity of shaking the facility should withstand. A factor of 1.4 applied to the P100-2006 design loading corresponding to shaking with a return period of around 100 years represents ground shaking which has a return period less than the 475 years we have considered to be the base level. On the other hand, applying a factor of 1.4 to the 475-year return-period shaking probably rises the effective shaking being considered to a value higher than that is reasonably possible at a site.

The Most Probable Earthquake was defined firstly in terms of the appropriate return period for energy sector facilities from an international perspective, and to identify what factor can be determined from the unusually limiting characteristics of the Vrancea earthquake source zone. Was recommended a return period of 1000 years (5 % probability of exceedance in 50 years) for the majority of the facilities.

Maximum Credible Earthquake

Was assessed the maximum earthquake that can occur in the Vrancea subcrustal source. The hypothesis advanced by the expert seismologists is that the maximum credible earthquake is one which would rupture the entire seismic source zone. The physical extent of the source zone is believed to be known. It is therefore possible to estimate the maximum possible release of energy, and thus the maximum magnitude. Previous studies undertaken in Romania suggest that this magnitude upper limit is M 8.1. The relationship between return period and magnitude is asymptotic towards the M 8.1 value and was assigned a return period of 2500 years to this Maximum Credible Earthquake.

Energy Sector

The main focus of the ESRA study of each energy field was:
- Electricity: power generation facilities (in hydro and thermal stations), major substations, and main transmission lines.
- Gas: production and distribution facilities, regulation facilities for transit and import uses, compression stations, depots, and administration facilities.
- Oil: refineries, storage tanks and pumping stations, transmission pipelines (including water crossing points).

A representative selection of the most important facilities in this zone has been identified by the energy sector specialists, and site visits have been made where possible to evaluate the vulnerabilities in terms of the two earthquake scenarios. In parallel, an investigation has been made of the earthquake design standards that were applied when these facilities were built or refurbished. Representative facilities studied include hydro-power dams, thermal power stations, storage tanks, pipelines, switchyards, and control centers. For each facility studied, a set of standard assessment criteria was applied which rated it as one of four levels for: importance to energy sector, damage severity, environmental impact of damage, economical and financial loss, impact on population, effect on recovery after earthquake.

From this evaluation, the facility was given an overall seismic risk score. In addition, details of the specific vulnerabilities were noted, and photographed where permitted.

A considerable diversity in the generation and distribution networks was identified. There is expert knowledge within the individual energy sector control organizations on the capability and redundancies of the plant and distribution networks. A number of the major electricity generation sites can be affected by Vrancea Zone earthquakes:

Transmission and distribution system

The transmission and distribution system can be grouped into three types of elements: transmission lines, distribution lines and substations:

a. Transmission lines

Transmission lines are very resistant to earthquake damage unless directly affected by fault movement. Their main vulnerability is foundation failure of transmission towers or the loss of a tower due to a landslide. It would appear that the low natural frequencies of the lines decouple their mass from the high energy content of earthquakes, and the design for extreme wind, ice and longitudinal load combinations is adequate for earthquakes.

b. Distribution lines

Distribution lines are also seismically robust. Their main vulnerability is from burn down, when earthquake induced vibrations cause adjacent lines to come in contact. If they are energized, they will arc and may burn through the line, causing it to fall. In that case, only a limited number of customers are impacted by any downed line and, if a meshed network exists, the customers will not be seriously impacted. Insecure pole-mounted transformers have caused many problems in some earthquakes.

c. Substations

The equipment operating at the higher voltages 220 kV and 400 kV are more vulnerable to earthquake. Inadequately anchored rail-supported transformers or flexible equipment supports have large relative allowed displacements. Also, current transformers and capacitive coupling voltage transformers could be damaged. One of the main difficulties when substation equipment is damaged is the issue of spare parts and the time-consuming task of repairing. Re-building of a transformer can take many months.

Power Generation Facilities

In general, the overall seismic performance of power generation facilities is expected to be good, although coal plants and large oil and gas plants have some limited exposure. The Romanian electrical system is strongly interconnected to the European system (eight tie-lines), and a loss of generation does not affect dramatically the consumers. On the other hand, it is usual for consumer demand to drop after an earthquake due to the probable falling of the distribution lines. It is also sometimes necessary to decrease the power generation under these circumstances in order to maintain the nominal power frequency.

Control, protection and communications facilities

In general, control, protection and communication equipment all exhibit good behavior during an earthquake. The exceptions are uninterruptible power supplies and emergency power supplies. Protective relays could be tripped because of earthquake-induced vibrations. Damage to substation equipment may result in poorer system protection. Public switched network telephone systems are typically congested in such cases, but existing communications systems owned by the electrical companies can cover the necessary communications with the important substations and power plants.

Seismic Vulnerability of the Energy Sector

Based on the evaluation executed in 2010 appears that a considerable proportion of energy sector facilities have been designed for levels of shaking considerably less than the one likely to be experienced from either of the two scenario events.

At the few facilities, the major structures appeared to be seismically robust. However, there appeared to have been little consideration to allowing substantial seismic movement between interconnected structures. This indicates that annoying damage quite capable of rendering a plant inoperable could easily occur in earthquakes more likely than the scenario ones of this study. This type of damage can be easily prevented by the use of simple techniques to allow relative movement.

With respect to smaller items of equipment (and, in particular, electrical equipment), two extremes of seismic robustness were generally observed. One the one hand, items such as station batteries were robustly secured in all places– possibly because of a standard detail being used from many years ago. One the other hand, nowhere was it observed that power transformers were adequately secured against movement (and in particular, overturning) in moderate earthquakes. This is a serious omission as the vulnerability of these transformers in earthquakes is well-known internationally. Moreover, appears that new transformers currently being installed in the Vrancea Earthquake Zone has no provision for such securing.

Observation of a number of electrical switchyards suggests that the electrical connections between major, flexible pieces of high-voltage equipment are too rigid – in a moderate earthquake, adjacent pieces of equipment can be structurally failed by each other as they try respond to the earthquake independently. The loss of support for structures because of liquefaction and lateral spreading of the foundation soils in strong earthquakes is a real possibility where support structures and pipes are close to (or cross) rivers. The subsoil maps of the Vrancea Earthquake Zone suggest that liquefaction in other parts of the zone is unlikely because of the particular soils that predominate.

There is evidence that the most vulnerable power generation and oil structures are now reaching the end of their economic life, and are being taken out of production. Even if these facilities were designed to the seismic requirements prevailing at the time of their construction, later design codes have required higher seismic resilience.

It is possible that a number of small hydropower stations to be vulnerable to a large earthquake; however, the combined production of these is a small percentage of the generation capacity available.

The location of the very large power generation plants at Craiova and Cernavodă is advantageous because they are at the outer edge of the Vrancea Earthquake Zone. However, the same cannot be said for the new, large generation facilities being built at Ploieşti.

Of particular concern are the following facilities:

a. Foreign-sourced facilities and equipment has not been checked for compliance with the seismic requirements specified in the procurement process, and

b. There is not the practice of an experienced earthquake engineer over-viewing the total installation to ensure that the overall seismic performance of the facility is not compromised by an interconnection or minor item whose failure would jeopardize the production in even a small or moderate earthquake.

The seismic design standards used for the nuclear reactors at Cernavodă were not assessed because of the inability of the management of Nuclearelectrica company to make the staff available for an consultations during the period of the study. Efforts are continuing to arrange a suitable time. It is fortunate that Cernavodă (and the major thermal power stations at Craiova) are at the outer limits of the zone within which shaking from the scenario events could be intense enough to cause damage to well-engineered structures.

Seismic Risk to the Energy Sector

Seismic risk is the result of <u>seismic hazard</u> and <u>seismic vulnerability</u>.

The scenario earthquakes are considerably larger than those experienced in the last 100 years in Romania. While the probability of their occurrence is low, they could occur at any time.

Should the 1000-year (return period) earthquake occur in the Vrancea Earthquake Source Zone, was considered that the following could be expected:

<u>Electricity Industry</u>

- Significant damage to electrical switchyards at generation facilities and distribution nodes mainly in the centre of the Vrancea Earthquake Zone.
- Significant damage to local area switchyards.
- Little significant damage to hydropower generation infrastructure.
- Little or no significant damage to transmission lines.
- Little disruption to generation facilities at Craiova area and Cernavodă.
- Possibly significant damage to new generation facilities in Ploieşti.
- Significant damage to older thermal power stations within the Vrancea Earthquake Zone.

<u>Oil Industry</u>

- Little or no significant damage to oil production facilities.
- Significant damage to oil storage facilities – particularly older ones.
- Significant damage to refineries – particularly at Ploieşti.

<u>Gas Industry</u>

- Little or no damage to the major gas supply lines.
- Little damage to underground pipelines within the Vrancea Earthquake Zone.
- Little damage to distribution and storage facilities.
- Possible damage at river crossings (particularly where via pipes are supported by bridges).
- Where town heating is supplied as a by-product of thermal power generation, this will naturally be affected by any damage to that generation facility.

<u>Awareness of Risk</u>

No institutional memory of the damage caused to oil facilities by the 1940 earthquake. With the exception of those actively involved in the design of new structures, there appears to be very little awareness of the vulnerability of equipment to earthquakes. As is common in many countries, an often received comment during the study was that, “because the facility in question survived the 1977 and/or 1986 earthquakes, its seismic resilience is of no concern”.

Although we were unable to verify it, there appears to be little evidence of risk management, active mitigation, or preparedness for Vrancea Source Zone earthquakes affecting the energy sectors.

Current Seismic Design Code

The current Romanian seismic Code is, like in many other countries, prescriptive rather than performance-based. Some respected senior professional engineers in Romania are concerned about the:

- Validity/provenance of the seismic factors used to derive seismic design loads, and
- The apparently low level of design load (in terms of probability of exceedance) with respect to international norms.

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Findings and Discussion

Risk Management Planning

Based on experience learned from recent March 11, 2011 earthquake in Japan, consideration should be given to the Romanian Government for requiring all organizations that have energy production and distribution facilities within the Vrancea Earthquake Zone to submit within 18 months credible assessments of their facilities' resilience to the two scenario earthquakes. These assessments should include estimates of the likely period of interruption, and the interdependency of the facilities.

To achieve that goal, risk management should be deployed across all energy companies with the same methodology, even if some operational or functional units claim that they need to make exceptions. Differences should not be ignored – they should be integrated in the overall approach and if the integration is too complex to realize on the spot, integrated during the next iteration.

The Romanian Government should take steps to ensure that the appropriate agreements are in place with neighboring countries and critical equipment suppliers for the mutual emergency provision of energy, restoration services and procurement should another large Vrancea earthquake occur. This should be done in conjunction with a spare parts inventory and accompanying purchase policy.

The Government should ensure that it knows the level of seismic resilience incorporated in the design of the Cernavodă nuclear facility.

Romanian Seismic Code

Consideration should be given to reviewing, and possibly increasing the seismic design parameters used, in the light of the semi-probabilistic hazard analysis undertaken as part of this study. In particular, the Importance Factors, the basis for the response spectra, and the design risk level (i.e., probability of exceedance) should be reviewed.

There should be a clear understanding of the performance required from the energy sector for the applicable importance factor. This might, for instance, set maximum restoration times for energy supply services.

Cost-benefit studies may need to be undertaken to decide on the appropriate level of seismic resilience for existing and new facilities.

Priority Strengthening

A program of strengthening needs to be undertaken across all sectors if the two scenario events of this study are to be resisted with only minor disruption.

A priority list of items/facilities requiring improvement in seismic resilience should be drawn up. This should **consider priority-strengthening of partial capacity to give a secure supply to lifeline facilities** such as hospitals, police stations, command and emergency intervention centers, water treatment plant, and railways.

The principal findings and recommendations:

- The energy sector is extremely vulnerable to widespread disruption if either of these two scenario earthquake occurs.
- The overwhelming reason for this vulnerability is the lack of appropriate seismic detailing of equipment restraints/holding-down.
- The current seismic design standards need to be increased and made consistent performance across all sectors.
- A program of strengthening needs to be undertaken across all sectors if these two scenario events are to be resisted with only minor disruption.
- A priority list of items/facilities requiring improvement in seismic resilience should be drawn up.
- Cost-benefit studies should be undertaken to decide on the appropriate level of seismic resilience for existing and new facilities.
- The Romanian government should ensure that it knows the level of seismic resilience incorporated in the design of the Cernavodă nuclear facility.
- Mutual assistance arrangements with surrounding countries should be negotiated for assistance of post-earthquake restoration of services. This should be done in conjunction with a spare parts inventory and accompanying purchase policy.
- Priority strengthening of partial capacity to give a secure supply to lifeline facilities such as hospitals, police stations, water treatment plant, and railways.
- Development of Memoranda of Understanding with adjoining countries/suppliers for emergency response after a large earthquake.

Author Biography

Mrs. Stela Petrescu is General Director of Project Management Unit for the Hazard Risk Mitigation and Emergency Preparedness Project in the Ministry of Regional Development and Tourism of Romania since April 2004.

Previous to leading the MRDT PMU for Component B of HRMEP Project, Mrs. Petrescu was Chief of Department regarding Projects for seismic risk and landslides mitigation in the General Technical Directorate of MDRT. She had the responsibility of coordinating the proper implementation, of the ongoing national/international projects in the field of seismic risk and landslides mitigation and to propose and prepare new projects to be financed by international organisms/donors. The most significant projects she was working on were:

- Project on the Reduction of Seismic Risk for Buildings and Structures, a technical cooperation program organized by the Japan International Cooperation Agency;
- EUR-OPA Major Hazards Agreement, Euro-Mediterranean partnership coordinated by the Council of Europe, to prevent, mitigate and solve crises situation generated by natural and/or technological disasters;
- Creating a nation-wide, unitary Geographical Information System (GIS) through a Pilot Assistance Project for Pan–European transportation priority investment, included in the High Technology and

Cross Border Operations Working Groups of the "Action Commission for an Enlarged Euro-Atlantic Community" under the authority of Center for Strategic and International Studies, Washington D.C.

Mrs. Petrescu was the Chief of Technical Department in the Project Management Unit for School Rehabilitation Project, Project co-financed by The World Bank, the European Council Development Bank and the Government of Romania. The Project financed civil works/building constructions (retrofitting existing schools and erecting new ones), professional architectural and engineering services to complete technical survey and design, school mapping, preparation of detailed building plans, specifications and bidding documents.

Mrs. Petrescu is member of the National Technical Committee for Seismic Risk Reduction of Buildings, National Union of Romanian Architects and of the Professional Association of Romanian Architects.

CRITICAL INFRASTRUCTURE RISK ASSESSMENT FOR ELECTRIC POWER GRID

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Keywords

Electric power, energy, power, black-out, grey-out, critical infrastructure, risk management, crisis management, human safety, resilient power, EC Directive 2008/114.

Abstract

There is a EC directive 2008/114 in place, which specifies the approach and necessary steps to protect the European critical infrastructure. By January 2011 the member states are supposed to have implemented basic methods and tools for the proper identification of important critical infrastructure objects and also to adapt the operation plans and communication schema to minimize the potential collapse. The National organization CEPS, which is responsible for the basic power transport system, initiated a project of the risk assessment as a base for preparation of operation plans. The project was implemented together with the company T-SOFT which supplied the consultants and IT tools for risk analysis. The method and results will be presented as an example of implementation of the 2008/114 EU directive in the energy sector of the Czech Republic.

Introduction

The electric power grid is one of the most important critical infrastructure elements. Its importance comes out of the fact that most of the basic processes in the industrial society depend directly or indirectly on the electric power. Key dependence on the electric power has the information and communication infrastructure, which controls most of the other technologies, including the electric power production and distribution.

The European Union, being aware of the rising importance of critical infrastructure and its complexity and vulnerability initiated the preparation of an overall strategy to protect the critical infrastructures.

European Commission adopted in October 2004 a Communication on critical infrastructure protection in the fight against terrorism which put forward suggestions as to what would enhance European prevention of, preparedness for and response to terrorist attacks involving critical infrastructures. After intensive effort there was issued a Directive 2008/114/EC, which

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constitutes a first step in a step-by-step approach to identify and designate European Critical Infrastructures (ECIs) with a focus to energy and transport sectors. It assigns the primary and ultimate responsibility for protecting ECIs to the Member States and the owners/operators of such infrastructures.

Among various tasks for the national and international bodies, the Directive stresses the necessary identification of ECIs objects by the international assessment and also the establishment of Operator Security Plans (OSPs). Those plans, comprising an identification of important assets, a risk assessment and the identification, selection and prioritization of counter measures and procedures should be in place in all designated ECIs.

There are no strict dates on this Directive, but the Member States were obliged to take the necessary measures to comply with it by 12. January 2011.

In the Czech Republic, the core of electric power transmission system within the country and all international transfers are managed by the state-owned company CEPS a.s. CEPS is responsible for the secure and reliable transmission of electrical power and from that point of view it represents one of the most important organizations not only for the Czech economy, but as the Czech Republic is an important transit country, also for the neighboring countries. It results in the necessity of permanent risk assessment and control, to minimize the impact of possible interruption of operation.

The starting point for building an appropriate OSP was the risk analysis, based on the identification of all the assets, which secure the operation and assessment of the possible impact of all the threats which might be relevant to the transmission system.

The combination of expert assessment and exact evaluation were used to bring to the company management the picture of the current security status of the system, which complies to the EC Directive and also serves as a source for the future decisions of the management at various hierarchical level of the company.

The risk analysis was done in close collaboration of CEPS security and operation experts and T-SOFT risk analysis consultants, using a T-SOFT software support tool RISKAN.

The Method and Risk Calculation

The method used is based on the qualitative assessment of input parameters using the expert guess. Such a method comprises the following steps:

- Identification of assets and specification of their value by the preset scale.
- Identification of threats and specification of their probability by the preset scale.
- Identification of impacts of threats to assets using the vulnerability of the assets by the specific threat and specification of the amount of impacts by the preset scale.
- Risk evaluation and division to the *low, middle* and *high* risk zones.

The calculation is then as follows:

$$\textbf{Risk level}_Y = \textbf{Threat probability}_X * \textbf{Impact rate}_{XY} * \textbf{Asset value}_Y$$

where

- x coordinate in the threat data space
- y coordinate in the assets data space
- xy coordinate of the intersection of actual asset and threat

The final calculation and presentation was done by the RISKAN calculator.

Assets identification and evaluation

The analysis worked with three main groups of assets

- Power lines
- Technology
- Command and control

Free space, space under surveillance, protected and specially protected areas were evaluated separately.

For the assets evaluation the pairing method was used at the beginning and the resulting preferences were recalculated to the scale 1-5 (low – extremely high).

Paired comparison

As the first information search through the company was performed using many people on various levels of management and operations, the simple pair-comparison method was used to gather the input information effectively. The questionnaire was distributed through the company and results collected.

Pairing method serves to find out the preferential relation of the criteria pairs. Each criterion is being searched for the number of preferences towards other criteria. For such a task is possible to use the following table. In the top-right part the evaluator probes if he/she prefers the the line criterion to the one in the column. If yes, puts the “1” to the field, otherwise “0”. In case of equality there will be “0.5”.

Criterion	K1	K2	K3	...	Kn	Number of preferences
K1		1	0	...	1	
K2			0		0	
K3					0	
...					...	
Kn-1					1	
Kn						

Normalized preferences of weighs are computed as:

$$v_i = \frac{f_i}{n(n-1)/2}$$

where

v_i normalized weight of i-th criterion,

fi number of preferences of i-th criterion,

n(n-1)/2 number of performed criteria comparisons.

Non-normalized weights can bet hen computed as

$$k_i = n + 1 - p_i$$

where

k_i	non-normalized weight of i-th criterion,
pi	order of i-th criterion in its preferential arrangement,
n	number criteria.

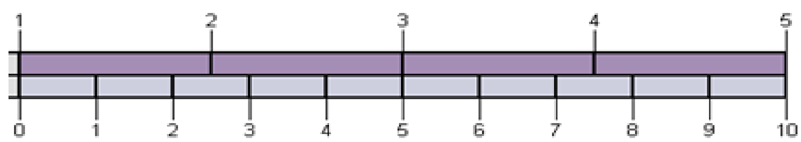
Mapping of preferences to the scale of assets value

The basic asset value scale corresponds to the following table:

1	**low**
2	**low importance**
3	**middle**
4	**high**
5	**extremely high**

We can map the preferences to the reduced scale …

Scale value
Number of preferences

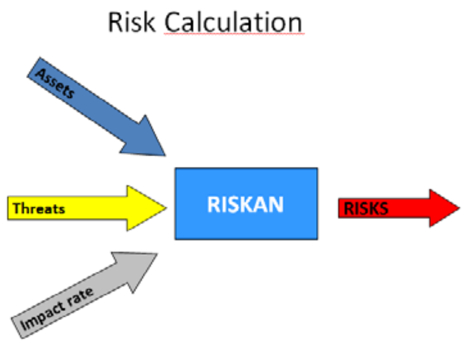


For the threat and vulnerability expert guess we used similar scales as for assets. In the scale of 1-5 the appropriate sets of values were generated, describing for example the relation of threat to the specific asset vulnerability to that threat, resulting in the consequential impact if the situation would really happen.

The threats were divided in several main groups, which were then split to dozens of single threat types:

- Natural
- Technical failures
- Human factor – organizational failure
- Human factor – physical failure
- Human factor - terrorism

After the filling-in all the information, we calculated the risks using RISKAN calculator: The calculation itself is very simple and fast and gives instant results, including graphical output.



Criteria for risk evaluation and acceptance

The resulting risk values fall into the inteerval 0 – 125.

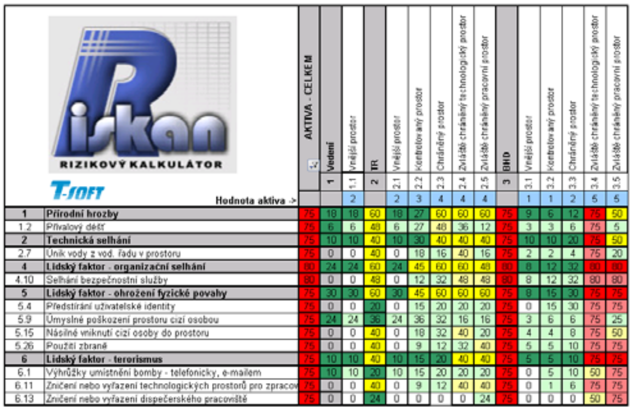
To be able to simply assess what risk is acceptable and to have the possibility of the illustrative visualisation of results, the risk range was divided to three zones.

Risk level	Range	Color
Low	1-39	Green
Middle	40-70	Yellow
	71 -125	Red

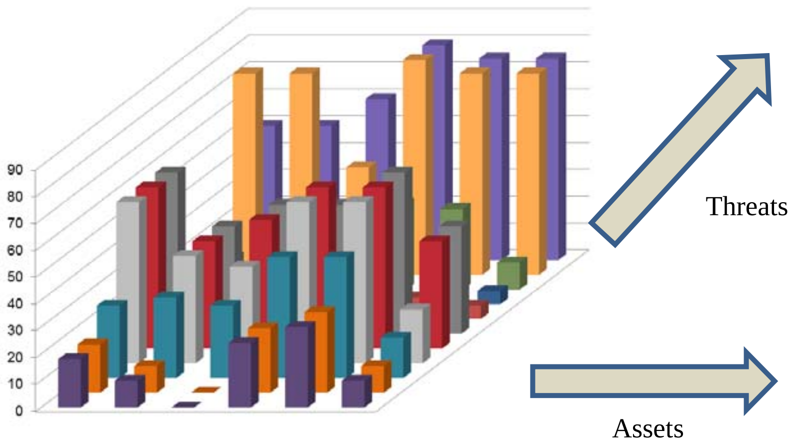
As the highest acceptable risk the value of 39 is defined. The low risk area shows the risks which are acceptable without a need of any measures taken (In other words, the costs for eliminating such a risks would not have an effective impact).

Threat probability		1					2					3					4					5				
Impact rate		1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Asset value	1	1	2	3	4	5	2	4	6	8	10	3	6	9	12	15	4	8	12	16	20	5	10	15	20	25
	2	2	4	6	8	10	4	8	12	16	20	6	12	18	24	30	8	16	24	32	40	10	20	30	40	50
	3	3	6	9	12	15	6	12	18	24	30	9	18	27	36	45	12	24	36	48	60	15	30	45	60	75
	4	4	8	12	16	20	8	16	24	32	40	12	24	36	48	60	16	32	48	64	80	20	40	60	80	100
	5	5	10	15	20	25	10	20	30	40	50	15	30	45	60	75	20	40	60	80	100	25	50	75	100	125

The resulting information appears both in numerical and graphical form and could be used for further discussion and what-if analysis.



		AKTIVA - CELKEM	1 Vedení	1.1 Vnější prostor	2 IR	2.1 Vnější prostor	2.2 Kontrolovaný prostor	2.3 Chráněný prostor	2.4 Zvláště chráněný technologický prostor	2.5 Zvláště chráněný pracovní prostor	3 BHD	3.1 Vnější prostor	3.2 Kontrolovaný prostor	3.3 Chráněný prostor	3.4 Zvláště chráněný technologický prostor	3.5 Zvláště chráněný pracovní prostor
	Hodnota aktiva ->			2		2	3	4	4	4		1	1	2	5	5
1	**Přírodní hrozby**	75	18	18	60	18	27	60	60	60	75	9	6	12	75	50
1.2	Přívalový déšť	75	6	6	48	6	27	48	36	12	75	3	3	6	75	5
2	**Technická selhání**	75	10	10	40	10	30	40	40	40	75	10	10	20	75	50
2.7	Únik vody z vod. řadu v prostoru	75	0	0	40	0	18	16	40	16	75	2	2	4	75	20
4	**Lidský faktor - organizační selhání**	80	24	24	60	24	45	60	60	48	80	8	12	32	80	80
4.10	Selhání bezpečnostní služby	80	0	0	48	0	12	32	48	48	80	8	12	32	80	80
5	**Lidský faktor - ohrožení fyzické povahy**	75	30	30	60	30	45	60	60	60	75	8	15	30	75	75
5.4	Předstírání uživatelské identity	75	0	0	20	0	15	20	20	20	75	0	15	30	75	75
5.9	Úmyslné poškození prostoru cizí osobou	75	24	24	36	24	36	32	16	16	75	3	6	6	75	25
5.15	Násilné vniknutí cizí osoby do prostoru	75	0	0	40	0	18	32	40	20	75	4	4	8	75	50
5.26	Použití zbraně	75	0	0	40	0	9	12	32	40	75	5	5	10	75	75
6	**Lidský faktor - terorismus**	75	10	10	40	10	15	20	40	40	75	5	5	10	75	75
6.1	Výhrůžky umístnění bomby - telefonicky, e-mailem	75	10	10	20	10	15	20	20	20	75	0	5	10	50	75
6.11	Zničení nebo vyřazení technologických prostorů pro zpracov	75	0	0	40	0	9	12	40	40	75	0	1	6	75	75
6.13	Zničení nebo vyřazení dispečerského pracoviště	75	0	0	24	0	0	0	0	24	75	0	0	0	50	75



The results

The final output from the risk analysis was used to prepare a report for the various management levels of the CEPS Company.

The higher-risk areas were for example the following:

- 1.2 Run-off rain
- 2.7 Water leak from the main water pipeline
- 4.10 Security service failure
- 5.4 User identity masquerading
- 5.9 Intentional area damage by alien person
- 5.15 Violent intrusion into the protected area
- 5.26 Weapon usage
- 6.1 Bomb threat – phone, e-mail
- 6.11 Damage or putting out of service ICT infrastructure
- 6.13 Destroyment or paralyzing of operation centre

Based on those identified and evaluated risks the risk mitigation plan was identified at the top management level.

Conclusion

The comprehensive risk analysis was performed at the main Czech power transmission company as a regular part of the management of such an important national critical infrastructure.

The analysis process utilized a broad set of entry values, gathered from the company structure and evaluated by a pair comparison. The assets values were then normalized to the 5 degrees scale and to the same scale potential threats and the vulnerabilities of assets to threats were evaluated.

In the collaboration of the CEPS experts and T-SOFT consultants the analysis was carried out, utilizing the software tool RISKAN. During the work a what-if analysis was performed to study various variations of the risk mitigation. Numeric and graphic outputs from the RISKAN tool allowed the easy building of output presentation for the management. The method and tool are very easy to understand and use, so it might be used also in other segments of industry or in other countries.

The CEPS risk analysis contributed to the fulfilling of the EC directive 2008/114 in the Czech Republic and thus adds to improvement of the European Critical Infrastructure.

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Qualitative Research on Terror Network Influence in Indonesia

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Keywords
Jemaah Islamiyah, Darul Islam, Islamists, qualitative interviews, terror networks

Abstract

Islamic extremism in Indonesia has a distinct set of goals and actions that could be viewed as quixotic in this democratic archipelago. Active groups of conservative Islamists often originate from Darul Islam, influencing Jemaah Islamiyah, an active Islamist group responsible for extremist violence. JI has claimed responsibility for significant terror events including the Bali night club bombing in 2002, the 2004 Australian Embassy bombing, and the Ritz-Carlton and Marriott hotel bombings in 2003 and 2009.

This paper reveals, through single person interviews, the influence of terror networks on community perception. Qualitative research utilizing first person interviews is rare in terrorism studies, predominately because of access to individuals with acknowledged and verifiable relationships to active Islamists groups is notoriously difficult for Western researchers. Applying the strength of weak ties theory, interviews with several Indonesian citizens, including Darul Islam activists, affiliates of JI, and the head of a conservative traditional madrasa were conducted in the summer of 2010. These field interviews revealed findings for identifying targets; financial sponsors; how ideological supporters are recruited; how operations are conducted. Applying grounded analysis theory the interviewer revealed a network based on Ganovetter's strength of weak ties.

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Introduction

Jemaah Islamiyah (JI) is an extensive terrorist organization spreading across Southeast Asia that has perpetrated numerous attacks in Indonesia. They have been found responsible for incidents including the Bali nightclub bombing in 2002 and the Marriot Hotel bombing in 2003. While researching a failed jihadist training camp in the Aceh region of Indonesia the researcher recorded interviews with three individuals familiar with the area, JI, and Southeast Asian terrorism. What resulted was a unique and in-depth series of discussions about aspects of JI targeting, financing, and recruiting. The information imparted onto the interviewer has been divided into four broad findings and presented to the reader. The excerpts provide a view into the functioning of a terrorist group rarely available to outside researchers.

Background

As with many modern Islamic terrorist organizations the origins of Jemaah Islamiyah can be found in the battlefields of Afghanistan in the late 1980s and early 1990s. Abdullah Sungkar and Abu Ba'asyir had been forced out of Suharto's Indonesia in 1985 and had settled in Malaysia with a group of supporters. The pair began creating a network of friendly businessmen and followers with the goal of eventually returning to Indonesia and creating an Islamic government. To this end they began sending their Southeast Asian recruits to Afghanistan's Camp Saddah where they shared space with the group Darul Islam (DI), of which Sungkar and Ba'asyir considered themselves the ideological heirs of the founder Sekarmadji Kartosuwirjo (Abuza, 2003). With the increasing number of recruits from the Philippines, Malaysia, Singapore and other Southeast Asian countries a schism arose between Sungkar and the leaders of DI. Darul Islam had a largely Indonesia-only concept where Sungkar and Ba'asyir had a vision of a pan-Southeast Asian caliphate that started in Indonesia but would quickly spread. In 1992 the recruits in Camp Saddah were given the choice of following Sungkar and Ba'asyir, joining a new group called Jemaah Islamiyah, or staying with Darul Islam (Hastings, 2011). Those that chose to join JI moved to a camp in Torkham, Afghanistan and would continue to receive training as well as instruct new JI recruits.

In 1998 following the fall of Suharto, JI moved back to Indonesia with an extensive network spread across multiple countries that required a mix of hierarchical and cellular networks. The organization has never been fully dedicated to terrorist activities and employs a *markaziyah* system with four top councils dedicated to different aspects of training, education, proselytization, and attacks. Below the top councils are the two *mantiqi* which are military-like division controlling large swaths of territory; Mantiqi I covered Signapore and Malaysia with Mantiqi II covering Indonesia. Progressively smaller units proceed down from the *mantiqi*, culminating in the *fiah* which are the individual cells of 6-10 people capable of moving across areas and independently pulling off operations and attacks (Hastings, 2011). The *fiah* can come up with ideas for attacks which are integrated into the larger hierarchy once they had reached a point of maturity requiring assistance from JI at large. Much like al-Qaeda, Jemaah Islamiyah engages in a sort of franchising, maintaining a clear ideological and supportive structure while allowing small groups to form and carry out missions with little direct control.

In the first half of 2010 Indonesian national police discovered and eliminated a jihadist training camp in the Aceh region of Indonesia. This region is almost exclusively Islamic and is largely autonomous from the Indonesian government, yet resistant to extremism. The camp was formed by a coalition of several like-minded influential jihadi leaders formed around the idea that JI had become too passive when it moved focus from jihad to religious outreach. The coalition included disenfranchised JI and DI members along with others. The coalition believed Aceh would be a safe place to build and run training camp that would receive public support. However, community support was almost non-existent and the coalition's plans were doomed from the start (International Crisis Group, 2010).

During a student exchange program in the summer of 2010 the interviewer had the unique opportunity to meet with university professors, an Acehnese cleric, and a *Darul Islam* activist through academic connections. The original intention of these interviews was to gather more information about Islamic extremism and the presence of radical thought in Indonesia.

Method

This study was undertaken using qualitative research methods (Patton, 1987) (Emerson, 1995). A general area of interest was expressed by the interviewer, the question of Islamist extremists, but was left open-ended for the interviewee to interpret. A cascading, organic, conversation then ensured with the interviewer allowing the subject to get comfortable and express their perceptions of the topic area.

The Strength of Weak Ties (Granovetter, 1973) theory is clearly present in the relationships that led to identifying these subjects for interviews. Presented chronologically, Subject #1 (S1) was a university professor in Aceh. During the interview S1 suggested Subject #3 (S3) be contacted since S3 had known ties and affiliations with Jemaah Islamiyah. During the interview with S1, which occurred in his office building, one of the subjects colleagues stopped by and joined the interview, providing additional information. His interview responses are coded a Subject #1-B (S1-B).

Subject #2 (S2) had a reputation as the head of a conservative *pesantren* / *madrassa* (school) where he and his family also lived. Subject #2, the head of the *madrassa*, was also known to have denied support to members of the training camp.

Subject #3 ended up being one of the longest and information rich interviews. His knowledge, participation, and understanding of Islamist extremists, and JI specifically, was unpatrolled by the other subjects.

Opening questions to the subjects varied, based on their area of expertise. Some of the initial questions were,

- Can you tell me about JI, how you got involved, and what made you interested in their ideologies? (S3)
- What is Darul Islam? What is its connection with JI? (S3)
- Could you please tell me about your research in terrorism? With regard to JI (S1)
- So where do they want to do jihad? In Indonesia? (S1)
- What is Darul Mujahidin? (S2)
- Could you tell me about your *pesantren*? (S2)

Field notes were written using ethnographic methods (Emerson, 1995) including inscribing experienced/observed realities. In addition, writing as participation philosophy was employed, although the entire conversations were recorded with the subjects' consent.

The interviews were conducted at various locations. Subject 1 and 1-B were met at the office of S1 in Lhokesmawe (Aceh) with the door open and other people present in the halls. The interview with Subject #2 occurred at his madrassa in his private living quarters, with his wife present, although she did not contribute to the conversation. Subject #3's meeting occurred in an open café settings with traffic and general background noises.

The interviews were conducted in the subjects' native tongue of Bahasa Indonesia, which the interviewer is also fluent in. These conversations were later translated by the interviewer into English and transcripts were produced totaling 37 pages.

One of the contributing factors to the success of the interview could be attributed to characteristics of the interviewer. As a young female, gender and status were of interest to the all the Subjects and it best reflected in the mid-point of the interview with Subject #1;

> **Interviewer: Do you think it would be alright for me to interview JI?**
> (S1) But it's hard since you're a female.
> **Interviewer: So there are no females among them?**
> (S1) Oh wait, there are. You could possibly interview their wives.

Interviewer: Would it be okay to interview them even if I am American?
(S1) No, you're not Muslim right?
Interviewer: I am Muslim.
(S1) Oh Muslim! Maybe you could.
(S1) *can't hear*
(S1-B) But if there are American Muslims they won't be killed.
Interviewer: Is that still the case even though Osama bin Laden said that American Muslims are also infidels?
(S1) Yes, they won't be killed. Because it's forbidden right?
Interviewer: So even though bin Laden said that American Muslims should also be killed, JI doesn't agree?
(S1) It's different.

Even though there were no formal entry requirements the interviewers religious status (Muslim), nationality (American and Indonesian), gender (female), and age (early 20's) clearly influenced the rapport. It is possible that these factors are what lead Subject #1 to eventually introduce the interviewer to Subject #3, a Darul Islam activist and self-proclaimed "helper" of Jemaah Islamiyah.

Findings

Qualitative evaluation inquiry draws on both critical and creative thinking – which is both a science and an art (Patton, 1990). Within grounded analysis the theory is derived from data, systematically gathered and analyzed through the research process (Strauss, 1998). Using grounded analysis approach the interviewer was able to approach the topics in a general frame;

> Gather information about Islamic extremism and the presence of radical thought in Indonesia.

The interviews were conducted in a way that allowed the subjects to interpret this question, and the answer had multiple possibilities. After the completion of the interviews it was clear that four findings were present within the interviews on Islamic extremism in Indonesia:

Finding A: Decision making points for identifying targets;
Finding B: Support of financial sponsors;
Finding C: How ideological supporters/members are recruited;
Finding D: The methodologies used in executing a terror attack

<u>Finding A – Target Selection</u>
The first finding of decision points for identifying targets was talked about by both Subjects #1 and #3. What is significant is variety of influences that contribute to target selection. JI does have ties to al-Qaeda and is influenced by then in target selection. These excerpts are from Subject #1's interview;

> "Well, JI always follows the *fatwas* issued by Osama bin Laden and Ustad Ablo Azzam. There are also *fatwas* from Sheikh bin Bas, then from Sheikh Nafsurudin Alabani, so they follow them." (S1)

> "And they pick targets based on for example translating the *fatwa* to go to war with America. Wherever they are…So they can't differentiate which ones are American, which ones are British, or German, or European. For them, all white people are American…It's based on very simple assumptions. Stereotypes. They're still very naïve. They're not very advanced yet." (S1)

As a contract, the interview with Subject #3 who had the most direct involvement with JI indicated,

> "This isn't about targeting hotel A or apartment B, instead we conduct surveys. There's always a survey. In the surveys, we are able to easily go inside the targets as workers, cleaning service, guards, whatever it took to ensure that we were really able to get to know the place. Where sins

> happen, we know. An example is of what we did in Bali at the nightclubs. We knew that there were a lot of our people that we had already planted to survey before the target was acted upon. Our people were already placed there, they knew it exactly. If the activities were just drinking coffee or something similar, it's okay. But if it's more than that, alcohol, nobody resisting temptation, and adding free socializing between men and women, wearing immodest clothes etc. It wasn't just foreigners, the Balinese themselves followed this outside culture that was already bad and was destructive. That's just one example, that's why Bali was a target. The ethics from that, was an announcement to the world that in Indonesia, behavior like that is unacceptable. (S3)

Subject #3 is able to discuss this contrast in target selection processing by acknowledging the influence larger Islamists organization have had by saying,

> "In previous years…there was still a background of *mujahidin* that were from the Philippines or Afghanistan. Then, what became the foundation of the road of movement at that point was the global *fatwa*, Osama bin Laden's *fatwa*. His *fatwa* had a base of killing non-Muslims that you meet, wherever you are, and whenever. That was the global *fatwa*." (S3)

> "The background is because one factor is based on the global *fatwa*. The *fatwa* of Osama bin Laden when we fought with the Taliban. Wherever the hate of the mujahidin was in Afghanistan at that moment, afterwards left after Russia was replaced with America…For those of us who witnessed their struggle, women and children were getting hurt. This was done to them more than was being done to animals. Young girls etc. were not safe. Also boys aged 15 and up. They were raped, killed, etc. Because of that, because of seeing the injustices firsthand, in the way of ideology and beliefs, in this situation it was feasible to defend Islam from America wherever. "(S3)

> "We (JI) don't just target foreigners. Among our targets are also Indonesians, Southeast Asians, and Middle Easterners, if they have a mission of destroying the Islam that is in Indonesia, then they are our targets."(S3)

Subject #2 frowned upon the method of target selection that JI uses, saying,

> "Those people (JI) had an understanding that was very far from the Acehnese ulammah. Their understanding is different than the understanding of the Acehnese in Islam. That's why they couldn't come in…Because in Islam women can't be killed. Even if there is a war, women can't be killed. That's true Islam, in the teaching of the Quran. In Yasin (a surrah of the Quran) if they're not holding weapons, you can't shoot them. Children can't be killed."

<u>Finding B - Financing</u>

The question of al-Qaeda's influence on JI is significant to both parties. The ideological influence can be clearly felt in the passages above that discuss target selection. Subject #1, who had done extensive research on JI said,

> "Yes, they receive their funding from al-Qaeda. But they just go along with their *fatwas*. And they don't even go along with all the *fatwas*."(S1)

Subject #2 drew from his personal experience being the target that JI wanted to recruit, saying,

> "From the beginning, since the end of 2008 they (JI) had already looked for support to Aceh. They came here to try and receive support. And when they asked for my support, I said like this. If in Aceh there are those who want jihad, you all have to ask for a fatwa from the Acehnese ulammahs. Because in Aceh there are still many ulammahs, I said. Because jihad can't be separated from its religious roots." (S2)

Subject #3 paints a less formal and more financially undefined relationship between JI and al-Qaeda, stating,

> "If you say they get money, yeah sure, you can say that they get money, but the characteristic of it is not a main help or permanent donations. It's better described as a helping factor from time to time, matching up to our needs. For example during the years '92-'93, there were donations from Saudi, but it wasn't permanent, it was just a gesture of helpfulness. We had a program, and they helped. Even until now it is already very rare to receive money from them. It just so happens also that relations are also difficult. The characters that used to be there have started to crumble. Our communication is also limited. But if for instance we have a plan and target, and if we are able to communicate with them and tell them of our plans, more or less they do help. The help is not only financial, but logistic help is also there."(S3)

<u>Finding C - Recruitment</u>

On the question of recruitment the answers were varied but what emerges is a network of information, volunteers and gatekeepers. Subject #1 indicated active recruitment techniques that included religious discourse,

> "Recruitment? They recruit people using a system, oh what is it called? No, door to door. Because, maybe they are not too academic, ya? So, what's it called, yes they recruit door to door. The process is through discourse. So they debate. They invite their acquaintances to read verses from the Quran. The first stage is called *pilawan*. Reading verses. Then after they have read verses, then it is the *hadith*, then the history of the prophet, then after is the *kastiyah* stage. *Kastiyah* is purification. They cleanse from understandings and ideas that have stuck in their heads. The people that they want to discourse. So they cleanse them from understanding of the constitution, understanding of Indonesia, understanding of democracy." (S1)

> "They lure them in…Then thy refute them one by one, by using verses and by using historical reflections about the struggles of the prophet Muhammad…Theorems, books from Sheikh Nasurudin Alabani, books from Sheikh bin Bas, Ablu Azam…Then books from Middle Eastern thinkers. Then after *kastiyah* is *ta'lim*. *Ta'lim* is giving knowledge. So it's *pilawan, kastiyah, ta'lim*. There are three. The methods of giving knowledge are through experience, so they can send them straight to the field, and knowledge of theories. Theory is giving them teachings in Arabic, religious thinking, teachings of *sharia*, teachings about a lot of things…so it's those three stages. So *ta'lim* is the last stage. Once they've completed *ta'lim* they can do *I'dat*. *I'dat* is the preparation to go to jihad."(S1)
> "In Java it's easy to invite people to do jihad…Because over there they are very dependent on leaders. But not in Aceh. If a leader here orders them to do a suicide bombing, they won't want to!" (S1)

This religious gatekeeping was also mentioned by Subject #3,

> "For example, let's say that you are not a member of JI. I want to invite you to join JI. So I teach you all about Islam, emphasize indoctrination, and increase faith in your personality….I have just implemented *dawah*. After I've performed *dawah* on you…until you truly understand Islam, I invite you to join…If you don't join, it's okay and there is no problem. The most important thing is that we have already sent Islam to you. If you are sure that Islam is right, then you may want to join. That is the integration of the self into Islam. Those that are not Muslim, it is important to befriend them. If they are already Muslims, you have to renew their commitment to defend what is right and defend your leaders and fellow *mujahidin*. *Dawah* is a gateway for becoming a member."(S3)

> "With JI in general, the recruiters and the recruited. In a general sense it's hard to identify absolutely…There are no uniforms or defining characteristics. We are free to do whatever we want. When we have to go on a mission, we go about as a normal person would. Not too different from intelligence agents…There is no particular fashion identification…For the segment of people, everyone is recruited, from *pesantrens* to college students, from every class there are recruiters. In meaning, whoever can accept Islam is released from the color of their skin, ethnicity, etc. If they accept Islam, that's a part of it." (S3)

Subject #2 describes how JI also seeks out the assistance of influential religious leaders like himself to help them their recruitment process,

> "They (JI) said that in Aceh it needed to open up a training for jihad. Had to strengthen the phrase "There is no God but God". Strengthen the Islamic state…Their understanding was to get people by inviting them." (S2)

Finding D - Operations

The question of operations was never brought up by the interviewer because of the assumption this would be incriminating. Spontaneously Subject #3 discussed operational activities evaluating targets and infiltrating locations.

> "For operations, they usually use these methods: the team consists of surveyors, logistics, etc. The bomber is someone we don't pick, but we get the message out about the project, they volunteer. We give them information; they say whether or not they want to join. It's not suggested, it's not chosen. It's not pressured upon them nor chosen for them. They volunteer themselves. Today there are no difficulties finding someone. This means everyone wants to do it. So everyone wants to do it, because it's considered a thing of grace for him. Grace is an opportunity that probably will not come anymore except for that day."(S3)

> "But because they have a lot of business in Indonesia, an example of the background of why the Marriott was a target. We knew that the Marriott was one of the places that was made a central coordination and consolidation site of Jews and Christians for their business in Indonesia."(S3)

> "Every hotel, apartment, and club, we know almost all of them. But if we want to target it, it's not just about knowing the name. There are some surveys that are very long, they can eat up a minimum of three months. Three months, six months, etc. until we know for sure that target is deserving to get destroyed."(S3)

> "If we intend to enter, technically we can gain access by finding work there as security guards, cleaning service, busboys, etc. We find out the situation of the target, we get to know people who visit, or whoever. There are also hotels that have not gone through and that we have not bombed. Because after doing a survey, even if there are a lot of foreigners, but they may not be there to disturb. If they are tourists, they are tourists. They come for the sole purpose of visiting Indonesia with no political motivations or other motivations. The longest we've surveyed a location is seven months. At the end, we canceled the operation. But we can get it done in two or three months."(S3)

Conclusion

These interviews, conducted for no other reason than that of personal curiosity, reveal an extensive amount of information about JI and their activities in Indonesia. Like the best qualitative approaches this research was undertaken without any preconceived ideas about the result of the information. If fact, it could be argued that the findings did not directly answer the initial question Islamic extremism and the presence of radical thought in Indonesia. While some understanding of radical thought was discussed by Subject #2, the head of a school, the most detailed information turned out to be about JI's methodologies relating to target selection and operations.

While these three subjects in no way represent all the possible actors involved in Islamist extremism in Indonesia they do provide an entry point for understanding how terror networks are formed, how members are recruited, and operational requirements.

Ideally future research could expand and focus on some of the points that were triggers for Indonesian extremists as mentioned by Subject 3#, specifically said,

> If one wants to come to Indonesia with good etiquette, acting not too differently from how one should act in Indonesia, then consider yourself a free person. Every state has rules of etiquette."(S3)
>
> "They aren't categorized as enemies as long as they don't make us into enemies…Meaning, that they don't act as hands and feet or tools of the enemy…An example is this: Why are we enemies with the Indonesian government? Because we see that the Indonesian government acts as the hands and feet from them [the enemy]."(S3)

What is clear is that there is a future possibility of attacks. Subject #3 indicated

> "I am not brave enough to reveal the current targets, but what is clear is that there are consistent plans. In order to have a clear plan right now, we must continue to gather data and survey. This means that those that have been made targets cannot be made public. We need to keep that secret. But if you ask if there are plans, we have plans. Currently, we are still in a position of surveying. We don't survey carelessly. From 2009 to 2010, there have already been 10 targets that we have cancelled, because from the results of the survey it was not allowed."(S3)

In addition it is also evident that JI has a culture of subversive intelligence and enemy evaluation. Subject #3 indicated they assess foreigners,

> "We don't just target foreigners. Among our targets are also Indonesians, Southeast Asians, and Middle Easterners, if they have a mission of destroying the Islam that is in Indonesia, then they are our targets." (S3)
>
> "When foreigners come we can't ask them for an interview. Get to know each other first, socialize, just talk. There have been those who got caught. By getting caught, that was our conclusion. We knew in their bag was a CIA card. We were certain, because we were already on good terms. They didn't show us, but asked us to help get their bag. It's like that…That's how we identify, there is the proof. One example also is that they have lived in Indonesia for some time. Although we aren't able to categorize them into American intelligence, but they are here on a research visa. The most common occurs when they are in Indonesia on a research visa as a reporter or journalist, there are a lot. But they also have a secret profession. We can identify tourists who are actually tourists from those who have a secret profession. That's how we analyze." (S3)

While subsequent interviews and research may not serve to mitigate potential attacks in Indonesia, it is possible that a better understanding of the issues causing Islamists extremism in the region could be revealed.

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The Use Suicide Terrorism by Foreign Terrorist Organizations

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Keywords
Terrorism, suicide terrorism, foreign terrorist organizations, organization delineation

Abstract
Suicide terrorism is a tactic heavily used by modern terrorist organizations that is highly effective, disturbing, and visible in the media. This paper seeks to address the question of whether or not suicide terrorism is used by certain groups with common goals or levels of achievability. The United State's Department of State's foreign terrorist organization list has been delineated into categories of goals and the possibility of achieving them. Each terrorist organization has been researched to find if they have ever used suicide terrorism.

This paper will show that suicide terrorism is used by groups with differing goals and levels of achievability. Suicide terrorism as a tool is shown to be valued by groups running the spectrum of religious, cultural, and political goals. Research focusing solely on the goals--and their achievability--of groups needs to move away from this narrow focus and onto the larger environments that create the need for and acceptance of suicide terrorism.

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Introduction

America's only recent experience with suicide terrorism has come from attacks that were either executed, directed, inspired, or logistically supported by al-Qaeda. The 1998 embassy bombings in Tanzania and Kenya, 2000 USS Cole bombing, and the September 11, 2001 attacks were successful suicide attacks. The failed "shoe bomber" of 2001 and "Christmas bomber" of 2009 would have been added to the list of successful suicide attacks linked to al-Qaeda (Elliot, 2002 & Adams, 2009). In President Bush's 2002 State of the Union address he described al-Qaeda's goal as, "…remaking the world and imposing its radical beliefs on people everywhere…to disrupt and end a way of life." From this point forward suicide attacks were popularly seen as the tool of a desperate organization fighting for some extreme, impossible goal. The research was approached by seeking an answer to a simple question: Are groups with certain types of goals and different levels of achievability more likely to use suicide terrorism than others? This paper addresses this question by first studying literature regarding suicide terrorism and then looking at each terrorist group on the State Department's Foreign Terrorist Organization (FTO) list. The goals of each group are categorized according to what they call for and also by the achievability of these goals. It will be shown that suicide terrorism is used by groups with varying goals and levels of achievability.

Background

Many authors have created models and conclusions that determine which groups are more likely to use suicide terrorism. Robert Pape (2005) describes suicide terrorism as, "a strategic effort directed toward particular political goals; it is not simply the product of irrational individuals or an expression of fanatical hatreds". He goes on to say that the main purpose of suicide terrorism is to, "cause democratic states to withdraw forces from the land the terrorists perceive as their national homeland". Hafez (2007) describes suicide terrorism as "powerful weapon" used in a "defensive war against a powerful and arrogant aggressor". Bloom (2006) believes much of the appeal of suicide terrorism lies in the organizations' need to continually gather funds from its support base and that the tactic maximizes publicity, garners greater attention to the group, and helps to mobilize support. Bloom goes on to say that under conditions of group competition there is incentive to, "ramp up the violence in order to distinguish themselves from other organizations".

The selection of terrorist groups to study has been made by choosing to use the US Department of State's Foreign Terrorist Organizations list which as of January 19, 2010, had a total of forty-five organizations named. Some of the organizations like the LTTE and Lashkar-e Tayyiba have declared an end to their violence (Roul, 2009) and these may be taken off the FTO list at some point in the future but remain part of this study. Transliteration spelling has been taken from the FTO list.

Method

The FTOs have been divided into three categories based on their goals: Government change, geopolitical change, and other motives. The category of government change includes FTOs that advocate government change without changing any of the physical boundaries of an existing country and include groups like the Armed Islamic Group of Algeria that sought to overthrow the secular regime in Algeria in the 1990s and replace it with an Islamic state (Vriens, 2009). It is important to note that not all groups included in this category seek to create an Islamic, *sharia* government. The Mujahedin-e Khalq organization works to violently overthrow the government of Iran and install a democratic government based on a mix of Feminism, Islamism, and Marxism (Fletcher, 2008a).

The category of geopolitical change includes those groups that desire the creation of a new state, destruction of a current state, or the redrawing of current boundaries. These conflicts are primarily focused around Palestine, Israel, and Kashmir. The 1988 Charter of Hamas declared that it sought to "obliterate" Israel but in 2009 HAMAS chief Khaled Meshaal announced the organization would accept the creation of a Palestinian state based on the 1967 borders (Solomon and Barnes-Dacy, 2009). Harkat ul-Jihad-I-Islami seeks the secession of Kashmir from India and its eventual accession into Pakistan (Chaudhry, 2004). Other organizations in this category include the LTTE, the Kongra-Gel in Turkey, and the Real IRA in Ireland.

The groups in the "other motives" category include organizations with vastly different goals. An example is Aum Shinrikyo, described as both attempting to "…orchestrate Armageddon" (Wessinger, 2000) and, "ad hoc and *reactive* outbursts of violence directed against individual enemies, often with the underlying aim of settling scores with those who had proved to be hostile to Aum" (Reader, 2000). al-Qa'ida has been included in the "other motives" category as its goals continually change to address current the current political climate and the intended audience.

Figure 1 FTO Goals

Government Change		**Geopolitical Change**	
al-Shabaab	Communist Party of the Philippines	Abu Sayyaf Group	Real IRA
Ansar al-Islam	Mujahedin-e Khalq Organization	Al-Asqsa Martyrs Brigade	Abu Nidal Group
Armed Islamic Group	National Liberation Army	Basque Fatherland and Liberty	Lashkar-e Tayyiba
Asbat al-Ansar	FARC	Continuity IRA	PFLP-General Command
Gama'a al-Islamiyya	Revolutionary Org 17 November	HAMAS	Popular Front for the Liberation of Palestine
Hizballah	Rev People's Liberation Party	Harakat ul-Jihad-i-Islami/Bangladesh	Palestinian Liberation Front
Islamic Movement of Uzbekistan	Shining Path	Harakat ul-Mujahidin	Palestinian Islamic Jihad
Lashkar I Jhangvi	Revolutionary Struggle	Jaish-e-Mohammed	**Other Motives**
Libyan Islamic Fighting Group	Communist Party of the Philippines	Jemaah Islamiya	Aum Shinrikyo
Moroccan Islamic Combatant Group	Islamic Jihad Group	Kongra-Gel (PKK)	Kahane Chai (Kach)
al-Qaida in Iraq	Kata'ib Hizballah	LTTE	al-Qa'ida
al-Qaida in the Islamic Maghreb	al-Qaida in the Arabian Peninsula		United Self-Defense Forces of Colombia

Determining the goals of terrorist groups for categorization is a difficult and potentially contentious task. Many organizations do not have any official website and those that do often do no translate into English. Multiple and politically neutral (if these even exist) sources have been used in an attempt to understand the motives of each group. Often the goals of the organizations are highly debated with the group saying one thing, its detractors declaring another, and moderates in the middle trying to remain objective. Hizballah has described itself as being motivated by the application of Islam in Lebanon through "…peaceful political means" (1998), while others define them as resisting Israel and through this resistance become a regional symbol of Muslim strength (Pan, 2006), and even so far as believing their goal is the genocide of the Jewish people (Levin, 2006).

Faced with multiple different accounts of a group's goal the author has chosen to categorize the groups based off their stated objectives when they can be obtained through official websites, interviews, speeches, and press releases. Where information directly from the groups themselves was difficult to find, multiple outside sources were reviewed and a general consensus was created. It can be argued that certain groups fall into a different category than the one given but the overall validity of the study would not be highly affected if some groups are moved around. When determining an organization's goal for the sake of categorization the most immediate goal stated by the organization was chosen. For example al-Qaida in the Arabian Peninsula's immediate goal of overthrowing the Saudi Arabian and Yemeni governments (BBC, 2010) was chosen over their larger goal of liberating of Jerusalem and the unification of Muslims around the world (Pike, 2010). The most immediate priority of terrorist organizations has been chosen when determining the potential for achievement.

<u>Achievability</u>

The categorization of the achievability of the group's goals is more difficult. The organizations have been divided into two categories: "Realistically achievable" and "realistically unachievable." In order to avoid arbitrary delineation based solely on the researcher's perception of what is *realistic* an attempt has been made to tie current organizations' goals with historical precedent and the politics of the situation. For example many of the organizations that desire regime change have been placed into the "realistically achievable" category as popular revolution has taken place numerous times in history and creation of an Islamic government has also occurred, Iran being a notable example. The groups whose goals are a unified Kashmir under Pakistani rule like Harkat ul-Jihad-al-Islami (Chaudhry, 2004) are more difficult to categorize. An undated statement from the Indian embassy in Washington declares that India's claim to Kashmir is, "final and legal and cannot be disputed" and "the problem of Kashmir today is one of terrorism sponsored by Pakistan". It seems very unlikely that India would let go of Kashmir and India's determination to hold onto Kashmir is the reason behind the groups that call for succession to be placed into the "realistically unachievable" category.

The FTOs whose goal is the destruction of Israel have been placed into the "realistically unachievable" category as well. Israel has shown its military strength through multiple wars and its resilience in the face of decades of terrorist attacks. Standing behind Israel is the United States' continual affirmation of its commitment to Israel's national security with declarations by special envoy George Mitchell in February, 2010 (Mozgovaya, 2010) and President Obama in April, 2010 when he wrote, "…our commitment to Israel's security is unshakeable" (*Jerusalem Post*, 2010).

It may be easier and more politically neutral to think of the "realistically unachievable" goals as those that could not be achieved in any foreseeable near--in some cases distant--future, ones that would require the drastic changing of the global political system, or that would require a monumental and previously unseen mobilization and movement of people. It is *possible* for Palestinian Islamic Jihad to destroy Israel and succeed in the, "creation of an Islamic regime in all of historic Palestine" (Fletcher, 2008) but it is not *realistic*. Just as with the categorization of the organizations' goals, the delineation of achievability is open to contention. The shifting of one or more groups between categories does not invalidate the findings. Figure 2 shows the FTOs' goals and the plausibility of those goals. Of course, it must be acknowledged that all the terrorist groups on the FTO list view their cause as an achievable one or they would not exist.

Figure 2 Achievability of Goals

Government Change		**Geopolitical Change**	
al-Shabaab	**Communist Party of the Philippines**	**Abu Sayyaf Group**	**Real IRA**
Ansar al-Islam	**Mujahedin-e Khalq Organization**	Al-Asqsa Martyrs Brigade	Abu Nidal Group
Armed Islamic Group	**National Liberation Army**	**Basque Fatherland and Liberty**	Lashkar-e Tayyiba
Asbat al-Ansar	**FARC**	**Continuity IRA**	PFLP-General Command
Gama'a al-Islamiyya	Revolutionary Org 17 November	**HAMAS**	Popular Front for the Liberation of Palestine
Hizballah	Rev People's Liberation Party	Harakat ul-Jihad-i-Islami/Bangladesh	Palestinian Liberation Front
Islamic Movement of Uzbekistan	**Shining Path**	Harakat ul-Mujahidin	Palestinian Islamic Jihad
Lashkar I Jhangvi	**Revolutionary Struggle**	Jaish-e-Mohammed	**Other Motives**
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Moroccan Islamic Combatant Group	**Islamic Jihad Group**	**Kongra-Gel (PKK)**	Kahane Chai (Kach)
al-Qaida in Iraq	**Kata'ib Hizballah**	LTTE	al-Qa'ida
al-Qaida in the Islamic Maghreb	**al-Qaida in the Arabian Peninsula**		**United Self-Defense Forces of Colombia**

"Realistically Achievable" "Realistically Unachievable"

<u>The Use of Suicide Terrorism</u>

For the purposes of this paper the "narrow" definition put forward by Moghadan (2006) will used which describes suicide terrorism as an, "...attack whose success is contingent upon the death of the perpetrator". Defined another way the death of the terrorist is part of the planning of the attack as, "the pre-meditated certain death of the perpetrator is the pre-condition for the success of the attack" (Schweitzer, 2001). The 9/11 attacks are a clear example of suicide terrorism whereas the attack committed by Baruch Goldstein where he gunned down Muslims praying in Hebron does do not fit into the "narrow" definition being used as the deaths of his victims were not contingent on his death as well.

When determining which groups have used suicide terrorism every attempt has been made to find clear cases of the use of the tactic. Accounts of suicide attacks by highly publicized groups such as al-Qaida, HAMAS, and Gama'a al-Islamiyya are easy to find. Finding examples from some of the smaller, less studied, and under reported groups is much more difficult. A terrorist organization falls under the category of using the tactic regardless of how recently the suicide attack occurred. It is important to note that unsuccessful attempts are included when determining if organizations use suicide terrorism, as a successful attack is not needed to show that a terrorist group used the tactic.

Findings

Figure 3 lists FTOs by their goals and shows those that have used suicide attacks. Figure 4 offers direct comparison between the FTOs' achievability and their use of suicide terrorism, and Figure 5 shows a comparison between their goals and the use of suicide terrorism. Only those groups that have been suspected in and claimed suicide attacks are highlighted in bold. It can be clearly seen from all three figures that the use of suicide terrorism is not limited to a certain kind of goal or a goal that is deemed unachievable.

Figure 3 Use of Suicide Attacks

Government Change		**Geopolitical Change**	
al-Shabaab	Communist Party of the Philippines	Abu Sayyaf Group	Real IRA (A)
Ansar al-Islam	*Mujahedin-e Khalq Organization*	**Al-Asqsa Martyrs Brigade**	Abu Nidal Group
Armed Islamic Group	National Liberation Army	Basque Fatherland and Liberty	*Lashkar-e Tayyiba*
Asbat al-Ansar	FARC	Continuity IRA	**PFLP-General Command**
Gama'a al-Islamiyya	Revolutionary Org 17 November	**HAMAS**	**Popular Front for the Liberation of Palestine**
Hizballah	**Rev People's Liberation Party**	**Harakat ul-Jihad-i-Islami/Bangladesh**	Palestinian Liberation Front
Islamic Movement of Uzbekistan	Shining Path	**Harakat ul-Mujahidin**	Palestinian Islamic Jihad
Lashkar I Jhangvi	Revolutionary Struggle	**Jaish-e-Mohammed**	**Other Motives**
Libyan Islamic Fighting Group	Communist Party of the Philippines	**Jemaah Islamiya**	Aum Shinrikyo
Moroccan Islamic Combatant Group	**Islamic Jihad Group**	**Kongra-Gel (PKK)**	Kahane Chai (Kach)
al-Qaida in Iraq	**Kata'ib Hizballah**	**LTTE**	**al-Qa'ida**
al-Qaida in the Islamic Maghreb	**al-Qaida in the Arabian Peninsula**		United Self-Defense Forces of Colombia

Suspected in and claimed suicide attack *Suspected in, but not claimed, suicide attacks* Not suspected in suicide attacks

Figure 4 Goals and Suicide Attacks

Government Change		Geopolitical Change	
al-Shabaab	Communist Party of the Philippines	Abu Sayyaf Group	Real IRA
Ansar al-Islam	Mujahedin-e Khalq Organization	**Al-Asqsa Martyrs Brigade**	Abu Nidal Group
Armed Islamic Group	National Liberation Army	Basque Fatherland and Liberty	Lashkar-e Tayyiba
Asbat al-Ansar	FARC	Continuity IRA	**PFLP-General Command**
Gama'a al-Islamiyya	Revolutionary Org 17 November	**HAMAS**	**Popular Front for the Liberation of Palestine**
Hizballah	**Rev People's Liberation Party**	**Harakat ul-Jihad-i-Islami/Bangladesh**	Palestinian Liberation Front
Islamic Movement of Uzbekistan	Shining Path	**Harakat ul-Mujahidin**	Palestinian Islamic Jihad
Lashkar I Jhangvi	Revolutionary Struggle	**Jaish-e-Mohammed**	Other Motives
Libyan Islamic Fighting Group	Communist Party of the Philippines	**Jemaah Islamiya**	Aum Shinrikyo
Moroccan Islamic Combatant Group	**Islamic Jihad Group**	**Kongra-Gel (PKK)**	Kahane Chai (Kach)
al-Qaida in Iraq	**Kata'ib Hizballah**	**LTTE**	**al-Qa'ida**
al-Qaida in the Islamic Maghreb	**al-Qaida in the Arabian Peninsula**		United Self-Defense Forces of Colombia

Suspected in and claimed suicide attacks

Figure 5 Achievability and Suicide Terrorism

Realistically Acvievable		**Realistically Unachievable**	
al-Shabaab	Basque Fatherland and Liberty	**PFLP-General Command**	**al-Qa'ida**
Ansar al-Islam	Communist Party of the Philippines	Revolutionary Org 17 November	Lashkar-e Tayyiba
Armed Islamic Group	Mujahedin-e Khalq Organization	**Rev People's Liberation Party**	**Al-Aqsa Martyrs Brigade**
Asbat al-Ansar	National Liberation Army	**Harakat ul-Jihad-i-Islami/Bangladesh**	
Gama'a al-Islamiyya	FARC **Kongra-Gel (PKK)**	**Harakat ul-Mujahidin**	
Hizballah	Shining Path	**Jaish-e-Mohammed**	
Islamic Movement of Uzbekistan	Revolutionary Struggle	Palestinian Liberation Front	
Lashkar I Jhangvi	Abu Sayyaf Group	**Palestinian Islamic Jihad**	
Libyan Islamic Fighting Group	Continuity IRA	**Popular Front for the Liberation of Palestine**	
Moroccan Islamic Combatant Group	**HAMAS**	Abu Nidal Group	
al-Qaida in Iraq	Real IRA	Aleph (Aum Shinrikyo)	
al-Qaida in the Islamic Maghreb	United Self-Defense Forces of Colombia	Kahane Chai (Kach)	
Islamic Jihad Group	**al-Qaida in the Arabian Penninsula**		
Kata'ib Hizballah	**LTTE**		

Suspected in and claimed suicide attacks

Conclusion

The research shows that suicide terrorism is a tactic that is used in both categories of goals and levels of achievability. Suicide terrorism is not the tool of desperate groups engaged in impossible missions. The tactic is used by groups with realistically achievable goals with both governmental and geopolitical aims. When seeking to address the particularly shocking act of suicide terrorism researchers must avoid simply using group goals as reasons for motivations. Suicide attackers were seen in a range of political, religious, and cultural groups dispelling the common misconception that this tactic is rooted in extremist Islam. Future research must continue to look at the broader political, cultural, religious environments that create terrorist organizations who view suicide terrorism as a valid tool.

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TERRORIST USAGE OF INFORMATION AND COMMUNICATION TECHNOLOGIES (ICTS)

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Abstract

Information and communication technology (ICT) encompasses information technology, mobile communications and other media technologies. Terrorist organizations have leveraged ICT to support their activities. Previous researchers constructed a model of terrorist activities and functions that support those activities (Don, Frelinger, Gerweher, Landree, & Jackson, 2007), and this paper examines instances where those functions have been supported by ICT. The terrorist functions most supported by ICT appear to be related to capacity building, communications and propaganda in particular. Advanced communication capabilities such as cryptography and steganography seem to be eschewed, perhaps due to the unwanted attention they attract. The ICT of the most value to terrorist organizations seems to be the website, which supports a multitude of terrorism related functions such as propaganda, communication, resource acquisition, recruiting, and training. The function least supported thus far appears to be attack operations, although other attack related functions are supported, such as communication, surveillance and reconnaissance.

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Introduction

On April 21, 1996, Chechen separatist leader Dzokhar Dudayev placed a call using a satellite phone at the outskirts of a small village. Dudayev was taking a risk using the phone, but it was an effective way for him to negotiate with the Russian government, and he kept his conversations short to prevent detection. Unfortunately, his precautions were insufficient. In a matter of minutes, the Russians apparently managed to identify him, locate his position, and kill him with a missile strike from a Russian fighter jet. Such a sophisticated attack was presumed to be beyond the capabilities of the Russians. The Russians have never given an official account of what transpired (de Waal, 1999), but rumors and speculation about Dudayev's demise may have had a chilling effect on the use of satellite phones by terrorists such as Osama bin Laden (Wright, 2006) (Gaudin, 2001) (Drozdova, 2002). Al Qaeda has referred to communications as "the double-edged sword" (Al Qaeda, n.d.), and with good reason; it has been estimated that 80 to 90 percent of the information on terrorists gathered by the United States comes from signals intelligence (Priest, 2005), the intelligence information derived from intercepting signals (The Interagency OPSEC Support Staff, 1996).

Concepts

The term Information and Communication Technology (ICT) attempts to reflect the convergence of internet, mobile and traditional media technologies. ICTs include computer systems and data networking, or Information Technology (IT) (Howe, 2000), as well as broadcast media and other audio/video processing and transmission systems (Howe, Information and Communication Technology from FOLDOC, 2008). The convergence of these technologies has generated new ways to process information, and could provide new opportunities for terrorist organizations.

Terrorism can be defined as "politically motivated violence, usually directed against "soft targets" … and with an intention to affect (terrorize) a target audience" (Martin, 2009).

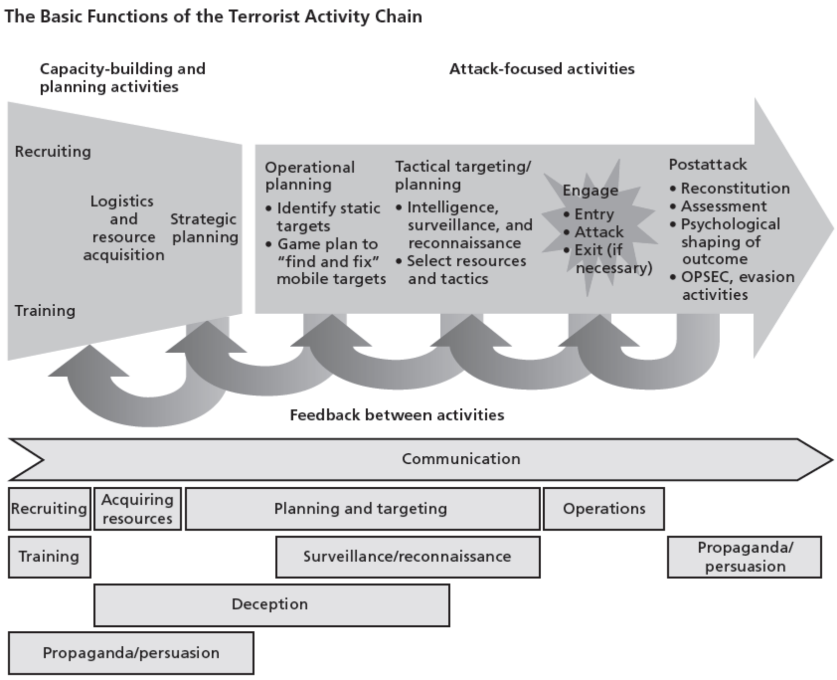
In a 2007 report produced by the RAND Corporation for the Department of Homeland Security on terrorist use of network technology, the authors defined a terrorist activity chain as a model of terrorist operations. The activities were divided into two categories by objective, capacity-building/planning and attack-focused (Don, Frelinger, Gerweher, Landree, & Jackson, 2007). The authors also defined nine basic functions that depend significantly on network technology that support the activities in the chain, and can be related to capacity-building, attack-focused, or both. We will look at instances where these functions, grouped by their focus, have been supported by ICT, and present several cases where ICTs have been used. The capacity-building related functions are recruiting, acquiring resources, and training. The specifically attack-focused functions are attack operations and surveillance/reconnaissance. Functions that contribute to both objectives are communication, planning/targeting, propaganda and deception.

Cross objective functions

Communication

Communications are a core function of any organization, and terrorist organizations would have special requirements because of operating in a hostile environment. At the very least, it is critical that they maintain operations security (OPSEC), to prevent exposure of critical information to their adversaries (Department of Defense, 2010), but since communications must take place, steps are taken to prevent or mitigate exposure of the information to unintended recipients. Methods of communication vary greatly amongst terrorist organizations, depending on factors such as the size of the organization, the location of the organization and the resources available to that organization. A small, regional terrorist organization operating in a failed state would have different operational challenges and opportunities than a transnational terrorist organization spread across multiple continents. State-sponsored terrorists might be provided with military grade communications equipment, but most terrorist organizations would have to operate with less.

Figure 1 - (Don et al., 2007)



Jemaah Islamiyah (JI) is a radical Islamic movement that often used cell phones and texting to communicate. This methodology was effective for them based on the resources available to their adversaries until the Australian Federal Police provided technical assistance to Indonesian investigators in 2002, following bombings in Bali (Jackson, Baker, Cragin, Parachini, Trujillo, & Chalk, 2005). Investigators were able to identify and arrest members based on their cell phone activity, forcing JI to change tactics, relying more on face to face meetings. Osama bin Laden was known to rely on couriers, one of which led to the discovery of his hideout (Mazzetti, 2011).

Ekaterina Drozdova theorizes that organizations operating in a hostile environment would favor low technology, fault tolerant methods of communication, even if it means sacrificing efficiency (Drozdova, 2002). An added advantage of using low technology methods is that they can be harder to counter with technology, and tend to require manpower to implement. For instance, consider the solutions available for screening of email and telephone calls compared to what would be involved in reading letters and searching and interrogating couriers.

One method of providing operations security would be to prevent an adversary from being able to gather information from an intercepted message using ICTs methods including codes, cryptography, and steganography. In discussing these types of communication, it is valuable to establish a basic model of communications and we will use elements from two of them. Berlo's SMCR model describes a sender and receiver, with information being encoded by the sender into a message that is transmitted across a channel to the receiver, who then decodes the message. The channel could be anything from a radio to email to a written letter. The more mechanical Shannon/Weaver model uses noise to inhibit decoding of the message. Classic examples of noise are static in a radio transmission, or “snow” in a television signal, but it can be broadly interpreted to include cognitive factors that would inhibit the receipt of a message (Lee, 1993).

Code and cryptography are often treated as one and the same, but they are actually two different methods of protecting the information within a message. In code, information is mapped to an unrelated phrase, number, or symbol (Mel & Baker, 2001). Codes require code books; a list of phrases and their real meaning. As the size of a network using the codes increases, so does the risk of exposure, since more members would know the codes, or else members might have to manage separate code books to communicate with other members. Code is perhaps one of the simplest methods of clandestine communication, but is also one of the most common.

Cryptography is more flexible for relaying information than codes, but is also more complex. Cryptography involves the use of a cryptographic algorithm, or set of rules, to convert plaintext into ciphertext. The recipient of the message would then use the algorithm and a unique key to decode the ciphertext back plaintext. The most sensitive part of encryption is the keys; the private key must be kept secret to prevent compromise of the ciphertext. This principle was formalized by Auguste Kerckhoffs in 1883, who wrote that in a well-designed cryptographic algorithm, only the key need remain secret (Schneier, Crypto-Gram: May 15, 2002, 2002).

In symmetric encryption, both parties must share the private key in order to encrypt and decrypt messages. Symmetric encryption methods face a similar problem to the use of codes; how do you securely distribute the key without it being intercepted? This can be a challenge just between two parties, but as the number of parties wishing to communicate increase, a choice has to be made; do you share the key amongst all parties, increasing the risk of catastrophic failure in the event of compromise, or do you generate a new key for each individual, geometrically increasing the complexity of managing the keys (Schneier, Secrets & Lies, 2000)?

Radical environmentalists with the Earth Liberation Front have used encrypted email to communicate their activities with “bright” portions of their organization, such as the North American Earth Liberation Front Press Office (NAELFPO), in order to protect their identities (Jackson, Baker, Cragin, Parachini, Trujillo, & Chalk, 2005).

Some terrorist organizations eschew common encryption algorithms for proprietary algorithms, presumably because of a lack of trust of the common algorithms, but this is generally a less secure approach. It would appear that Islamic extremists have been distributing their own suite of tools for encryption, Mujahideen Secrets 2, which is based on common algorithms (Vijayan, 2008). Hamas is also known to communicate over encrypted channels (Conway, 2003).

Encryption is generally sound, but flaws do exist. Users can often be convinced to surrender their passwords and keys, or they may not follow proper operational security. Encrypted files were discovered on a computer seized during a raid on Aum Shinrikyo, but the encryption key was found on a floppy disk (Conway, 2003). Weak encryption keys (strength is measured by bit length, the longer the better) and simple passwords can be compromised more easily; until 1996, products using strong encryption were a restricted export under the Arms Export Control Act in the United States (Clinton, 1996). Cryptography has a complimentary discipline, cryptanalysis, which specializes in the breaking down of cryptographic algorithms. Brute force attacks and exploitation of vulnerabilities in algorithms are other ways that encryption can be circumvented (Denning & Baugh, Encryption and Evolving Technologies: Tools of Organized Crime and Terrorism, 1998). Even the “best of breed” encryption, TLS, suffers from an implementation flaw that could allow a party with sufficient resources to act as a “man in the middle”, allowing them to eavesdrop on encrypted traffic of internet users (O'Brien, 2010).

Steganography can be literally interpreted as Greek for “covered writing” (Ballard, Hornik, & McKenzie, 2002). A classic example of steganography is the use of invisible ink. In terms of the communications model, the message is disguised as noise. In the digital age, it has become possible to use the same basic methodology to hide a file within the contents of another file. Digital mediums such as audio files and photographs are ideal for steganography, as it is possible to hide a message within the file that might be indistinguishable from background noise (Ballard, Hornik, & McKenzie, 2002). Codes, cryptography and steganography can be used to complement one another, in such a way that a code phrase could be encrypted, and the generated ciphertext could be hidden using steganography within a photograph.

There are reported cases of steganography use by criminals, but the practice seems rare (Conway, 2003). There has been speculation that al Qaeda has used steganography to conceal messages in photographs on eBay and in pornographic images and videos (Kolata, 2001). It has been widely reported, but no credible evidence has been produced in a public forum (Manjoo, 2002) (Levine, 2006). In 2010, alleged Russian spies (or “illegal agents”) arrested and accused of operating in the United States explicitly mention the use of steganography to communicate with their handlers in the Russian Federation (National Security Division, US Department of Justice, 2010) (Montgomery, 2010). While steganography is not terribly difficult with freely available software, there is a complimentary study, steganalysis, much as cryptography is complimented by cryptanalysis. Steganography can be detected by steganalysis, and the hidden object can be decoded or easily destroyed, increasing the likelihood that that message cannot be decoded (Conway, 2003).

Conway also discusses what she calls “low-tech steg” such as semagrams and null ciphers. A semagram is communication through symbols. Changing direction or color of an icon on a webpage may have a pre-arranged significance (Conway, 2003). Null ciphers include the plaintext in another message, for instance, an apparently normal message where the first letter of each word can be used to form the plaintext (Kessler, 2004).

Conway’s research into the communication of the 9/11 conspirators found no indications of either encryption or steganography, but the use of code words and phrases that made the conversation appear innocuous (Conway, 2003). Why is this? In many cases, the communications were taking place amongst a small group of people, so the sharing of secret information was not as problematic. Another possibility is that the terrorists wished for their traffic to blend in with other internet traffic. Even if their cryptography and/or steganography were sound, it would stand out from other internet traffic, and would subject their messages to additional scrutiny, such as traffic analysis, which does not require that the message be understood. As Schneier notes, “in a world where most communications are unencrypted, encrypted communications are probably routinely recorded. The mere indication that the conversers do not want to be overheard would be enough to raise an alarm” (Schneier, Secrets & Lies, 2000).

Another method that terrorists might use to avoid discovery is evasion. Keeping conversations short, using different phones or internet service providers (ISPs). Rather than encoding their messages, they have been known to try to use anonymity or impersonation to obscure their communications traffic. Khalid Shaikh Mohammed of Al Qaeda and other terrorists used pre-paid cell phone SIM chips that could be purchased without providing identity information (Van Natta Jr. & Butler, 2004). Other organizations have used cell phone cloning to duplicate the identity of legitimate cell phones to avoid detection in the short term (Denning & Baugh, 1998). Cell phone cloning involves capturing the electronic serial number (ESN) and telephone number (MIN) of a legitimate phone, and then using those settings to make the 'clone' indistinguishable from the original phone, allowing them to make phone calls that are attributed to the original phone (Federal Communications Commission, 2008). Denning and Baugh reported that there were phones capable of storing multiple "identities", and that one drug cartel had cloned a DEA cell phone. In 1993, Somali warlord Mohamed Farrah Aidid's troops sent messages using drums to circumvent telephone eavesdropping (Conway, 2003) (Associated Press, 2001). According to the Al Qaeda Training Manual discovered in 2000, operatives are advised to distort or change their voice when doing "undercover work" (Al Qaeda, n.d.). In 2008, participants in a forum on the Ansar al Jihad website were discussing voice changing products for use with voice of internet protocol (VoIP) systems (304th Military Intelligence Battalion Open Source Intelligence Team, 2008).

There are some commercially available technologies that hamper monitoring of communication, such as Skype, Tor, and the BlackBerry smartphone. Skype is a communications program that allows audio, video, text and files to be shared between multiple parties. It is also capable of serving as a Voice over Internet Protocol (VoIP) telephone, so that the user can make and receive conventional telephone calls. Skype uses 256 bit AES encryption, but also uses Peer to Peer (P2P) technology to route its traffic through optimal pathways on the internet, rather than going through a central point where traffic could easily be intercepted (Skype). The combination of encryption and indirect routing of traffic makes it more difficult capture, much less decode communications (Shaw, 2006). British intelligence has reported that Taliban forces in Afghanistan have used Skype because of its encryption (Savvas, 2008). Skype has been under pressure from the United States and India to weaken its encryption or provide "back door" access to its traffic (Savage, 2010) (Reisinger, 2010).

Tor is an open source software product and its associated network of relay nodes that are designed to allow anonymous internet access through a distributed network of encrypted virtual tunnels made up of about 2000 globally distributed relay nodes, made up in part of volunteers (The Tor Project, Inc.). The Tor project was inspired by the onion routing protocol developed by the U.S. Navy Research Lab (The Tor Project, Inc., 2010). The relay nodes of the network are dynamically organized similarly to a cellular organization, so that each node only knows about the node it receives traffic from, and the node it relays the traffic on to, and the relay nodes will form a new mesh roughly every 10 minutes. During the entire process, the traffic is encrypted, so that only the last node in the network path will handle "normal" internet traffic, and the Tor client negotiates separate encryption with each relay node, so the plain text is encrypted for the final relay node, and that entire element is encrypted for the next to final node, etc. in a fashion that resembles the layers of an onion. Tor is inherently slow, because of the layers of encryption used, and the lengthy path taken through the relay network. Security researchers have found tutorials on using Tor on cyber jihadist forums in 2007 (Poulsen, 2007).

The BlackBerry is a series of smartphones produced by Research in Motion (RIM), a Canadian company. One of the BlackBerry's strengths is its robust security, and BlackBerry has become the de facto smartphone for enterprises around the world (Reardon, 2010). In order to do business in some nations, BlackBerry has had to comply with local regulations, and has provided its encryption keys to Russia and China (Carr, 2010). India, Saudi Arabia, the United Arab Emirates and the United States are trying to get RIM to provide them access to their encryption keys (Savage, 2010) (Charette, 2010). BlackBerries were used by Lashkar-e-Taiba terrorists during the 2008 attack in Mumbai, providing them telephone and internet access even after the power was disconnected (Shachtman, 2008) (McElroy, 2008).

Propaganda and persuasion

One area where terrorist use of ICT has been especially prevalent is in the area of propaganda and persuasion. The DOD defines propaganda as communication designed to influence the opinions, attitudes, or behavior, either directly or indirectly (Department of Defense, 2010). The internet has caused a sea change beginning between 1998 and 1999; in 1998, less than half of the 30 groups on the U.S. State Department's Foreign Terrorist Organizations (FTOs) had a website; by the end of 1999, almost all of them did (Hoffman, The Use of the Internet by Islamic Extremists, 2006). Before 9/11, al Qaeda only had one website, alneda.com, in May 2006, they had over 50 (Hoffman, The Use of the Internet by Islamic Extremists, 2006). Bruce Hoffman stated, "in recent years, the art of terrorist communication has evolved to a point where the terrorists themselves can now control the entire production process: determining the content, context and medium over which their message is projected; and towards precisely the audience (or multiple audiences) they seek to reach" (Hoffman, The Use of the Internet by Islamic Extremists, 2006). The appeal of a global presence, available 24 hours a day with minimal maintenance to an organization eager to reach an audience is readily apparent. Terrorist websites can serve many functions beyond propaganda, including fundraising, training, and recruitment. Many have chat rooms or forums where visitors can interact (Swann, 2008), and the sites can have public and private areas to serve a variety of purposes.

Propaganda is an area where websites can excel, but ICTs provide increasing opportunities beyond simply providing text on a web page. In early 2009, Hamas created palutube.com to serve video clips to rail against Israel and Fatah, one of their main political opponents (Stern Y. , 2009). Al-Manar ("The Beacon") TV, a Lebanese television network that has been tied to Hezbollah is banned in the United States, but hackers have been known to post Al-Manar content on vulnerable websites to make it available where it would otherwise be blocked (Hylton, 2006). In what may be the digital age equivalent of dropping propaganda leaflets, Hamas has also been reported to have sent text message threats to Israeli cell phones (Waked, 2009). Although it would seem to be a relatively trivial exercise, it might still have an impact.

An example of shrewd use of ICT for propaganda is Anwar al-Awlaki, who some have referred to as the "Osama bin Laden of the Internet" (Madhani, 2010). Al-Awlaki has made extensive use of the internet to preach his radical teachings. In the last two years, al-Awlaki has given speeches by video link to mosques and campuses in the United Kingdom, despite being linked to Islamic extremist attacks going as far back as 9/11, including the Fort Hood shootings, the failed Christmas Day "underwear bomb" attack, and the failed Times Square bombing (Temple-Raston, 2010). Al-Awlaki is currently believed to be somewhere in Yemen, and until about the time of the Christmas Day bombing attempt, it was very easy for people to get in contact with him. He has his own website as well as Facebook and YouTube presences (Lubold, 2010). His recordings have been advertised and sold in the UK (Quilliam, 2009).

Currently, al-Awlaki is being tried in absentia on terrorism charges in Yemen (DeYoung, 2010). Google has recently been removing his video content from YouTube by request of the British government (BBC, 2010); meanwhile, a new sermon appeared online on November 8, 2010, in which al-Awlaki says that killing of Americans does not require a fatwa (Kasinof, 2010). This fluid nature of web content might serve as another example of the "double-edged" nature of the internet.

Planning and targeting

Planning and targeting can leverage the massive amount of information freely available on the internet, what the military refers to as open source intelligence, or OSINT (Department of Defense, 2010). Khalid Sheik Mohammed used flight simulation software in the planning of the September 11th attacks (Fielding, 2002).From an ICT perspective, it seems that planning and targeting seem to have overlapped with the surveillance and reconnaissance, since it is possible to gather large amounts of quality information remotely.

Deception

Deception can be defined as "measures designed to mislead the enemy by manipulation, distortion, or falsification of evidence to induce the enemy to react in a manner prejudicial to the enemy's interests" (Department of Defense, 2010). One area where Don et al., expressed concern was that terrorists would be able to create false identities and other types of forgery more easily, with less dependence on specialists who were outside the organization (Don, Frelinger, Gerweher, Landree, & Jackson, 2007). This capability would increase the organization's operational security.

They were also concerned with the sophistication of photograph and video manipulation available on the open market, and the capability to use them to distribute convincing disinformation. In 2008, it appears that the Iranian government released photographs of a successful missile test launch that were sophisticated enough to fool many news organizations in publishing them before the alterations were discovered (Nizza & Lyons, 2008). Desktop publishing software can be used to provide documents and credentials that can pass superficial scrutiny, or be used to present a front business with professionalism and perceived legitimacy. Preparations for the 2008 Mumbai attack were done by establishing a Mumbai branch of a front business that provided immigration services.

Equipment that might have been difficult to locate is much easier to track down in the information age. Students at MIT investigating vulnerabilities in the Massachusetts Bay Transit Authority (MBTA) found special ID badge printers, MBTA uniforms, and license plates available on eBay (Ryan, Andersen, & Chiesa, 2008). The same students acquired equipment that allowed them to explore and manipulate MBTA magnetic stripe cards and RFID cards.

Online communities could be used to provide large amounts of disinformation. Whether intentional or not, the excessive amount of conversations in public, semi-private and private internet forums frequented by Islamic extremists might provide a sort of deception; for instance, whether a technology or method is actually in use or not, its mere mention in a terrorist-related context could consume investigative resources.

Capacity-building objectives

Acquiring resources

Resource acquisition most often refers to fundraising. Some terrorist websites have published routing numbers to solicit donations (Hoffman, The Use of the Internet by Islamic Extremists, 2006), and Hezbollah sells publications on their website (Orris, 2007). The Ejército de Liberación Nacional (ELN) and Fuerzas Armadas Revolucionarias de Colombia (FARC) also use their websites in part for soliciting funds (Orris, 2007). Prior to 2000, Lashkar-e-Taiba ("Army of the Pure") in Pakistan was using the internet for fundraising (Stern J. , 2000), and Chechen guerrillas accept Paypal on their website (Byman, 2008). A 2002 newspaper article claimed that Qassam.net, a now defunct website, amongst its other activities, was raising funds for Hamas, with recommended pledge levels such as $3 for bullets or $2,000 for an AK-47, and that email inquiries would respond with bank routing information that regularly changed (Kelley, 2002).

Another method by which terrorist organizations might use ICT to acquire resources would be from cybercrime. One of the most prominent figure in terrorism on the internet would probably be Younis Tsouli (Levine, 2006). Tsouli, known online as Terrorist 007, was part of a cell that was acquiring stolen credit card information and laundering the money through online gambling websites (Krebs, 2007). Tsouli's cell was also involved in hacking, media production, website management. In Gladwell's model of social networks, Tsouli seemed to play a role as a maven of internet media and hacking, and he had evolved into a connector between members of the internet extremist community and members of Al Qaeda (Gladwell, 2002).

Recruiting

Use of the internet expands organizations' ability to reach potential recruits to a potentially global, twenty-four hour a day presence. As the RAND report on network technology and terrorism points out, a single recruiter can interact with numerous potential candidates across the world nearly simultaneously (Don, Frelinger, Gerweher, Landree, & Jackson, 2007). In written testimony submitted to the House Committee on Homeland Security, Bruce Hoffman theorizes that internet terror recruitment allows terrorist organizations to radicalize and recruit individuals with a low expenditure of resources (Hoffman, Internet Terror Recruitment and Tradecraft: How Can We Address an Evolving Tool While Protecting Free Speech?, 2010). Internet-based recruiting can facilitate the expansion of terrorist networks that will remain dark networks, or decentralized covert networks (Raab & Milward, 2003), for their usable lifetime, if only because their lifetime is relatively short and their existence on the fringe of the network.

Training

Don et al. determined that terrorist training can be divided into basic (small arms), advanced (tactics), and technical (bomb making), and they are typically handled in region through apprenticeship, but internet training may be of value to organizations who do not have safe haven, or for 'disposable' personnel. They also point out that training may be spread through the entire terrorist activity chain, that some training would actually come with indoctrination, and that operational training specific to an attack would be considered part of attack operations and defined this training as specialized and advanced training (Don, Frelinger, Gerweher, Landree, & Jackson, 2007). Aside from providing their message, some terrorist websites also provide educational resources, such as Technical Mujahid; a bi-monthly online magazine published by the al-Fajr Information Center. One issue contained articles on weapons, website design, video production and encryption and steganography (Bakier, 2007).

<u>Attack focused objectives</u>

Surveillance and reconnaissance

The Department of Defense defines surveillance as the systematic observation of an area, persons, places or things, and reconnaissance is defined as a mission to obtain information about an adversary or area (Department of Defense, 2010).

Global Positioning System, or GPS, technology allows a user to determine their position on the Earth with a high degree of accuracy. Software applications such as Google Earth can also leverage geospatial information, and can be used to create custom files that can be distributed. Google and their competitors have also provided 'Street View' features in their map websites, which allow the site's user to call up a panoramic photograph taken at ground level at a specific point on the map (Google, Inc.). There is also concern about webcams that show near real-time views of areas that might be of interest (National Counterterrorism Center, Weapons Tactics and Targets Group, 2010).

Camera capabilities continue to increase; the taking of a usable photograph with most modern digital cameras is practically a given. Some cameras have integrated wireless, or can accept storage cards that contain the same abilities, allowing images to be transmitted elsewhere immediately after being taken (Eye-Fi). Geotagging of photographs is becoming more common, where users (and increasingly the cameras themselves) can attach GPS information to the metadata of a photograph or video (Eye-Fi), websites like flickr.com can then generate a map of "pushpins" where the photographs and video of one or more users were taken. Smartphones provide a strong combination of potential surveillance tools, incorporating cameras, GPS, and wireless data connectivity in an inconspicuous device (Apple, Inc.).

Attack operations

Attack operations is probably the function of a terrorist organization least supported by ICTs, although not for the lack of trying. The most obvious and recurring instance of ICTs being used in attack operations has been the history of remote detonation mechanisms.

Cellular phones have become the new wireless detonator and have been used by Jemaah Islamiyah, even as backup triggers for suicide bombers (Jackson, Baker, Cragin, Parachini, Trujillo, & Chalk, 2005). In the cache of documents released by Wikileaks in October 2010 were reports that Iraq and Syria had provided instruction in the enhancement of suicide vests used in Iraq, including miniature cameras to allow remote monitoring (Spencer, 2010). While the validity of these documents is currently difficult to ascertain, the premise does not sound unreasonable.

An area that is cause for much concern is the capability of ICT to allow remote attacks across the internet. Thus far, a cyber-attack that would qualify as a terrorist attack by Martin's previously discussed definition has not occurred, although as previously discussed, that is not to say that terrorists and their supporters do not engage in cybercrime or hacking. Specifically, the components of Martin's definition, "politically motivated violence" and "with an intention to affect (terrorize) a target audience" are problematic, and Lewis speculates that cyberterrorism does not align well with the goals and motives of terrorists (Lewis, 2003).

Conclusion

In Don et al.'s original report, the authors determined terrorist organizations were likely to continue to acquire and use technology in supporting activities, although operationally, ICTs are not critical for the way terrorists currently operate (Don, Frelinger, Gerweher, Landree, & Jackson, 2007). In any case, technology and ICT in particular are here to stay; proliferation of information and communication technology is a driving force behind globalization (Levin Institute).

ICTs can be important in terrorism because they can provide unprecedented capabilities and the potential to reach and interact with larger audiences. Where ICT really shines for terrorist organizations is the website; it is versatile, capable of fulfilling many of the terrorist activity functions; communication, propaganda, resource acquisition, recruiting, and training.

Not only can they be continuously available, but content can be backed up and replicated with relative ease, and even hidden in hacked websites or in difficult to find locations.

Terrorist organizations do not seem to leverage ICT communications capabilities as well as they could, perhaps because they do not wish their communications to draw attention. Propaganda is where ICT has changed thing the most for terrorist organizations. While the violence has not changed significantly due to ICTs a terrorist organization's violence is directed at an audience, and ICTs have acted as a virtual stage for their performance. Terrorists no longer need to rely as heavily on the media to relay their message.

Effective counter-terrorism exploitation of ICTs and countermeasures can be broken into three main areas: intelligence gathering, countering terrorist messages, and active intelligence operations.

While the internet and ICTs provide the terrorist organization avenues of gathering open information on target organizations and societies, that same capability awaits intelligence organizations against the terrorists. As these organizations publish more and more ideology and information in the public domain, intelligence agencies can use this information (and already are) to compile information on the terrorist organization, including rhetoric, links to other terrorist organizations, main personalities, and geographical areas of operations.

Countering terrorist messages is an area where more policy development should occur. For some reason, many Western governments are not willing to engage in debate with terrorist organizations in an online forum. If effective arguments were made against terrorist organization claims and/or rhetoric, their credibility and therefore ability to raise personnel or materials would be diminished. This approach could be a cost effective method to reduce the effectiveness of ICTs in spreading terrorist propaganda.

Finally, policy that is designed to deceive terrorist organizations via active intelligence operations in the realm of ICTs may be effective. As stated earlier, terrorist organizations are using the internet as a means of gathering information and enhancing surveillance and reconnaissance operations. By using 'false flag' tactics, government can spread inaccurate information or disinformation. These types of operations are not suppressive of ICT usage, but could impact terrorist planning, recruiting, and information gathering. Last, these types of intelligence operations could result in low level infiltrations of terrorist networks.

Given the benefits of ICT and the difficulties that would be encountered trying to restrict terrorist access, it would seem that efforts would be best served studying how ICTs are used by terrorists, and how that might be exploited. Since the majority of U.S. intelligence comes from information intercepted from ICT, it seems that such an initiative is well underway, and the double-edged reputation of ICT is well earned.

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To Brad for his cleansing skills

Author Biographies

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Mr. Merrick is a recognized expert in disaster technology systems and has over fifteen years of experience in software design and development. He has conducted extensive research on exercise design and evaluation, special needs populations during a disaster, and the ideological franchising and expansion of terrorist organizations. Mr. Merrick has been sponsored by the US Department of State to conduct emergency management training in Ghana, and had presented research around the world, including Prague in 2008 and recently at the Chinese Academy of Sciences in Beijing.

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Jarrett Broder (MS) is the Director of Information Technology at the Center for Disaster Risk Policy. He has 11 years of experience in the Information Technology field as a network administrator, server administrator, systems administrator, web master, programmer, project manager, graphic designer and provider of technical consultation and support to both public and private sector organizations. Mr. Broder has been a key member in a group of programmers and designers that have built several enterprise level federal web applications which have received recognition from the governor of Florida and the President of the United States. His 7 years participation in state and federal exercise programs give him a well-rounded understanding of the state and federal models for training and testing as well as the key role technology can play in the dissemination and management of training materials. Mr. Broder has built several computer applications that have assisted in the planning and real-time play of many exercises including, The Bioshield Exercises (Strategic National Stockpile), Beleaguered Bus (Florida Department of Health) and Caduceus Shield. He has also been involved with furthering the distance learning efforts of several colleges at Florida State University. Mr. Broder serves as an adjunct instructor for technology related classes at the Askew School of Public Administration at Florida State University.

Christopher Church is a senior network supervisor and information security expert at the Florida Public Service Commission. He has over 18 years of experience in managing and securing information in both the public and private sector. In addition to his information technology work, he has contracted with the Center for Disaster Risk Policy at Florida State University as an emergency management exercise controller and researcher. Mr. Church is a graduate student in the Emergency Management Academic Program at Florida State University, where his research is focused on terrorist activity and information technology in emergency management. Mr. Church holds degrees in Psychology and Management Information Systems and several information technology certifications, including the Certified Information Systems Security Professional (CISSP).

COMMUNITY RESILIENCE TO FLOODING

KEY PERSONAL ATTRIBUTES OF SOCIAL RESPONSIBILITY

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Keywords

Climate Change, Community Resilience, Risk Perception, Social Responsibility, Decision Making

Abstract

Recent extreme weather events and their tremendous impacts on highly interconnected modern world have called on individuals to work together to enhance resilience of community where they live. Despite well-documented evidence of the potential physical impacts of flooding, the research has so far neglected to fully investigate the manner by which decision making at community level could influence the extent of damage and the resilience to flooding. A research is currently being conducted to investigate this gap in knowledge by exploring ways in which a better understanding of the perceptions of social responsibility could potentially increase community resilience. These perceptions may affect people's behaviour towards the issues of climate change and extreme flooding events. This paper presents some initial findings of an investigation of social responsibility in three communities (Selly Park, Witton and Digbeth) in Birmingham, United Kingdom. A questionnaire survey of householders, managers of local businesses and policy makers yielded 343 completed responses, which were then subjected to Principal Component Analysis (PCA) to better understanding the underlying constructs of social responsibility. The finding suggests two personal attributes, namely 'societal duty' and 'powerlessness', which are believed to be significant antecedents of resilience-enhancing behaviours for preparation and mitigation of flooding at community level. This finding indicates that any attempt to enhance community resilience should encompass appropriate strategies, measures and activities that higher the level of 'societal duty' and lower the level of 'powerlessness'. The finding will be of interest to community leaders and provide considerations for professionals embarking on the development of resilience measures. Future research includes validating the measures and developing a tool for facilitating joined-up thinking amongst members of community.

Introduction

Climate change, considered as the greatest challenge for humanity in 21st century, is altering weather patterns all across the globe and creating changes that our global ecosystem is now struggling to cope with (Pitt, 2008). This has been attributed to a more frequent and severe flooding events, presenting unprecedented threat to the fabric of communities. The impact of flooding around the world is widely documented, prompting relevant stakeholders to take actions. The majority of people in the UK live in urban areas that rely upon an enormous amount of support from organisations to provide them with the water, electricity, gas, communications, transport and food that are necessary elements of everyday life. The systems of this critical infrastructure are reliant upon increasingly complex technology to provide

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them with greater interconnectedness. However, the networks that organisations use to support such a large amount of interdependencies are based upon an outdated infrastructure that lacks the capacity to support our ever more complicated lifestyles. This enormous amount of interconnectedness means that should an extreme flood take place then these interdependencies leave communities vulnerable to the effects of flooding. The ageing physical infrastructure, rapid economic development and growing populations all add to the vulnerability of our built environments to severe floods (Stewart and Bostrom, 2002).

Enhancing the resilience of community to flooding promises many immediate benefits in preparing for disaster and increasing the capacity to recover after the events at a local neighbourhood level. Although this has become an important government and research agenda in the last few years (Pitt, 2008), the effort has been plagued by theoretical and practical challenges. One of which is a lack of understanding of what constitute a resilient community. This is further exacerbated with a lack of consensus upon what its constituent parts (i.e. resilience and community) actually mean within a particular context of discourse. The existence of technological measures is not sufficient for achieving community resilience to flooding (Miceli, Sotgiu and Settanni, 2008). During the summer 2007 flood in the UK, 50% of the flood defences that were tested by the flood waters were overtopped (Pitt, 2008). These failings were found in technological resilience measures across the country and together they demonstrate why non-technological resilience measures must be found and harnessed.

To enhance resilience, members of a community need to adopt appropriate behaviours to prepare for disasters before, during and after flooding events. Questions remain, what makes them willing to adopt these resilience-enhancing behaviours? How can we facilitate the process? A literature review on factors governing resilience-enhancing behaviours at community level suggests that value, belief and attitude related to social responsibility present a promising venue to a greater understanding of community resilience (Berkowitz and Lutterman, 1968; Trainer, 2005). As most social responsibility literature was written in business and corporate strategy context, there is a need to operationalise this concept for investigating social responsibility of members of a community. This will enhance an understanding of social responsibility attitude which is believed to be a significant antecedence to resilience-enhancing behaviours at community level. A questionnaire was developed based on the early conceptualisation of social responsibility by Berkowitz and Lutterman (1968), and was used in a survey of households, managers of local businesses, and policy makers in communities of Selly Park, Witton, and Digbeth in Birmingham, UK. A dataset of 343 responses was obtained and subsequently subjected to Principal Component Analysis (PCA) to reveal the underlying constructs of social responsibility. Discussion of findings and conclusions for further research work are then elaborated. A literature review of community resilience and social responsibility is presented as follows.

Community Resilience

Many definitions of resilience describe a community dealing with the effects of a flooding event and then returning to its normal functioning prior to the event. If a community returns to its previous state then it may have bounced back from the event but it has not actually increased its resilience to similar events. Instead, resilience must be thought of as containing elements of learning and adaptation to events so that community resilience can be increased. The resilience of a community is determined by the interconnected system’s ability to absorb disturbance, self-organise and contain the capacity to learn and adapt (Walker and Salt, 2006). It is the attitudes, perceptions and behaviours that members of a community adopt or display prior to a flooding event that can determine the ability of that community to absorb the disturbance. Furthermore, these aspects also determine their motivation and ability for self-organisation during the event and how much they are willing to learn from the event in order to change their perceptions and behaviours.

There has been research conducted on a number of aspects of extreme flooding events and climate change, such as resilience, adaptive capacity and vulnerability at the national, regional and sector levels (Gallopin, 2006), but there has been very little research conducted within the heart of our built environments, at the local community level. As a conceptual framework, it is helpful to understand a community in geographical terms as the members of this community not only share the resources of that area but also have a shared risk of hazards. Furthermore if members of this community share common resources and hazards, it may be easier to identify the differences between individuals that possess different levels of engagement with the issue of climate change. A localised approach will provide a better context for understanding the decisions of members of the community who fail to engage in resilience promoting actions. Lorenzoni and Pidgeon (2006) support this view, stating that although there is concern regarding climate change present in Europe and the USA; it is not a high enough concern to change behaviours in daily lives and therefore saliency of risk must be increased by concentrating communication of risk at the community level.

There are four main stages to the resilience process, collectively known as the social resilience cycle (see Maguire and Hagan, 2007, for further description). The first stage is mitigation where there is a general process of increasing a community's ability to cope with a flooding event, for example by not building on flood plains or by better protecting buildings. The decisions associated with this stage are the planning and preparation decisions made before the flooding occurs, such as training staff, which provide a basis for community resilience to the flooding event. This first stage is arguably the most crucial stage in determining the degree of resilience that a community will have to a flood as it can also affect the capabilities of the later stages. The first stage is also the phase where perceptions, beliefs and other human barriers can create the most diverse behaviour. Therefore, these potential barriers to resilience need to be better understood.

Social Responsibility

Social responsibility is a term that has been utilised in a variety of forms but is widely recognised as relating to the relationships between the economic, environmental and social aspects of an organisation or group activities that endeavour to benefit society (ISO, 2004). It is largely agreed that social responsibility is an important topic not only for the business environment but also for wider society. Negative effects, such as new legislation and adverse publicity, are seen as arising from a failure to recognise and maintain a suitable level of social responsibility (Peterson and Jun, 2007). Social responsibility has also long been an important field of research for both academics and business practitioners and continues to provide a valuable research area for those wishing to investigate modern societal issues (Peterson and Jun, 2007). Social responsibility has been the focus of research that has (i) investigated business social responsibility by exploring and comparing the perspectives of businesses and social workers (Boehm, 2009), (ii) investigated the relationship between perceptions of personal and social responsibility and intrinsic motivation in the field of education (Li, Wright, Rukavlna and Pickering, 2008) and (iii) explored social responsibility as a factor when investigating genetic and environmental components of pro-social attitudes (Rushton, 2004). These studies indicate that personal responsibility for behaviour is important to increase resilience, and understanding how people perceive themselves and each other in relation to a particular aspect may be a useful way of investigating that aspect itself. Therefore, exploring perceptions of social responsibility for flooding events will provide an excellent platform from which to investigate barriers and drivers to community resilience.

This platform must explore social responsibility from a person-centred perspective, rather than the business-centred perspective associated with corporate social responsibility (CSR). Much previous research has largely focused on how businesses attend to societal needs through CSR, however it could be argued that this has largely been an investigation of public relations rather than actually exploring the processes associated with social responsibility. CSR and public relations share such strong similarities in their origins, theories and practices that the distinction between the two fields has become blurred. It has even been stated that public relations is simply the practice of social responsibility, despite there being key differences between these two fields (Clark, 2000). Therefore, when one thinks of social responsibility, they think of the responsibility that businesses have to the general public and how they communicate information to the public and act upon the feedback (Trainer, 2005). This may actually be a more fitting description of the foundations of public relations models, such as the four step management process (Cutlip and Center, 1978) and the RACE framework (Marston, 1979), rather than social responsibility. Even the foundations of CSR models themselves, such as the four-step process of corporate social involvement (Preston and Post, 1975), may not be suitable to investigate the relationship between social responsibility and community resilience. This is because CSR models are built with the purpose of being related to the business, with the public being a part of this particular business process. CSR is influenced by a number of driving actors, such as investors, consumer demand, government regulation, supply chain requirements and civil groups, all of which apply in varying degrees to different businesses (Clark, 2000).

In the context of community resilience, it is not solely the community group's responsibilities to each other which is being investigated, but is instead their responsibilities to the community itself and their roles within it. This is an important distinction that highlights why social responsibility is an independent aspect, rather than CSR and public relations models. Although public relations models allow a two-way flow of information, they are not suitable for climate change research as they do not provide true equality and integration between multiple community groups. It is unknown therefore whether or not the drivers identified for social responsibility in a corporate context will apply to perceptions of social responsibility in relation to climate change. Further, the underlying constructs that underpinned socially responsible behaviour in the context of community resilience to flooding have not been addressed by the existing literature, and therefore are less understood.

Given that community resilience to extreme weather events relies upon the successful integration of each of the three key stakeholder groups, householders, local businesses and policy makers, it is reasonable to suggest that social responsibility research should not be conceptualised or investigated as a circular process, as this limits integration. Social responsibility research instead needs to investigate perceptions of the roles and responsibilities that the key community groups have not only of themselves, but also how they perceive the other groups. New ideas generated and communicated by each of the groups create a multi-path framework of perceptions and provide a basis for integration, rather than the public simply providing feedback on business ideas or policies. Exploring social responsibility in this integrated manner will highlight potential links between these community groups, how they are contextualised by social responsibility and how may affect overall community resilience. For example, it is reasonable to state that householders may expect policy makers to undertake measures to prevent flooding and policy makers may expect householders to do everything they can to lessen the impact if it does flood. However, history shows us that householders do not do anything until it is too late, such as ignoring flood warnings due to experience of false alarms, and when it does go wrong they then shift the responsibility to the policy makers. The policy makers have to follow procedures which often assume that the householders are taking actions to lessen the impact of flooding. It is these kinds of gaps and misunderstanding of social responsibilities that can cause failings in resilience measures and drain extra resources. The householders are blaming the policy makers when in fact they have decreased their own resilience (by not taking actions to protect themselves) and their community's resilience (by allowing the flood to cause greater damage and thereby using up more of the limited resources available).

The resilience of many communities across the UK had been undermined by gaps in people's expectations of their own and other community group's social responsibilities. These gaps are indicative of barriers to community resilience and are brought about by a lack of integration and joined-up decision making between householders, local businesses and policy makers.

The emergency services and utility companies are responsible for many of the immediate impacts of flooding in the built environment, but the continued successful resilience of the community in the short to medium term relies upon the groups which make up that community. The Pitt Review (2008) supports the importance of these three groups, highlighting that local government plays a central role in managing flood risk, with community groups, such as local flood groups and the National Flood Forum, helping to inform the public of the risks they face before, during and after a flood event. Businesses are beginning to understand the need for a business continuity plan, seeing it as a critical element of good business practice. They are gaining help from policy makers to increase their own level of resilience as well as better safeguarding the infrastructure which provides services to householders (Pitt, 2008). This highlights some of the interdependencies that the individuals within these three groups possess.

A community is made up of individuals, each of whom can have an effect upon their personal level of resilience to flooding, which in turn will influence their community resilience. Thus, individuals have a responsibility to increase their own resilience and they can do so through the decisions they make about being aware of the risks faced by their community, accepting these risks and engaging with the issue of flooding. Unfortunately many people are unaware or are in denial about the risks they live with each day. It is these counterproductive attitudes and flawed decision making which needs to be changed in order to increase resilience. In order to instigate the necessary changes, researchers need to firstly understand how and why people reach the decisions they do about the risk of flooding, as well as understanding how the interdependencies within the community can affect these decisions. These individuals are not simply householders within the community, but also heads of businesses and local policy makers, each of which has a key role to play in increasing resilience. For example, why do local policy makers make the decision to build houses on flood plains when they know that this decreases their community resilience to an extreme flooding event? Why do householders and businesses make the decision to occupy buildings on flood plains when they know that this decreases their personal resilience to an extreme flooding event? This example indicates that there is a lack of individual and social responsibility being taken for actions that can affect personal and community resilience to flooding. It is time for individuals to play a greater role in increasing both their personal and community resilience to ensure that in the future communities will be better protected against these events.

Research Method

The research adopted a quantitative method by developing questionnaire and administering survey to selected sample of key community members, representing households, managers of local businesses and policy makers in three communities (Selly Park, Witton and Digbeth) in Birmingham, UK. The questionnaire is based upon a modified version of Berkowitz and Lutterman’s (1968) social responsibility questionnaire, which has provided a valid and reliable basis for researching social responsibility since its creation. Modified versions of the original questionnaire have been used in previous research such as Reed, Jernstedt, Hawley, Reber and DuBois (2005). The original social responsibility questionnaire measured an individual’s acceptance of the traditional values of their society. The aims of this project though are to reflect the perceptions of community members in relation to a particular aspect and as such the original questionnaire was extended and the attitudinal statements were modified to meet the aims of the research (see Table 1, column 2 for the modified self-perception statements). The respondents were asked to indicate their level of agreement to these 12 statements on a Likert scale from 1 (indicates ‘strongly disagree’) to 4 (indicates ‘strongly agree’). In addition to this, some background information from the respondents were collected including age, gender and ethnicity.

The data set was collected at different times, Selly Park was around Easter 2010 (end of March/start of April), Witton was not too long after that and Digbeth was in Autumn 2010 (start of September). Witton and Selly Park were flooded in 2007 and 2008 respectively, so data were collected 2 and 3 years after events. They were summer floods. Digbeth has not flooded recently. The questionnaires were distributed in person, with stamped-addressed envelopes were provided for the return of the questionnaire. In total, 343 completed questionnaires were received, consisting of 224 householders (94 from Selly Park, 81 from Witton and 49 from Digbeth), 78 local businesses (28 from Selly Park, 23 from Witton and 27 from Digbeth) and 41 policy makers.

The data were subjected to principal component analysis (PCA) to reveal the underlying structure of the data, which provides an insight into the constructs of social responsibility by key community groups. First, the data were tested to confirm sampling adequacy. Kaiser-Meyer-Olkin (KMO) measure of 0.859 indicates that the PCA could be meaningfully applied to data analysis. This was further confirmed by Bartlett's test of sphericity ($p<0.0005$) which suggests the presence of correlations between variables. PCA produces a structure correlation matrix between the components and the variables after rotation. The number of components was determined based on Kaiser's criterion that the eigen value for each component should be greater than 1. Promax oblique rotation with the power (*Kappa*) at 4 was applied to achieve the simplest possible structure to obtain more interpretable components. That is, this procedure clarifies the grouping of variables under principal components. For a detailed description of PCA, readers might wish to consult Tabachnick and Fidell (2007).

Table 1 Social responsibility statements, their average scores and component loadings

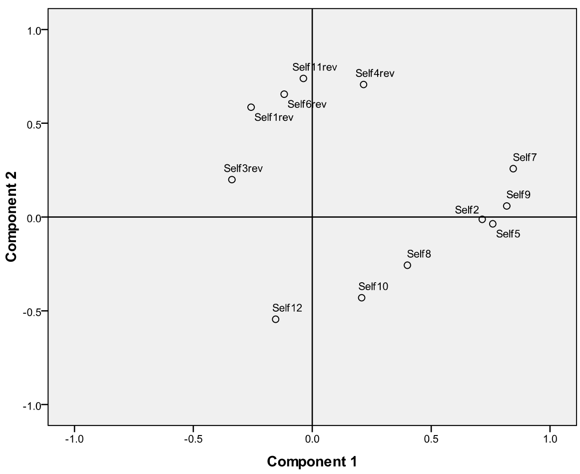
ID.	Statements	Average Score	Component 1	Component 2
Self1rev	It is no use worrying about extreme flooding within the community as I can't do anything about it anyway.	2.1370	-0.555	**0.716**
Self2	Every person should give some of their time for the good of their local community.	2.8776	**0.721**	-0.376
Self3rev	Our country would be a lot better off if we didn't have so many rules.	2.0991	**-0.439**	0.371
Self4rev	Letting your neighbours down is not so bad because you can't do good all the time for everybody.	2.4956	-0.144	**0.596**
Self5	It is the duty of each member of a community to do the very best they can to increase their protection against extreme floods.	2.9767	**0.778**	-0.423
Self6rev	People would be a lot better off if they could live far away from other people and have less interaction with each other.	1.9504	-0.452	**0.715**
Self7	I would like to take part in a community volunteering project.	2.7668	**0.714**	-0.173
Self8	I feel very bad when I have failed to finish a job I promised I would do.	2.9942	**0.531**	-0.461
Self9	I feel it is important to always tell the truth to others.	2.8980	**0.788**	-0.358
Self10	I feel it is important to get on well with your neighbours.	3.0175	0.427	**-0.536**
Self11rev	I do not feel that climate change is an important issue that will affect me.	2.3848	-0.414	**0.758**
Self12	I feel that it is important that people should always obey the law.	3.1458	0.123	**-0.467**

Results and Discussion

Descriptive statistics obtained from the dataset provide demography characteristics of the respondents, which will be a useful basis for interpretation of the findings. The average age of respondents is 34.7 years, with 19 the youngest and 64 the oldest. However, the distribution is somewhat (positively) skewed toward younger age (skewness statistic of 0.591, with first quartile, median and third quartile of 26, 33, 41 respectively), although it could still be considered as a normally distributed sample (Kolmogorow-Smirnov test, $p<0.0005$). The gender distribution of participants (M=Male, F=Female) was as follows: Witton householders (M=32, F=49), Witton local businesses (M=17, F=6), Selly Park householders (M=38, F=56), Selly Park local businesses (M=18, F=10), Digbeth householders (M=33, F=16), Digbeth local businesses (M=22, F=5) and policy makers (M=30, F=11). This indicates that the generalisability of the results is not limited by gender as there is near equal representation throughout. The distribution of ethnicity amongst the participants was 275 White British ethnic group (80.1%), 48 Asian ethnic group (14%), 9 Black ethnic group (2.6%), 4 Chinese ethnic group (1.2%), 2 Mixed: White/Asian ethnic group (0.6%) and 5 Other Ethnicity (1.5%). This indicates that the generalisability of the results may be limited to a White British population. Nevertheless, if these communities are representative of the ethnic distribution of communities within the UK, then the results will be more widely applicable. Furthermore, there are sufficient numbers of both White British and Asian ethnic groups in order to compare the results of each. The average score for each statement is provided in Table 1, column 3.

The PCA yielded two principal components, which explain 46 percent of the variation in the variables. The correlation coefficient between the two components is -0.509, indicating a negative relationship between the two (see Table 1 columns 4 and 5). Factor loadings suggest that *Self2*, *Self3rev*, *Self5*, *Self7*, *Self8* and *Self9* should be included in *Component 1*, and *Self1rev*, *Self4rev*, *Self6rev*, *Self10*, *Self11rev* and *Self12* in *Component 2*. Further examination of Figure 1 confirmed that the variables are clustered into two groups, although this division is not very clear cut in the factor loadings of components 1 and 2. That is, few variables may not be allocated to the 'right' components. Nevertheless, the analysis has revealed an interesting insight into psychological constructs underpinning the perceptions of social responsibility on community resilience to flooding.

Figure 1 Component plot with the variables after rotation



Further examination of components and variables suggests that component 1 could be interpreted as 'societal duty', and component 2 as 'powerlessness', which both to some extend are related in opposite directions. That is, respondents who demonstrate higher scores in 'societal duty', tend to score low in 'powerlessness' attributes, and vice versa. However, members of community could fall within four possible quadrants in Figure 1 (i.e. a combination between (high and low) scores in 'societal duty' and 'powerlessness'. The favoured attitude is high 'societal duty' and low 'powerlessness' scores, which are more likely to induce social responsible behaviour and community resilience. Behaviours for enhancing community resilience might be motivated by a number of factors (Steg and Vlek, 2009), however 'societal duty' finds resonance with the finding of Miceli et al. (2008), who found that emotional factors (affect) were significantly related to preparedness to disaster, whilst cognitive perceptions of risk (i.e. likelihood judgements) were not. Based on Value-Belief-Norm theory, Hansla, Gamble, Juliusson and Gärling (2008) argued that engagement in environmental issues and performing proenvironmental behaviour are determined by the belief in and concerned on the adverse consequences of environment problems for themselves, others or the biosphere. Here, the extent to which an individual includes other people and other living being in their notion of self in decision making in response to potential threats (i.e. self-transcendence/universalism value) determines their level of responsibility to the community. Concern about the adverse consequences is the underlying factor here, whereas our research stresses on the responsibility of a member to their community, which could extend beyond preparing and responding to flooding. Social responsibility could be blocked by 'powerlessness', leading to intense discontent (Trainer, 2005). 'Powerlessness' is the opposite to 'self-efficacy', which is often considered as an antecedent of motivation to undertake a certain action/behaviour. Human being is more motivated to undertake a particular action if they feel that they are capable to do it and can see the outcomes/benefits of their action. 'Self-efficacy' was found to determine the level of disaster preparedness (Mulilis and Lippa, 1990 cited in Miceli et al. 2008). Powerlessness is also the adverse to 'confidence' to undertake particular action. This will impact on the actual behaviours (and level of effort) that a member of community exhibits in preparation and mitigation to flooding events. In summary, this finding suggests that enhancing community resilience should encompass appropriate strategies, measures and activities, which should be directed to elevating community sense of belonging/being part of community and to building confident/feeling in control in that by acting together, they will enhance the resilience of community and their own.

Conclusions and Further Work

Recent extreme weather events and their tremendous impacts on highly interconnected modern world have called on individuals to work together to enhance resilience of community where they live. However, the great challenge for scientists and public at large is to understand the meaning of resilience within particular community context, the factors which may influence resilience, and the behaviours/ actions that may enhance resilience. A thorough review of existing literature suggests that social responsibility provide a promising area from which the underlying factors influencing community resilience could be better understood. Further, existing discourse of social responsibility revolves around applications in the corporate context, in which members of public is largely considered as a 'recipient' within the process, and the activities are very much driven by companies with main concomitant benefits of enhanced corporate image. This highlights a lack of understanding of the concept and the role of social responsibility in the context of enhancing community resilience to flooding. Here, social responsibility means members of community proactively adopt certain behaviours and take actions individually and/or together with others (e.g. neighbours), in effort to improve community and their own resilience.

A questionnaire survey of three communities in Birmingham, UK, was undertaken to obtain the perceptions of social responsibility. In total, 343 completed questionnaires were received and subjected to principal component analysis (PCA) to reveal the underlying structure of the data. The data represent the opinions of diverse members of community, in terms of their age, gender and ethnicity. The PCA produced two components, subsequently named as 'societal duty' and 'powerlessness', which are believed to be significant antecedents of resilience-enhancing behaviours for preparation and mitigation of flooding. This finding indicates that any attempt to enhance community resilience should encompass appropriate strategies, measures and activities that higher the level of 'societal duty' and lower the level of 'powerlessness'. Any attempts should be directed toward elevating community sense of belonging/being part of community and to building confident/feeling in control. This paper makes a contribution in highlighting the importance of proactiveness of community members to enhance the resilience, and potential strategies that could be deployed to enhance 'societal duty' and overcome 'powerlessness' within the mind of community members.

Future work will require a validation of these two attributes for the purpose of creating a tool for informing strategies for enhancing community resilience through joined-up thinking. Comparison of the levels of social responsibility between community groups (i.e. householders, local businesses, policy makers), age, gender and ethnicity will allow more specific strategies to target appropriate groups. This acknowledges the fact that there are no 'one-fits-all' strategies for enhancing resilience. Investigating the gap between the expectation of one group on the level of social responsibility they believe the other groups should have, and their perception of their own level would highlight barriers to community resilience. Here, community groups may not even be aware that they are failing to meet their expected level of social responsibility. In conclusion, this research represents the first attempt to understand the perceptions of social responsibility in relation to community resilience to flooding, and provides an important platform to developing resilience-enhancing behaviours from within the mind of individuals that make up the community.

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CIVIL RESPONSE TO TEN DISASTERS AND MAJOR ACCIDENTS IN THE NETHERLANDS

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Abstract

The Netherlands Institute for Safety has conducted a study concerning civil response to disaster. The aim of the study was to gain insight into what can be expected from citizens in dealing with the aftermath of a crisis. To enable 'real' data to be considered, ten different disasters and major accidents in the Netherlands were studied and examples of civil response and cooperation between civilians and emergency services were gathered. The study consisted of a brief literature review, followed by interviews conducted with 79 emergency responders and 73 civilians. Over 200 best practises have been identified, and the following themes have been analyzed: activities carried out by civilians, prevalence of panic, apathy and antisocial behaviour, background of civilians, willingness and motivation of civilians to help, duration of help provided, origin of materials used, reaction of emergency responders to help of civilians, selection of civilians, instructions provided by emergency responders, cooperation between emergency responders and civilians, coordination of civil response, and the impact of the incident and after care of civilians. Altogether, emergency responders and civilians were very positive about their mutual cooperation during the investigated incidents. An important point that needs attention however is the safety and aftercare of civilians that have helped. The question of the need for coordination of civil response should be elaborated on further. Although emergency responders have a strong urge to coordinate civil response, it remains to be questioned if this coordination is really necessary in many cases.

Introduction

Since 2004 the Netherlands Institute for Safety has conducted several studies concerning civil response to disaster. These studies have provided relevant insights into the behaviour of the public in disaster situations (NIFV, 2005, Kobes, 2010). Public response has been proven to be very valuable, if not indispensable, in overcoming a crisis (NIFV, 2006, Oberijé, 2007). Emergency response services in the Netherlands acknowledge the power of public response. However they do experience difficulty in dealing with this phenomenon, as (up till now) they are not trained to work together with the public in crisis response (NIFV, 2008, Tonnaer, 2008). To help emergency response services overcome this problem a study was conducted in

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order to gather examples of best practises in civil response and cooperation between civilians and emergency services (NIFV, 2010).

Methodology

At first a short literature review was executed in order to determine which accidents would be subject of further investigation. The criteria that were used for this selection were:

1. Year and place of occurrence: the incident should have taken place in the Netherlands within the last 20 years.
2. Impact of the incident: it should be an incident with a large impact; a major incident or a disaster (on a scale that emergency responders were unable to handle without support).
3. Availability of information; there should be some indication that information on civil response is available.
4. Availability of respondents; there should be a reasonable chance to find emergency responders and civilians that were involved in the handling of the incident.

For each incident a brief literature review was executed. The aim of the literature review was to gather examples of civil response on the one hand and to identify emergency responders and civilians with experience on civil response on the other hand. After the literature review, interviews were conducted with emergency responders and civilians. A questionnaire was used as a basis for these interviews. The following themes were addressed in the questionnaire:

- Activities carried out by civilians.
- Prevalence of panic, apathy and antisocial behaviour.
- Background (occupation, education, etc.) of civilians.
- Willingness and motivation of civilians.
- Duration of help provided by civilians.
- Origin of materials used by civilians.
- Reaction of emergency responders to help of civilians.
- Selection of civilians by emergency responders.
- Instructions provided by emergency responders.
- Cooperation between emergency responders and civilians.
- Coordination of civil response.
- Impact of the incident and aftercare of civilians.
- Disagreements and problems during civil response.
- Positive and negative sides of civil response.

At the end, the themes mentioned above have been analysed across all ten disasters/major accidents in order to see if any similarities or striking differences could be found.

For this purpose a distinction was made between incidents that occurred instantaneously – sudden impact incidents - (aircraft crash, fireworks explosion, pub fire, dyke breach, attack on the Queen) and slow impact incidents (flooding of the rivers, power cuts, heat strokes at Four Days Marches, and dune fires).

For the operations performed by civilians an extra analyses was executed to see whether civil response differed per disaster planning process[2].

Results

The following disasters and major incidents matched the criteria mentioned earlier and have been investigated:

1. Aircraft crash Bijlmermeer, Amsterdam, 1992.

   On the evening of Sunday the 4th of October 1992 a Boeing 747 crashed into an apartment building in Amsterdam. The building was situated amongst many other high rise apartments, in a multicultural area, with a significant level of deprivation. . 43 people were killed and 26 people were injured.

2. Flooding of the rivers Rhine, Maas and Waal, 1995.

   At the beginning of 1995 the water in the rivers Rhine, Maas and Waal rose to a very high level due to heavy rainfall and melting snow . Flooding of a large area was expected and 250.000 people evacuated from their homes. In the event most of the area was not flooded, because emergency dykes were built to keep the water away. No one was injured.

3. Fireworks explosion, Enschede, 2000.

   On Saturday the 13th of May, a warm summer day , a storage facility containing a large quantity of fireworks exploded in the centre of the city of Enschede. 22 people were killed and nearly 1000 people were injured.

4. Pub fire at New Year's Eve, Volendam, 2001.

   A fire started in a pub where youngsters were celebrating at New Years Eve. Some of the emergency exits were locked and 14 people were killed. Nearly 250 youngsters were injured, most of them had severe burns.

5. Offset dyke (dyke breach), Wilnis, 2003.

   In the middle of the night at the end of the summer of 2003, a dyke shifted due to a long period of drought, which caused the dyke to dry out and become instable. The village of Wilnis flooded. No one was injured.

6. Power cut, Haaksbergen, 2005.

   In November 2005, due to heavy snowfall and a high winds, part of the electricity network in Haaksbergen failed . The resulting power failure lasted for three days. No one was injured.

7. Heat strokes, Four Days Marches (Vierdaagse), Nijmegen, 2006.

   During the Four Days Marches in Nijmegen in July 2006, two people died and approximately 300 people collapsed due to the high temperatures and the efforts of the long distance walk.

8. Power cut, Bommeler- and Tielerwaard, 2007.

   At the 12th of December 2007 an Apache helicopter hit high voltage power cables that fell into the river Waal. Because of this a power failure occurred in an area where

[2] In the Netherlands there are 23 different disaster planning processes. These processes are divided between and assigned to the services that are responsible for emergency response in the Netherlands: the fire brigade, the police, the medical services and the municipality. In this way, every service is responsible for several disaster planning processes. This responsibility includes the preparedness as well as the response phase.

approximately 100.000 people lived. The power cut lasted for three days. No one was injured.

9. Attack on the Queen, Apeldoorn 2009.

   On the 30th of April 2009, during the celebrations of Queen's Day (a national holiday) an attack was made, with a speeding car, on transport carrying the Queen . The car hit a group of spectators who were watching the Queen coming by. 8 people died (including the attacker) and 10 persons were injured.

10. Dune fires, Schoorl, 2009 en Bergen 2010.

    After a long period of drought, the dunes in Schoorl and Bergen caught fire at the end of the summer season in 2009 and 2010. The fires expanded in the direction of the villages Schoorl and Bergen. The fires were extinguished before the villages were directly effected and no one was injured.

All together 79 emergency responders, mostly from police, ambulance and fire brigade services, and 73 civilians were interviewed. Over 200 examples of help provided by civilians were gathered from the literature review and the interviews.

Activities carried out by civilians

The analysis shows, that civilians have helped at almost all disaster response planning processes. Activities within very specialist processes, like fire fighting and criminal investigation, were less often performed than activities within more common processes like the evacuation of the disaster scene, provide shelter and support to victims, protecting and containing the disaster scene and the supply of basic necessities of life for victims.

When we look at the processes, categorized by emergency services that were held responsible for the handling of these processes, it is found that civilians mostly executed tasks within the so-called multi-disciplinary/ multi-agency processes. Also tasks within the medical processes (like first aid) and the police processes (like traffic control and the protection and containment of the disaster scene) were often performed by civilians. Processes from the fire brigade as well as the governmental processes were less often performed by civilians. For the fire brigade tasks, the reason for this could be that these tasks were often dangerous and special equipment was needed which civilians had no access to. For the governmental tasks no plausible reason can be found, although it might be the case that those tasks were less visible for civilians, as they took place further away from the disaster area (and therefore it simply did not occur to civilians to help with these processes).

When the different types of disaster were concerned, it appeared that with sudden incidents, civil help consisted mostly of search and rescue work, first aid and protection and containment of the disaster scene. In these cases civilians were already present and immediately started with the work that seemed most urgent to them at the moment. With more slowly developing incidents, people more often performed specific tasks that matched their capacities or specific resources they had available.

Prevalence of panic, apathy and antisocial behaviour;

During the investigation, specific attention was paid to the prevalence of panic, apathy and antisocial behaviour. Amongst assisting civilians no panic, apathy or antisocial behaviour was found. At sudden incidents with lots of casualties, panic or (to a lesser extent) apathy was sometimes found amongst victims and their friends and family. Some mentions of anti social behaviour (looting) were found at two disasters: the aircraft crash in Amsterdam and the explosion of a fireworks storage in Enschede. This happened on a small scale and was sometimes prevented by other citizens.

Background of civilians

From the analysis of the background of helping civilians, it appeared that 27 percent of the interviewed people had some training as an Emergency Response Officer (ERO) or fire marshal and 34 percent had First Aid training. 36 percent of the respondents had previously been involved in an incident (either as a victim or as a helping civilian).

Almost half of the respondents had relevant secondary employment (paid or voluntary). They were for instance a member of a rescue brigade or a reservist for the Dutch army. Almost all of the people that had delivered First aid had a medical background (general practitioner, medical specialist or nurse) or had a First aid certificate.

Willingness and motivation of civilians

In general people were very willing to help. There are lots of examples from, for instance, the plane crash in Amsterdam and the fireworks disaster in Enschede where people that came to the incident out of curiosity, spontaneously offered their help when they arrived at the scene. At other major accidents like the attack at Queen's Day, many people witnessed the accident and immediately started to help the victims.

During the incident with the rising rivers in the south of the Netherlands, civilians and emergency responders had time to prepare themselves. Most of the civilians acted on own initiative. Some civilians were approached by emergency responders to help and responded positively.

When asked for their motives to help, most people mentioned that they just wanted to help and make themselves useful. Some people said it was their nature to be helpful. Many people said they saw it as their moral duty to go and help. During the flooding and power cut incidents people thought it was a natural thing to do to help their neighbours, friends and relatives.

For some civilians (mostly with a medical background) an important reason to help was the knowledge that they could actually make a significant contribution to help overcome the crisis.

Also the social connection felt with the community was mentioned as a motivation to help, for instance at the air plane crash in Amsterdam, the fire at New Years Eve in Volendam and the dune fires in Schoorl and Bergen.

Duration of help provided by civilians

The time people helped varied and strongly depended on the type of the incident and the type of help that they provided. The time varied roughly between half an hour and three weeks of work. Civilians usually did not stop helping until the incident was over; other reasons to stop helping were when their activities were taken over by emergency services or when they were mentally or physically exhausted. Civilians usually did not organize their own replacement. Replacement only happened with the long-lasting incidents, especially when general tasks were performed.

Origin of materials used by civilians

Most of the time, civilians used materials they had organized by themselves. For instance most of the casualties at the pub fire in Volendam were transported by people in their own cars to hospitals. The owner of a gas station in Volendam provided fuel for this transport. Wet curtains and table cloths were used to keep burns cool. General practitioners supplied bandages.

In some occasions materials of emergency services were used. At the fireworks disaster in Enschede first aid kits from police cars were used. Also the police handed out vests in order to make the helping citizens easier to recognize. During the power cut incidents emergency generators from the fire brigade were used. In the dune fires citizens used scoops and fire beaters supplied by the fire brigade. And after the attack at Queen's Day people used medical supplies from ambulances.

Reaction of emergency responders to help of civilians

Most emergency responders reacted positively to the help of all civilians. After the sudden incidents (like the attack at Queen's Day and the pub fire at New Years Eve) a lot of civilians were helping already when most professionals arrived. Because of the shortage of emergency responders all help that was offered was very welcome. During the fireworks disaster and the attack at Queen's Day emergency responders even actively involved civilians in several tasks that had to be performed. At the aircraft crash in Amsterdam (1992) however, the emergency services ignored most of the help offered by civilians. At some point the whole area was cleared including the helping civilians, because their safety could not be guaranteed.

Selection of civilians by emergency responders;

At most of the incidents no selection of helping civilians occurred. The reasons, that were given by emergency responders, for this were that there was no time for selection on the one hand and on the other hand, that this was not necessary since some kind of selection had already occurred naturally. After the attack at Queen's Day for instance, a lot of people with a medical background directly started delivering first aid. When the emergency responders arrived the civilians informed them about their medical skills, and were allowed to continue their work. In all the other incidents it was also found that civilians were honest when informing the emergency responders about their background or skills. They were very well capable of judging the situation and the help they could provide.

Any selection that did occur was based on:

- The knowledge and experience these civilians (said they) had.
- Their physical appearance.
- Their behaviour at the incident scene.
- The materials/resources they brought with them.
- Emergency responders sometimes also selected civilians just intuitively.

For general, simple activities, selection occurred less often than for more complex activities that needed specific knowledge or competences. At the dyke breach in Wilnis and the high water of the rivers Rhine, Maas and Waal, people with specific technical knowledge were used. At incidents that developed rapidly with large consequences, people were selected less often than at incidents that developed more slowly or where an incident was predicted to be due to occur.

Instructions provided by emergency responders

In some cases emergency responders instructed civilians what to do to help. These instructions were usually well followed Civilians that received feedback stated that this feedback was very much appreciated and made them feel more secure in conducting their tasks.

Cooperation between emergency responders and civilians

At a lot of incidents emergency responders and civilians cooperated in dealing with the incident. It appears that cooperation was more common with the larger incidents and the life threatening situations. In the situations that cooperation occurred, both emergency responders and civilians were very satisfied about the way they cooperated.

Coordination of civil response

Coordination of civil response differed strongly between incidents. It appears to go together with cooperation. Any increase in cooperation that occurred, appeared to be mirrored by a proportional increase in coordination. No examples where found of central coordination of civil response during the acute phase of the incidents. If coordination occurred, this happened mostly at a 'micro-level' for instance per victim or part of the scene of the incident.

In situations where emergency responders did not take a coordinating role, civilians did discuss amongst themselves what was the best way to handle the situation. After the acute phase of the incidents, coordination did occur more often. For instance ,the aftercare after the pub fire in Volendam and the fireworks disaster in Enschede were coordinated by the government in cooperation with civilians.

Impact and aftercare

For many of the civilians that have helped during the incidents, the incident had a large impact on their lives. On the one hand they were glad that they had helped and all of the interviewed civilians stated that they would help again if a similar incident would happen. On the other hand some of the civilians developed psychological problems after the incident. This was not only the case when the incident had caused a lot of casualties, but also for instance after the Four Day Marches in Nijmegen.

Aftercare was not always offered to civilians. Many of the interviewed civilians stated that they would have wanted some kind of aftercare. Virtually all of them stated that they had expected some kind of acknowledgement and appreciation by the government during and after the incident. Most of the times civilians did feel appreciated by the victims they cared for, but not by the government or emergency responders also involved.

Disagreements and problems during civil response

Although the help of civilians went very well in general, there were some disagreements and problems. In most of these cases the safety of the civilians was at stake and emergency responders did not want them to help anymore because they would otherwise injure themselves. This was especially the case with the incidents where a fire occurred. Sometimes people desperately tried to rescue other people from the fire, this happened at the aircraft crash in Amsterdam as well as at the pub fire in Volendam. At other times ,at the dune fires in Schoorl and Bergen, people who were sent away by the fire brigade because the situation was too dangerous, re-entered the area again via another route to help extinguishing the fire . In these occasions people exposed themselves to the risks of burns and smoke inhalation, because they did not have suitable clothing and respiratory protection to work in close proximity to the fire. In the cases of the aircraft crash and the pub fire in Volendam people actually injured themselves due to their exposure to the fire. In some cases people afterwards stated that they had underestimated the risks of fire (and smoke). In other cases their motivation to help simply was more powerful than their fear of the fire.

Another problem that was caused by the help of civilians was the lack of a clear overview of the incident for the emergency services. At the aircraft crash in Amsterdam, the fireworks disaster in Enschede and the pub fire in Volendam for instance, civilians had transported many injured people by own means to hospitals for instance. It was therefore difficult for the emergency services to keep track of the number of victims and the locations they had been taken to. As they were supposed to be responsible for this process, they felt uncomfortable with the fact that they did not control this, although they did realize that they could never have transported the numbers of injured people to hospital in a comparable time without the help of civilians.

Other problems that have been identified are differing viewpoints of how some incidents should be dealt with. At the high water situation of the rivers and the dyke breach in Wilnis, for example, discussions arose between the fire brigade and building constructors about the way the dykes should be strengthened.

Additionally sometimes inappropriate assistance was implemented. After the aircraft crash, some people in a shelter treated burns with toothpaste as they thought this would have a cooling effect. After the attack at Queen’s day, a church wanted to organize a meeting especially for children. The health care office however disagreed with the way this meeting was organized because of the way it was considered it could affect the children’s mental health.

The main problem that was mentioned by civilians was the fact that they would have liked some feedback and/or confirmation by official emergency responders. At the Four Day Marches (Vierdaagse Nijmegen) for instance a civilian who had offered water and some shade to over 300 people in his garden stated that he would very much have liked an emergency responder to check on him to see if he was still able to cope with the situation.

Positive and negative sides of civil response

When emergency responders and civilians were asked what they thought were the positive and negative sides of civil response the following positive items were mentioned:

- Civilians can prevent damage or injuries because:
    - they are immediately present at the incident/disaster scene to offer their help;
    - they are present in large numbers;
    - they often have specific knowledge or materials/resources.
- Civilians can enhance the information flow from the disaster/incident scene to the responsible authorities or emergency responders.
- Civil response enhances the feeling of connectedness between people (civilians, victims as well as emergency responders).
- Helping makes people feel good and might improve the emotional coping process afterwards.
- Aftercare is more easily accessible for civilians if they are also involved in this process.

The negative sides that were mentioned were[3]:

- Civil help can make the overview of the incident/disaster scene difficult.
- Helping civilians can obstruct the emergency response.
- Civil response can impair the information flow from the disaster/incident scene to the responsible authorities or emergency responders.
- It is difficult to incorporate civil response in the command and control structure of the emergency response services.
    - It costs time and capacity to coordinate or guide civil response.
    - When the incident happens there is no insight in the skills of the helping civilians.
- It is difficult to plan the use of civil help in advance.
- Civilians may not be trained to assess risks and can expose themselves to dangerous situations.
- Civilians are not trained how to cope with the emotional impact of incidents and disasters.

All of the interviewed emergency responders have stated that the civil response contributed a large deal to the emergency response. They also stated that they would use the help of civilians again at another major accident or disaster. Apparently the advantages of civil response outweigh the disadvantages. This means it is important to find solutions in order to minimize the presumed disadvantages. More specifically this is about the coordination of civil response and the prevention of physical and psychological trauma of civilians.

[3] Note that these remarks were made by the respondents and do not necessarily match the view of the authors; see also the Discussion paragraph.

Discussion

In this paper we have analyzed the results of a literature review and interviews with both emergency responders and civilians about civil response after disaster and major incidents in The Netherlands. Having interviewed over 150 emergency responders and civilians across ten different major accidents and disasters we believe that the results we found can be considered quite solid. They are also in line with previous research where we analyzed civil response internationally (NIFV, 2006). However when it comes to the 'so called' positive and negative sides of civil response, we have to make one remark. Many emergency responders name the fact that it is difficult to coordinate the civilians as a major disadvantage of civil response. However in the view of the authors it remains to be questioned if the lack of coordination of civil help is really such a great disadvantage. In most of the cases civilians are helping with small tasks at a small part of the disaster scene: for instance applying first aid to a victim. Our research shows that no problems occur with this, especially when civilians receive feedback from the emergency responders at the scene. Only in some cases coordinated action is preferable, for instance at the construction of dykes, in order to ensure that resources are used at the most effective parts of a dyke and that no counterproductive measures are taken. The period immediately after a disaster is chaotic by definition. Why not accept that and put some more trust in the capacities of our partners in emergency response.

Conclusion

This investigation has shown, that civilians contribute significantly to disaster and emergency response. Over 200 examples of help provided by civilians were gathered. Civil help has been provided in almost all of the disaster planning processes of the emergency response services. Even more, emergency responders as well as civilians that have worked together during emergency response are very positive about their cooperation. According to this research the following conclusions can be drawn regarding civil help in the Netherlands:

- Civilians can and want to provide their help during disasters and major accidents:
    - They are directly present at the incident scene
    - They provide knowledge, helping hands and materials
- Civilians will specify the knowledge they have and can be trusted to give reliable information about their skills and capabilities
- Civilians follow instructions provided by emergency responders well; they also expect to receive feedback on the tasks they execute.
- Civilians expect some kind of acknowledgement and appreciation by the government during and after the incident. Sometimes they also need aftercare.

Two important issues that need attention are the safety of civilians during civil response and the aftercare of civilians that have helped. Some recommendations are made in the next paragraph in order to overcome these problems. The question of the need for coordination of civil response should be elaborated on further. Although emergency responders have a strong urge to coordinate civil response, it remains to be questioned if this coordination is really necessary in many cases.

Recommendations

Based on the previous research the following recommendations can be made for emergency responders:

1. Accept the help of civilians.

   Let civilians help if it is safe for them to do so. Do not take over any activities from civilians if this is not necessary. Do give civilians clear instructions about task delivery, give feedback and check from time to time that the task remains within the capacity of those undertaking it. If necessary make sure assisting civilians are easily identified, by, for instance, handing out marked vests.

2. Have trust in the skills of civilians.

   Let civilians take care of activities within their capabilities, and have trust in the skills they declare they have. Let specialist civilians take care of complex activities and let the other civilians take care of the more general activities.

3. Coordinate civil help only if possible and necessary.

   Do not emphasize the need for coordination of civil help too much. In most cases civil help does not need to be coordinated at a large scale by emergency responders. Instructions and feedback of the tasks being undertaken are, however, very valuable. Civil response should be addressed in the standard agenda of the incident management teams. In this way it is ensured that awareness of what citizens are doing and how this can help an adequate response is raised among the emergency responders. Consider installing a contact point (either physical or virtual) that people wanting to help can turn to.

4. Show your appreciation of civil help.

   Make sure civilians are acknowledged and appreciated during the incident as well as after the incident. Thank civilians involved for their help.

5. Make sure civilians are involved in evaluation and aftercare.

   Make sure civilians are involved in evaluation and aftercare. In order to be able to do this it is important to register as many helping civilians as possible (during or after the incident). Do not forget to offer the civilians that have helped aftercare. This care should be offered in an open way, whenever required. Accept and embrace initiatives from citizens concerning aftercare.

Furthermore three recommendations for preparedness are made:

6. Enhance the resilience of civilians

   The civilians' awareness of their abilities to help during incidents should be developed. This is difficult in a non-disaster prone area as the Netherlands usually are. Therefore knowledge and skills should preferably be enhanced in a more general way, for instance, by stimulating a First aid training for civilians or even obligating a first aid training via a drivers license, schools, corporations or communities.

7. Incorporate civil help in education and training of the emergency services.

   Make sure civil response is addressed in educations and training of the emergency services. Make sure civilians are involved in large drills in order to make these more realistic. Address the use of civil help in preparedness plans in a process-based manner, not content-based, as every incident/disaster will be different.

8. Enter into agreements regarding safety and liability.

   Ensure that emergency responders know for what activities they can or cannot approach civilians. Also make arrangements to manage the liability of helping civilians and emergency responders that have asked civilians to help them (for instance via insurance). Make sure there is a fund from where claims from civilians that were involved in the emergency response, or civilians that have become injured physically or psychologically due to civil assistance, can be financed.

This investigation has shown, that civilians as well as emergency responders are very positive about cooperating during emergency response. By developing local guidance to support recommendations, it can be ensured that civilians and emergency responders can provide mutual support during any emergency response. In this way the efficiency of the emergency response can be enhanced and more lives can be saved.

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SHOCK!

HUMAN BEHAVIOUR WHEN DISASTER STRIKES

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Abstract

There are no automatic built-in rules for people on how they should respond to a disaster. For as many disasters there are, there can be as many different responses, which can exponentially increase depending on the number of people involved. Each person and each organization will have different responses to disasters; some will have a level or understanding of what to do and others will have no idea what to do. Then there are those that simply respond in a way that takes leadership and guidance of others to a new level. Human behaviours and responses can help settle the confusion around a crisis or disaster but they can also exasperate the disaster and increase the level of impact. This presentation/paper discusses the various ways people react and how behaviours - both positive and negative – affect the impacts of the disaster.

Using a wide variety of examples, this paper will show how organizations and people can prepare and amend their responses so that they are better able to survive and work through critical situations.

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Introduction

It's midnight and the fire alarms are ringing; What do you do? You hear a loud bang during your 1pm afternoon meeting; what do you do - and how will you respond?

The reasons for the alarms and the loud bang can vary depending on the cause and there could be disaster/continuity plans in place to deal with the causes but there are very little plans that can be put in place to tell people how they should respond personally, or rather internally, to the situation. This can be a challenge because of the potential for varied responses that people can have when faced with adversity and chaos.

A disaster can be characterized by the number of injuries, the level of casualties, the impact upon the community, the impact upon a corporation and the level of chaos and destruction it can have on facilities, personal property and mental psyches. Combine these together and there can be a myriad of responses and behaviours people will have to calamitous events.

Human beings are individuals, though social beings by nature and each person believes they are unique and unlike others; this is what will cause varied responses and behaviours when disaster strikes. Many will 'freeze' when alarms sound, while others take control and become heroes; running into burning buildings to save the person trapped on the second floor, heedless of the danger to themselves. It's this cross section – from doing nothing to playing the part of a hero and all the various response in between – that will be presented in this paper. First, let's look at some myths regarding the response and behaviours of people during actual disasters.

Myths, Movie and Media Portrayals

Hollywood movies would have us believe that people panic on mass during a disaster. It sure does make for interesting and fun scenes of course but that isn't always the case. There are varying responses to disasters and much of what Hollywood has us believe is myth, not fact.

A myth is something that is untrue and/or has an untrue explanation. In the movies, there is always someone who can manage the situation and become a hero; but there isn't a hero in every disaster, at least none that makes a few million bucks to pretend to be a hero. The hero always comes out on top. This isn't always the case; people do suffer and will be impacted, either long-term, short-term or mentally, which can occur at any time. In the case of New Orleans, there were many varying behaviours apparent throughout the population left to fend for themselves, which will be addressed in another section of this paper. Still, the myth is what many believe to be true. These aren't the kind of myths about the Loch Ness Monster or Bigfoot but the myth that specific behaviours are customary in a disaster.

The media perpetuates stereotypes or myths in disasters; it's called *'sensationalism.'* Media sensationalism will focus on single cases and one-off's that aren't reflective of the overall situation. What's reported isn't always correct. Media are not disaster experts. These one-off's then become the story which ultimately becomes the stereotype for people and their relationship with disasters; it's what makes the headlines. These stores are rarely the case. Even comments about Martial Law are misleading; not all disasters have Martial Law imposed and as of writing, Martial Law has never been imposed in the United States during any of the many tornadoes, Hurricane Katrina or during the September 11, 2001 World Trade Centre attacks (9/11). For instance, the cases in New Orleans is different from what some myths and realities discovered by research shows us. The following chart shows the various aspects of what the myths were against established research and against the New Orleans appearance.

When it comes to disasters, we all feel that people run rampant, steel, loot and basically revert back to 'caveman-like' behaviours, or at least that's what some reporters would have us believe it certainly what some Hollywood blockbusters movies would have us believe. But this isn't really the case. In New Orleans, many of the myths were put to the test and if you watched the new reports each night, you'd believe that all the myths are correct.

Myth 1	*What Happens in a Disaster* - Widespread looting is expected. *The Reality (from experience and research):* There is no increase in criminal activity and little or no looting. *The New Orleans Reality:* We all saw looting and there were numerous media reports and reports by local officials, people in the streets, blogs, etc. There was evidence of looting by officials, Some reports of looting an criminal behaviour have been withdrawn, Looting has been redefined by some commentators to exclude much of the behaviour: the hunger were feeding themselves, the drug addicted were raiding hospitals for their needs and so forth. Criminal drug gangs were very active.
Myth 2	*What Happens in a Disaster* - Helplessness and abandonment of the weak. Disasters strike randomly. *The Reality (from Research and Experience):* People help those in need. Differential impacts on the vulnerable. *The New Orleans Reality:* More than 100,000 people did not have the means to evacuate and became dependant on others to keep them alive. This help was very slow to come and seriously inadequate. Some in nursing homes and private hospitals were abandoned and died. *(St. Rita's Nursing Home – pending criminal charges.)*
Myth 3	*What Happens in a Disaster:* Officials experience conflict between their official duties and family demands. Some will hide from the crisis. *The Reality (from Research and Experience):* Officials will do their job and not abandon their posts because of "role conflict." *The New Orleans Reality:* Large-scale abandonment of officials' posts and duties. Fifty officers were fired for going AWOL (Perlstein, 2005). Police were also caught looting department stores. The situation seemed well beyond the capabilities of CEO's at all levels of government. Priority went to security rather than attending to the shoe desperate for food and water and to those dying for want of medical attention, There were no public heroes.
Myth 4	*What Happens in a Disaster:* Large-scale demand for temporary official accommodation. *The Reality (from Research and Experience):* Little need for official emergency accommodation. *The New Orleans Reality:* About 200,000 people were being housed through official channels a month and half after the disaster, About 120,000 needed accommodation on the day. The mass evacuation centres were over-whelmed. (There is a dispute over the actual figure, with much higher numbers occasionally quoted.)
Myth 5	*What Happens in a Disaster:* People take advantage of the vulnerable. *The Reality (from Research and Experience):* Much behaviour is altruistic. *The New Orleans Reality:* There was no shortage of price gouging and people being evicted from private rentals, creating homelessness. And adding to the burden for public authorities. The town of Gretna, across the Mississippi from New Orleans, barricaded itself f and at gunpoint prevented refugees from entering the town (Khaleej Times, 2005).
Myth 6	*What Happens in a Disaster:* Outside rescue teams save many lives. *The Reality (from Research and Experience):* People next door do the saving as outside help may take too long. *The New Orleans Reality:* There are reports of people assisting each other but the

	general picture is of an absence of rescue and help by neighbours.

Adapted from Handmer 2005, P. 32 & McEntire 2007, p. 72-73.

Often, the myths perpetuate a disaster and overshadow the good behaviours of people. You could liken it to *'one bad apple spoil the bunch.'* Sometimes this is seen as a negative. During Katrina, many individuals were going through debris helping people find their belongings but reporters thought that people were looting and stealing personal effects, when they were actually helping their neighbours.

The Delayed Response

A delayed response is as it seems; delaying one's response to the disaster situation. Some people will respond immediately; grab their coat and head for the nearest exist when the fire alarm bells begin to ring. Others, will delay any action at all, wondering what they should do; they procrastinate, sometimes with tragic results.

According to a 2005 study performed by The National Institute of Standards and Technology (NIST), the average time of response to the World Trade Centre disaster of September 2011, showed that the average person (in the tower(s)) waited for six (6) minutes before executing any kind of response. In another survey of 1,444 survivors of the Twin Towers attack, 40% admitted to taking the time to gather things from their offices (cubicles); such things as pictures, a book they were reading or other trinket they thought was of value.

The reason was that by taking the time to gather familiar items, it lessoned the seriousness of the disaster, even when they might not know what the situation or disaster was. It helped them deal with the possibility of a worst-case situation. Many others in the same set of surveys, admitted to taking the time to call friends and family about the situation. These calls were above and beyond the ones that made the news headlines where people trapped in the upper floors contacted loved ones in their final moments of life.

A delayed response is a type of procrastination – if you wait long enough the disaster will pass. It's like those individuals that refuse to leave when the fire alarms go off in the building. Many times they've gone off prior and they've evacuated but if they'd stayed in the office they could have continued working and not been interrupted by the situation. So, they don't leave believing it is another drill or that it's nothing.

A delayed response can also be caused as a result of a past experience with a situation. For example, if the fire alarms have been activated numerous times but the result is always discovered to be someone having bumped into the alarm. People eventually become numb to the alarms and don't respond as they should. Their experience tells them that a clumsy person has probably set off the alarms once again and thus, they don't respond and when they do, it's delayed. It's all been normal before when he alarms go off, so when disaster really does strike, people believe it really isn't happening and they internally delay their response to the situation. It is a way for people to take control of their situation; if they delay their response – for good or bad – they believe they are in control of the circumstances and that the disaster isn't in control of the situation.

People will also try to disassociate from the disaster, which is a means of a response delay. Some may call it denial of a disaster or a situation, just as a child distances themselves internally from abuse or terrible experiences when they were young. It is a coping method so that they can continue on with life and forget the trauma; a means to survival in harsh and sometimes, terrible circumstances. Sometimes disassociation takes the form of laughter or silence but this is still a form of denial and a delayed response to the disaster or crisis at hand.

The Risk Response

A risk response means that people balance the probability of the disaster with the consequence, which can mean their own personal past experiences. For example, if an area is known for having many thunderstorms but nothing ever comes from them – no damage – then when they are told to take cover due to an oncoming storm, they believe the consequence of that storm is as they remember the other storms; inconsequential. It is like hearing the story of the boy who cried wolf. Newscasters and weathermen can state over and over again that a bad storm is coming but every time the storm arrives, it turns out not to be of no significance. People accept the risk that even if the coming storm *is* stronger than others have been, they still believe the consequences are negligible because experience outweighs reality.

The probability of a stronger storm is lessoned due to their past experiences and thus, they accept the risk of the coming storm because their experience says that the consequence and the probability – of a stronger storm – is minor. If a person wasn't impacted in a prior storm, then they believe they probably won't be in the next storm.

This holds true especially for the elderly. The elderly have many years of experience with disasters, crisis and bad storms. They have survived all the previous situations they've been presented with so they believe – it's ingrained within them – that they can survive any other storm or situation presented to them. Hurricane Katrina presented an example of this.

M.P. Turner was a World War II veteran and lived through many storms in the New Orleans area. When Katrina was forecast to make land fall, he ignored the pleas from his grown children to leave and head to a safe area; even take shelter if he didn't want to leave the city. Mr. Turner believed that since he'd survived many hurricane's in the past and survived the war, he could ride out the prophesized devastation of Hurricane Katrina. When the storm came in and the levee's broke, Turner was still in his home; he'd still stood steadfast and didn't evacuate. Sadly, he was found days later in the attic of his home holding a crucifix and a baseball bat. He'd died of a heart attack. His balance of probability and the consequence didn't equal in his favour. Experience isn't always the best teacher. Risk – regardless of one's experience – is always present and can result in devastating consequences.

The Response of Fear

Have you ever walked down a dark street and felt something that made the hairs on the back of your neck stand up? It is an old primitive response for humans that alerts them to the possibility of danger; an early warning signal to watch for trouble. It's an involuntary motion that for many centuries, has saved lived. Responses are based on these feelings and triggers – the hairs on our necks – that helps us determine what we should do; it ensures our survival.

Fear is being afraid of the unknown and it gives us reason to determine out surroundings, either real or perceived. If our surroundings are comfortable and we don't feel in control, we have fear. We have anxiety. Our brain decides what is important to us during a disaster or impending situation – or perceived situation – such as the hairs prickling on the back of our necks. It helps us to prioritize what is important and what we need to do. For example, if we are fearful, our brain tells us to leave the area and place ourselves in a better surrounding or location. We must leave what is giving us fear - anxiety.

However, when the brain does this it also puts other activities, other reactions lower down the list. These are the moments when you forget how to put on a life jacket when you're told to do so; when it's obvious to do so. It takes away other aspects such as those that are of the simplest responses. It makes a person forgetful and not sure of what to do. Fear has positive and negative aspects. On a positive side it can save a life but on a negative side, it shuts down – or lowers the priority – of other internal triggers and patterns.

The Resilient Response

A resilient response comes from a resilient person, but what kind of person is resilient? There are three characteristics of a resilient person.

First, they believe they can *influence life events*. These people believe within their soul they have the ability to create change and influence those around them. It would be the kind of person that believes their single vote could make a difference int he world. The recent fall 2010 municipal elections in the Waterloo, Ontario, Canada elections was one by a single vote (confirmed after two re-counts).

Second, resilient people tend to *find meaning and purpose in life's turmoil*. They remain calm no matter what comes their way and they deal with the situation as it is, not as it's perceived. Tragedies don't get them down. This doesn't mean that there isn't grief but it does mean they don't let the grief control them so that they cannot function.

Third, and last, resilient people believe they can *learn from both the positive and negative experiences of life* – both personal and professional.

Many resilient people have strong personal skills, knowledgeable and are educated. This doesn't mean that a resilient response can only come from someone who attended the best universities but it does mean they are open minded to situations and keep current on events.

Resilient people see what their situation is and then respond appropriately and accordingly. They are known for being confident and have a healthy view of the world and all that is around them – the more confidence they have the better the ability to be resilient based on the situation encountered.

The Group Response

Earlier, it was noted how Hollywood portrays groups of people during disasters and those portrayals aren't accurate. It is correct to say that disasters happen to groups of people and their communities; when there's impact here, it's going to be a disaster but the response isn't always what you'd think.

There have been many instances where neighbours, who are strangers to each other most often, don't remain strangers for long when a disaster strikes. Many come out to help each other for comfort, social interaction and stability. Disasters actually draw people together.

A case in point; the great blackout of 2003. Many residents walked with their families up and down the streets, meeting much of their neighbours for the first time. It brought people out and made some communities closer, when during non-emergency time periods, these same people never came into contact with each other. The blackout caused problems for governments, financial institutions, factories and the daily lives of millions of people yet, many made the best of it. People afraid of having their food spoil held bar-b-q celebrations with other neighbours who shared the same concern. Together, neighbourhoods got together and held little 'block' parties to get to know each other and help each other. Those that didn't have enough candles were given some by those who had plenty. Together, the blackout disaster – and it was a disaster based on the amount of time lost in productivity and consumerism – it brought people together. There was no panic; people came together to help others.

Many volunteers come out to help neighbours, often more than what can be coordinated. A great example of people coming together is the September 11, 2001 World Trade Centre disaster. First, in Gander, Newfoundland, Canada, residents who were also shocked by the events in New York took in airline passengers when their flight were grounded. These people who didn't know the individuals on the many grounded airplanes, feed strangers, housed them and provided comfort for them as best they could. There have been stories where the local populace held dances and parties to help people overcome their traumas and gave tours of their wonderful island.

Second, when the planes struck the World Trade Centre Towers, thousands upon thousands of people were required to evacuate Manhattan (New York); some people wwere there for business purposes but others were actual residents of the city. Due to the sheer number of people and the fact that subways were closed, the few routes out of Manhattan were clogged and congested. Others came to the rescue.

Many boat owners across the river in New Jersey, motored over to help evacuate those escaping the carnage of 9/11. Again, people from various communities stepped up to help those in need. They didn't panic, they lent a helping hand.

People move as groups in a disaster for support and strength. Evacuations aren't panic situations where people are climbing over each other because in most cases they are very controlled and calm; obviously, with a sense of urgency attached. A group will move in a panicked formation when fear is introduced. As an example, walk into a busy room and yell "fire!"

The Panicked Response

Panic comes from the Greek god Pan. Pan had a human torso and had the legs, head and even the beard of a goat. Sometimes at night he would play tricks on human beings. He'd hide on the trails and the bushes on mountain passes and make noises to spook passersby. He'd spook them slightly over and over again until eventually people feared for their lives and ran away in fright. The fear of what essentially was a harmless playful joke became known as *'panic.'*

Panic can be an *emotion* and it can be *behaviour*. Many have seen instances where people seem to 'freak out' over a situation; this is panic; they've lost control. What has happened to them is they are unable to control the situation, which disrupts their normal behaviours and thus causes a panicked response.

However, the more prepared and educated people are, the better they can control their panicked response. For example, during World War II in the days prior to the Battle of Britain, the British people sandbagged streets, sent young children to the countryside for protection and ensured bomb shelters were easily accessible to everyone; preparing for what would eventually come. When it did come, they were prepared and didn't panic at being bombed for days. The attempted invasion proved to be a failure. It was even noted that the British sense of humour played a major role, with many neighbourhoods bragging about the amount of bombs landing in their streets or who had the largest pothole as a result of the latest bombardment. They were educated on what would come and prepared for it; they were in control of the situation – even if it was a dire situation – and didn't allow panic to set it. If panic had set in, the results may have been different.

As a behaviour, panic can mean irrational shrieking and clamouring that can jeopardize the survival of ourselves and others. It can be a fear of harmless things –a s well as harmful – and can cause people to behave in an irrational way.

It can spread quickly throughout a crowd when a feeling of unease sweeps through the multitude. From 1990 to 2006, 2,500 people lost their lives during the annual pilgrims of Muslims to Mecca because panic swept through the crowd. As the crowds got bigger and bigger, as they reached the religious statues and areas, the crowd became more dense and many lost their ability to control their own actions; they just moved with the crowd due to the sheer numbers. However, when some people become uncomfortable or someone falls due to tripping over something, the momentum of the crowd continues to move them. Those that fall or are uncomfortable can't stop the movement and thus they begin to panic. It is these times when the crowds sheer number and inertia flows over those that can't keep up with it. Panic ensues, as the crowed becomes unmanageable and unstoppable. Panic is losing control and the inability to control the crowds, as at the holy Muslim sites, which created panic and caused the loss of many lives.

On February 12, 2011, Nigerian President Goodluck Jonathan was holding an election campaign rally in front of a large crowd of supporters. The crowd itself was very large and overwhelmed the sports arena in which the rally was being held. To help move the crowd and disperse some of the congested areas, a police officer allegedly fired a gun shot into the air to get people to move but the results were deadly. Not knowing the reason for the gunshot, the supporters panicked and eleven people died at the gates to the stadium, as people tried to leave.

The Paralysis Response

A paralysis response is the ability to do nothing about the situation and not knowing what to do when a situation occurs. Many leaders don't' do anything because they don't know what to do. This can relate back to having a lack of awareness with disaster planning or crisis management but it also can mean that simply 'shock' sets in or a wait and see viewpoint sits in.

They will wait to make decisions in the hopes that by analyzing things it gives the perspective they are in control when in fact they aren't doing anything. One of the most prolific video clips during the aftermath of Hurricane Katrina is of former President George W Bush congratulating the Director of FEMA (The Federal Emergency Management Associations' Michael Brown) on his teams skills and role during the disaster; telling him they were doing a great job, yet the reality was people were suffering. Or, the same GW

Bush freezing – with a blank look on his face - in a classroom when he was initially told about the terrorist attacks on the World Trade Centre. On both accounts, the opposite was true; things weren't as smooth as communicated and serious corrective action – action in general - was needed immediately. The greater the level of fear and shock, the more chance there is of someone experiencing paralysis.

During the Virginia Tech shootings on April 16, 2007, student Clay Voiland used a slightly different approach of paralysis. When he saw shooter, Seung-Hui Cho enter his intermediate French class carrying a gun, he simple collapsed to the floor. He was in an uncomfortable position but he stayed that way. He believed that the shooter would attack anyone that was moving, so he just froze and pretended to be dead. Like most people, he hadn't been in a situation like this before but he thought that by doing nothing – freezing – he would probably be save. For him it worked.

When people – or even animals – aren't responding to a situation, the other party looses interest. Many animals when attacking another animal will lose interest when it stops struggling. Think of rolling in a ball when confronted with by a bear; if you do nothing and not respond to it, the bear – hopefully – will lose its interest in you and move on if it thinks you are dead. If you respond with paralysis.

The Heroic Response

Heroes. The world loves a hero. There are never enough but heroism is a response to crisis and disaster situations. A person can suddenly move beyond their own safety concerns and put others' safety first. Immediately after a sudden chaotic event some people 'jump into the fray' to save the lives of others; often putting their own lives in jeopardy.

On January 13, 1982 Roger Olian happened to be at the right place at the right time; in his pickup truck near the Potomac River when a Boeing 737 crashed into the river. Mr. Olian jumped into the below '0' temperature river, and helped pull a few individuals – the few survivors – of the plane crash to safety. The water was so cold he could have died within moments of jumping into the water. Still, he kept trying to save those in need, climbing over and falling off of large chunks of ice broken because of the planes decent into the river. He put his life in danger to save others who were also in danger.

Heroes also don't have to do anything seemingly large or as grand as swimming into frozen water to save lives. On May 28, 1977 Walter Bailey, as bus boy at the Beverly Hills Supper Club outside Cincinnati, Ohio didn't do anything that remarkable – at least it would seem that way. A lowly busboy, a position that didn't seem to call for any interaction with the wait staff or other higher up on the totem pole, saved the lives of many people from. A shy individual with few friends at the club warned his superiors of a fire in one of the rooms and wanted the manager to get people out of the building. But being a busboy didn't carry any weight, so his warning went unheard and upon Walter's return to the banquet room he's told his manager to vacate, he found it still full of celebrating patrons. He did something he would probably never do otherwise; in front of celebrants watching a show on stage, he walked up onto the stage and walked straight to the microphone – taking it away from a performer – and directed people to leave via three exits. He pointed the left, right and rear exits and spoke in a calm manner; people followed his direction and the room was vacated saving dozens, if not hundreds, of lives.

After the 9/11 attacks, the world saw firefighters and police officers as heroes...and rightly so. As many died that day, it often overlooked that many firefighters die from a heart attack rather than from fighting fires. A hero doesn't always have to be a famous musician, actor or politician; sometimes it's a regular person that suddenly responds in a certain way.

Conclusion

Disaster and crisis situations breed many varied responses; some that can be planned and prepared for while others can – and often do – surprise people and catch them off guard. With some may variables associated with a disaster, there can be as many varied responses. Add into that the number of people involved and the result can be an incalculable number of human responses. No two people are exactly the same, so it's a foregone conclusion that people will respond differently.

Hollywood would have people believe that each disaster brings specific responses but in most cases, Hollywood is wrong and perpetuates the myths associated with disasters and crises. After all, these myths portrayed by Hollywood can bring allot of fortune to the movie makers, even if the stories they tell aren't quite reflective of real disaster behaviours.

Human beings do have some set in behaviours based on our species history but there is no telling how these responses will appear when a disaster occurs. Each is unique and can take on characteristics of their own; this is what can be called the 'unknown' element of disaster responses. It's the varied responses of people that cannot be fully accounted for. Each will have their own experiences to draw from and each will have their own perspective on the situation. Still, one person can make a difference during a situation, like Roger Olian during the Potomac River air disaster and yet, many might not be able to influence the one person they want to reach; like M.P. Turner who didn't heed the warnings of his children during the Katrina disasters.

Each person has their own response to a situation and those differences can mean the survival of many or the survival of none; it can also mean the loss of many or the loss of one. Understanding these different responses and working with people on them can help reduce the overall impact on peoples' long-term ability to deal with disasters.

Author Biography

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Risk Management Practices in the Saudi Business Organizations: A Case Study of the City of Jeddah

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Abstract

This paper discuss business continuity planning (BCP) in City of Jeddah with emphasis on risk sources, causes, and mitigation measures to prevent or reduce monetary losses and improve business competency. During the last two years the city witnessed two floods which caused large human and monetary losses which emphasized the need for having business continuity plans (BCPs) that are based on realistic business impact analysis. It is found that several risk sources are of importance which need to be considered: Commercial and legal relationships, economic circumstances, human behavior, natural and human caused disasters, government activities, technology and management. There is a lack of awareness of business risks in our sample and there is a need to consider future plans and strategies to prevent and reduce business' losses through building business' resilience culture.

Key words: Business Continuity, risk management, Jeddah business continuity

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Introduction

With advances in information technology BC planners look for information systems solutions to develop and execute BCPs. Graphical user interface along with data-base-management systems are used to store and analyze data from different resources to develop BCPs. Erlanger (2006) pointed out that

> Strohl systems' LDPRS is one of businesses continuity packages that guide planners step by step through a logical sequences of business continuity planning tasks. Sun Gard's program is another useful package that could be used in business continuity management. This package uses a central database and guides planners through the business continuity planning process with libraries of questions for business unit survey and numerous plan templates.

Another option for BCP could be outsourcing of key processes or services to maximize profits and reduce costs. Walker (2006) and Runyan and Huddleston (2009) provides guidelines to successfully work with outsource providers.

Business risks are rapidly increasing due to natural and man-made causes with escalating more human and monetary losses. However, business continuity planning did not follow this trend. A research study for Gartner analyst that was conducted in 2000 "found that only 35% of small and midsize businesses have a comprehensive disaster recovery plan in place and fewer than 10% have implemented crisis management, contingency, business recovery and business resumption plans (Swartz, 2003)". Mitroff, Pearson, Puchant (1992) suggest that crisis management should take a strategic role within organizations, given that resources and priorities should be considered to save lives and property by top management.

Moreover, Herban, Elliot, Swartz (2004) examined the potential of considering the business continuity planning on a strategic level. Moreover, they show general parallels between strategic management and continuity management in terms of: Planning processes, capability development and socio-technical approaches, speed, configuration, resilience, obligation and embeddedness. In this research, two UK-based financial firms show that Business Continuity Management (BCM) provision is more aligned towards a mission critical strategic role. Clas (2008) outlined the ten essential elements of BCM which are generally accepted principles of business continuity management from the Institute of Continuity Management (US) and the Business Continuity Institute (UK). They are: Program initiation and management; risk evaluation and control; business impact analysis; business continuity strategies; emergency response and operations; business continuity plan; awareness and training; business continuity plan exercise; audit and maintenance; crises communications; coordinate with external agencies.

Additionally, in order for business continuity plans to be implemented effectively and efficiently, as well as be able to prevent and/or reduce human and monetary losses Momani (2010) proposed 11 elements as part of effective continuity plans. They are:

- legal requirements;

- business continuity planning policy;
- business risk analysis;
- objectives and targets;
- BCP;
- structure and responsibility;
- BCP resources;
- training and awareness;
- BCP documentation;
- BCP testing;
- management review.

Moreover, Claire Lee Reiss, J.D., ARM (2001) released a document for risk identification and analysis through Public Entity Risk Institute (*www.riskinstitute.org)* which will be used in this paper.

Case Study: City of Jeddah

The city of Jeddah on the west coast of the Kingdom of Saudi Arabia with a total area of 748 square kilometers one of the most important cities in Saudi Arabia, and the gateway to trade, which has gained great importance the movement of international trade with foreign markets. Jeddah is characterized as a main gate of the Two Holy Mosques, and the first stop for the pilgrims and pilgrims coming to the leading of the Holy Land (Mecca and Medina) enters through Jeddah's King Abdul Aziz International Airport. The numbers could be up to 5 million people annually with the purposes of Hajj, Umrah, work, tourism, and entertainment.

Jeddah is directly affected by the climate of their geographical location, with high temperature and humidity during the summer, and temperatures of up to early forties centegrades, where the percentage under the influence of seasonal low over a warm air mass, solid and up to the higher humidity in the summer due to rising sea temperatures and lower in winter.

The city of Jeddah, commercial gate to the Kingdom of Saudi Arabia, including an estimated population of 14% of the population of Saudi Arabia, seen in 25 / 11/2009 what is known as a disaster of Black Wednesday, where a heavy rain for a period of six continuous hours lead to the deaths of more than 121 people with monetary losses in the rise. For the monetary losses amounted to about three billion riyals, long installations and government facilities and compensation for those affected is estimated at 5. 1 billion riyals. As for the number of deaths it has reached 121, and other sources, 122 cases with number of missing of 30 people. The number of sheltered was includes 26,711 people in furnished apartments and also pay subsistence for the families of 7821 people. An estimated of 11849 damaged properties and 10913 damaged cars. Commercial traffic was paralyzed and sales fell to about 60% in some shops and the fear of the spread of epidemics and diseases (dengue fever). What is more, it led to the destruction of farms along the road in length of about 100 kilometers. Some buildings get cracks such as residential buildings, shops, which led to the collapse of some houses. In addition, some main and branch roads had washed away a number of cars and high water levels in residential neighborhoods. Floods also led to the displacement of hundreds of families during the crisis and the evacuation of homes in the affected districts and neighborhoods close to them during the crisis and then to avoid the rain later. As for the side effects of the disaster mental disorders have emerged, especially among children who lived through the suffering and frequent theft because thieves are waiting for what will be drawn by them as floods increased theft of equipment and cars and many more. (Momani and Fadil, 2010).

After about 15 months, another flood in 26th 2011 impacted the city of Jeddah which resulted in ten fatalities and billions in monetary losses. The Jeddah Flood of January 26th 2011 damaged about five thousand stores and incurred large economic losses in billion riyals. The Wholesale Food and Beverage Committee at Jeddah Chamber of Commerce reported that about 20 per cent of the owners of these shops holds a comprehensive insurance and the remaining did not get the insurance and they have to pay for their own losses[2]. Moreover, the Tourism Committee of the Jeddah Chamber of Commerce revealed that the rate of occupancy in apartments and hotels in Jeddah, rose by 200 per cent as a result of influx of victims of the flood[3]. In a report of Jeddah Flood for the director general and chief economist at Banque Saudi Fransi, Dr. John said that 13 billion riyals (3.4 billion dollars) will be paid through the insurance sector, while there are losses of about 4 billion riyals ($ 1.1 billion) is not covered by the insurance system. These losses in addition to the ones resulted from the destruction of public places, roads, bridges and public buildings that require maintenance[4]. The industrialists and traders in Jeddah bear huge losses due to Jeddah flood since they suffered after stopping their production in the factories and their raw materials subjected to damage as a result of the floods that swept the city industrial and warehouse in addition to the extensive damage, which affected the infrastructure in the industrial area and the disruption of many machines from the factories there.

Business Risk Management

As the economy evolves, business continues to meet a market need and recognizes and responds effectively and efficiently to changes in its internal and external environment. Risks in such environment could retreat not prepared businesses while progress other ones. The presence of risk is not essentially harmful: risk is simply a measurement of the potential for deviation from an expected outcome, and the consequences of this deviation may be either good (resulting in opportunity) or bad (resulting in threat).

[2]**Jeddah Flood Resulted in more than 5 Billion of Replacement Cost,**
http://www.aleqt.com/2011/02/05/article_500294.html

[3] **Jeddah: 50% loss of tourism .. And 100 million for urgent asphalt in the streets affected,**
http://www.aleqt.com/2011/02/08/article_501623.html

[4] **$ 4.5 billion loss Jeddah Flood .. The insurance covers 75% of which.**
http://www.alarabiya.net/articles/2011/02/02/135959.html

The process of dealing with this uncertainty in identifying potential risk consequences, and trying to achieve the best outcome for the business in a changing environment, is the essence of business' governance.

Through effective contingency planning, a business can continue to serve its customers, clients, and suppliers even after an adverse event affecting the business which could affect business competitiveness and make them liable for public and government lawsuits.

An essential element of any framework for corporate governance is an effective approach to risk management. Therefore, we investigated the risk management practices in Saudi business organization to identify different drives for risk, causes, effects and mitigations measures. This investigation will augment awareness which could lead to future preparedness and action plans that prevent or reduce future losses for Saudi business organizations.

A semi-structured interview was implemented to take participants' contribution to understand the business risk management practices in Jeddah City. Our sample was chosen from the industrial and commercial sectors such as banks, factories along with members from Jeddah Chamber of Commerce. Since the research findings were considered to be sensitive to participants due to competition in the market we will discuss the findings in general perspective.

As for commercial and legal relationship risk the ones which were of concern in order were: employer/subcontractor relationships, customer relationships/contracts, supplier relationship/contracts. These risk sources could cause tangible assets and financial losses. For example, a business could be financially responsible for damages arising from the acts of its employees or agents in the scope of their work. Also, it could lose investment if the leased property is damaged or destroyed, or the lease was canceled. Moreover, a business may incur additional contractual liability for failure to purchase insurance as required by a contract term. Customers could cause business losses since if supplier's breach of contract it will prevents the business from meeting its contractual commitments and eng up with losing more customers. In order to prevent or reduce such losses due to commercial and legal relationship it is important to plan in advance to deal with events that may disrupt transactions with suppliers and customers and to invest in multiple ordering systems to enable business continue taking orders if one system temporary failed. In addition, there is a need to diversify supply stream to avoid dependence on one source of essential suppliers or services and to make advance arrangements for back-up sources of essential supplies and services that the organization provides and support. Due to time urgency in crises and there is a need to return to normal operations it is needed that an organization to identify critical operations and priorities them to receive supplies in the event of disruption in the supply stream.

Economic circumstances could cause financial and operational risk for organizations. Among the most sources of risk in order are: Recession, inflation, change in interest rates, foreign or domestic trade barriers. Recession may impair a business' access to investment capital and inflation may erode the value of a business' financial assets. These could impair business' ability to respond effectively to changes in its industry which could affect its reputation and market share. Moreover, a high unemployment rate may enable the business to hire skilled workers for lower pay and benefits and may affect the cost of hiring an adequate number of skilled workers. As for customers, economic circumstances could changes in consumer loan interest rates or lender credit requirements which may affect customer purchases of major items that require loan financing. In order to deal with such risk sources it is important to maintain a strong relationship and a good credit history with the business' bank and stay aware of developments in the national and local economies, and make advance plans for buffering the effects of recession, or seizing opportunities during a recovery.

Human behavior could contribute to overall business losses. For instance, a business may be liable for bodily injury and property damage caused by the business owner, the business' employees, or its agents. Also, members of the public may vandalize the business' premises. In addition, employees may sabotage the business' computer system and a business can incur substantial legal fees and costs to either defend or pursue claims arising from human behavior. Therefore, it is important to maintain safe business premises to identify and immediately remedy unsafe conditions and to identify important business safety issues and train employees how to address them. Also, business need to establish strong internal controls to discourage and detect employee embezzlement and fraud such as separation of invoice approval and check writing and implanting internal financial controls that will provide an audit trial to ensure employee accountability, and detect employee embezzlement.

As for natural and human caused disasters floods were considered the only risk that business could face in the City of Jeddah. Due to previous experience with floods as we discussed above in the city there are vast interest in adopting a written emergency action plan for each of disaster the business may expect and is based on business impact analysis. Such plans should assign responsibilities to specific employee. The business' assets such as buildings, plants, equipments, vehicles, computers may be physically damaged or destroyed due to disasters. If not damaged it might be not accessible or usable due to loss of utilities among which are electricity, water and sewage. Such things will force business' to suspend operations which may have contractual liability for failure to make contracted deliveries to customers such as what happened after Kobe Earthquake in 1995. After the earthquake, some companies' activities were disrupted even if their infrastructure were intact, since they lost some of their employees. Also, looking for lost relatives or securing shelters after they lost their homes might occupy the workers and affect their performance. Mitsubishi temporarily shut down operations of it is plants because it was missing about 50 employees (Cataldo, 1995)

Government activities could have both positive and negative impact on business. Therefore, most of our sample decide to not consider that government activities could cause financial or monetary losses to their business. For instance, upon the arrival of the King Abdulla Bin Abdul Aziz from his long trip recovery in end of February 2011 he issued number of decisions to improve social and economic situations of citizens which will be reflected on business' investments.

Technology and management risk were considered not controllable and could be biased in favor of responders to our structured interviews. Given that the industry rely on external technology and any changes with this technology will not have impact on local competition and it only will impact the ones who have external investments. We think these sources of risk could have devastating consequences in terms of monetary losses and they need to be understood before we could advice proper prevention and mitigation measures.

Conclusion and Recommendation

It is apparent that business risks are not considered in most business except banking and oil and gas industries. Banking sector are prepared due to fear of financial losses and the strong auditing by the governmental body. Oil and gas industries understand the potential human and monetary losses for their investments. Some interviewers thought that we are very pessimistic in discussing several risk factors that could never happened. Therefore, we recommend to build awareness culture in terms of business continuity planning for business' stakeholders such as owners, managers, suppliers, and customers. Jeddah Chamber of Commerce agreed to include business continuity planning session during Jeddah Commercial Forum in May 2011 in which business impact analysis standards that are applicable to Jeddah City will be discussed in two days workshop for business' stakeholders.

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The role of sustainable urban development in reducing the flooding disaster incidence in Iranian cities: the City of Neka

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Keywords
Flooding, debris flow, land use, physical sustainability, socio-cultural sustainability

Abstract
Construction in close proximity to rivers and streams in Iran is not very well managed or controlled. Despite the fact that Iran has a hot and dry climate and is less known for flooding problems and more for earthquakes; such lack of planning controls on construction near flood zones has led to many deadly catastrophes during the past decades. In this paper, the results of a research on the role of urban planning in reducing the disaster incidence caused by flooding in Iranian cities are discussed. Here, the parameters of sustainable development and principles of public participation are used along with a study of the status quo of the Iranian cities to develop strategies for reducing damage caused by floods. The City of Neka, which has witnessed several minor and a major flooding and debris flow disasters and the consequent losses in life and property within the past decades, is discussed here as the case study. The Neka River cuts through this City which is located near the Caspian Sea and where the climate is hot and humid with considerable rainfall. First, the criteria and indices are obtained from the literature review on sustainable development, as they relate to flooding and its implications for the future generations. Next, the City's information on strengths and weaknesses as well as opportunities and threats, obtained from a SWOT analysis, is crossed with those criteria in order to lay out a platform for planning strategies in the flood areas. The issues conferred here, and the relevant strategies include appropriate land use and type of construction, incentives for public to participate in shunning away from construction in flood areas, and the role of the municipality and government agencies in implementation of rules and regulations based on good governance.

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Introduction

It is estimated that about 95 percent of all victims of natural disasters are from developing countries (Kreimer et al. 2003). Iran is one such country which faces various natural disasters such as earthquakes and landslides every year. Flooding events in urbanized areas is also on the rise in Iran. One reason for this could be the economic development and its consequent pressure on land use which disturbs the natural settings, increasing the potential for flash flood casualties and damages (Marchi et al., 2010). In this paper, the results of a research on the role of urban planning in reducing the disaster incidence caused by flooding in Iranian cities are discussed. The question is whether urban planning based on principles of sustainable development could play a constructive role in preventing future loss of life and property in cities due to flooding.

For the past several decades, such unplanned development had been the norm in the City of Neka. Along the path toward such development, this City also witnessed water overflow of the Neka River and several minor flooding and debris flow. It could be hypothesized that the City's unplanned development has disturbed the natural settings, and therefore, has increased the flooding incidences. The minor flooding events could be taken as warning signals that disturbing the land near the Neka River's course could have disastrous consequences for the City's residents. Such warnings were unheeded until, in 1999, a major flooding disaster took place, leading to many losses in life and extensive property damage and destruction. In this paper, Neka is taken as a case in which urban planning strategies are proposed to reduce occurrences of such disaster.

The questions, which were the focus of this research, include the following: First, how urban development and construction along and near the Neka River contributed to damages? And second, what are the sustainability principles which could contribute toward less damage in case of a fluvial flooding in Neka? Answering these questions provided a basis upon which strategies to deal with the flooding problem were presented.

Theory and Method

The concept of sustainability carries with it the notion of knowing and respecting the limits and capacities of the Earth. A disaster such as flooding in cities, therefore, could be regarded as a consequence of unsustainable development which has ignored the limits and capacities of a fluvial catchment, disturbing the needed balance between the environment and development. In this paper, therefore, strategies toward reducing damages caused by the fluvial flooding in the City of Neka are derived from principles associated with the concept of sustainable urban development. Thus, to come up with a theoretical framework that could provide the parameters necessary for developing the strategies, a discussion of the effects of unplanned development on a natural disaster such as flooding is briefly presented here.

A "natural disaster" in general is defined in Iran as an event, taking place with short warning lead time, occurring without intentional human intervention, and leading to loss of life or property. Among different types of such disasters, earthquakes and floods are more frequent in Iran. For example, it is reported that for the past two decades, about 11 percent of all deaths caused by natural disasters in this country is due to debris flow during flooding incidence. Climate, location of watershed, plant coverage, and land use all are factors which determine the extent of flooding damages. However, disturbing the natural settings of rivers, especially by construction of structures and other man-made barriers on and near river course, contribute to water overflow and flooding. Proximity of urban facilities and buildings to river banks together with their structural characteristics could affect the extent of loss of life and property; while installation of flooding alert systems could reduce such loss. The Pitt Review of 2007 (Pitt, 2008) in England discussed, in full detail, the relationship between land use and flooding. Others, who have worked on the hydrologic effects of land use changes, also point to deforestation, drainage of wetlands, road construction and urbanization as major changes that affect hydrology, leading to flooding (Calder, 1993; De Roo et al. 2001, Yates et al., 2003).

Thus, economic development and urban growth, if unplanned, could work against the health, safety, and welfare of present and future generations living in cities. Here is where the concept of sustainable urban development could play a role. Principles discussed within sustainable urban development paradigm attempt to address the issues which have plagued the cities, making them more livable. Sustainable development is defined here as a type of development that satisfies the needs of present generation without reducing the capacity of future generations to satisfy their own needs (Brundtland Commission, 1987). It could be any kind of positive change that does not destroy the environmental and social systems of a society (Rees, 1988). It also refers to the power of a system for protecting the lives of people who are dependent on that system for an unlimited time (Soemarwoto, 1991, Roseland, 2005). Thus, sustainable urban development is, in itself, the theoretical framework for a concerted effort toward environmental planning and land use planning within cities and their peripheries. In this regard, strategies and policies based on sustainable urban development require attention in the following areas (based on an interpretation of Elliot, 1999):

- an environmental system that respects the fundamental principles of ecology for development.
- an economic system that provides solutions to challenges erupting from disintegrated and unplanned development.
- a political system and governance which guarantees public participation within the decision making process.

In this paper, we discuss these three areas as the principles of sustainability, forming the theoretical framework, with the following subheadings: 1- environmental sustainability, 2- physical and functional sustainability, and 3- socio-cultural sustainability.

As noted, we were interested in understanding the effects of unplanned urban development and construction along the Neka River's course on flooding and suggesting strategies to reduce the risk of flooding incident. The study of the City of Neka provided cognition of the particulars about the development activities along the River and the characteristics of the River itself. The 2006 data on the land use of the area along the River was collected and analyzed. The data included the tabular data obtained from the Statistical Center of Iran as well as the graphic map data from the National Survey Organization.

For the analysis, the SWOT method was used to understand the City's strengths, weaknesses, opportunities, and threats. More tabular data and video clips on the River's disposition and the flooding incidence in the year 1999 were reviewed and analyzed to get a more accurate picture of the threats the City faced by unplanned development. A set of planning objectives were thus developed by crossing the principles of sustainable urban development, discussed above, with the realities of the City. These objectives provided for strategies that could allow for a sustainable development with lower risk of losses in life and property caused by fluvial flooding.

Discussion: A Perspective on Neka

Iran is considered to be a hot and arid country. The City of Neka, however, is situated near the Caspian Sea with a hot and humid climate (figure 1). Its average rainfall is 760 mm per annum at the Gelvard meteorological station. The Neka River is located inside the Neka catchment (see figure 1) with an area of 1992 square kilometers to the south of the Caspian Sea. The River originates at the Shah-Kuh Mountains with a height of 3500 meters and runs 135 kilometers to reach the sea. The River's average slope is 2.5 percent, running a meandering course. The River's slope, cutting through the City of Neka, however, is 3.4 percent, causing a deeper cross-section than the rest of its course to the sea. Thus, near the City, soil erosion is also greater than the rest of the River's course toward the sea. At peak rainfalls, considerable erosion is seen near and inside the City due to flooding hydrograph. Another factor which contributes to flooding is the overall poor drainage. This is due to existence of the thick layer of silty clay loam which is made up of clay and silt to a depth of 8 meters into ground.

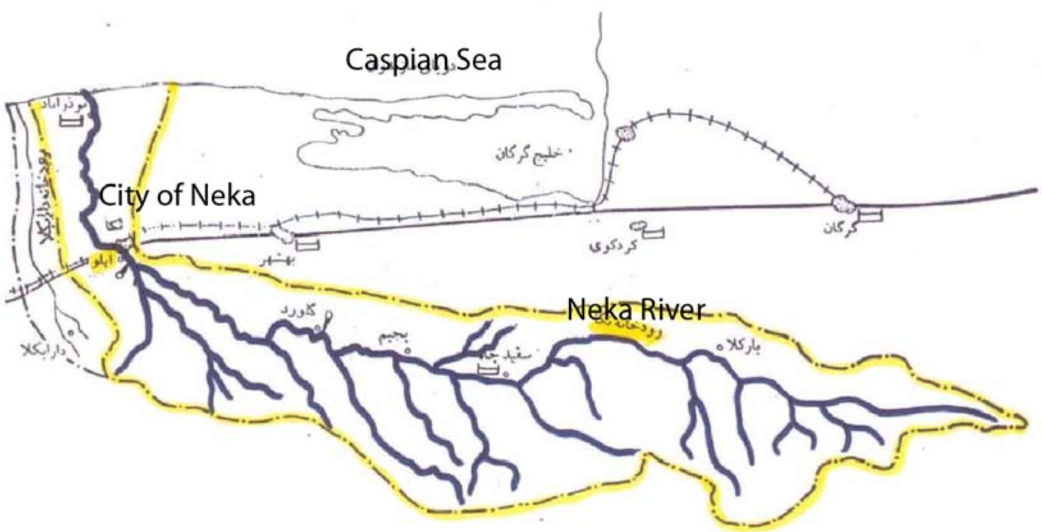

Figure 1: Location of the City of Neka close to the Caspian Sea and within the Neka Catchment area

According to the 2006 Census data, Neka has a population of 98,439 people living within the City's border and its suburbs. On July 25, 1999, heavy rain began at about hour 17 and continued until 4 a.m. the next morning. A total of 120 mm of rain is reported in these hours. The flooding began at 1 a.m. and, before long, tree trunks blocked the River at the bridge spans, causing the water to raise to heights of over 9 meters. By 4:30 a.m., the buildings near the River within the City's borders were totally submerged in water. The speed of water running through the City is recorded at 3.2 meters per second, causing extensive destruction of buildings and infrastructure. Quickly, the two concrete bridges collapsed. The 120 ton railroad bridge was also destroyed and its debris was carried by the water force to more than one kilometer to the north. More than 37 people were killed and 3000 residential and 600 commercial buildings were damaged. Other damages include destruction of 9750 hectares of agricultural land around the City, loss of more than 2000 ---- dam, and 3000 personal automobiles, buses, and heavy machinery.

Flooding in the City of Neka can be contributed to both natural and man-made factors. The former, at first glimpse, deals with unexpected rain pouring over the region on the day before the fluvial flooding. As stated before, 120 mm of rain led to a water surge (debi) of about 2300 cubic meters per second in the Neka River. Second, Neka River's course has a steep slope even when it cuts through the City of Neka. Inside the City's borders the River's width is comparatively narrower while the slope is still relatively steep. Thus, water moves throughout the City with higher speed than the rest of its course toward the sea. Third, the meandering morphology of the River causes water overflow to spread out as in a fast-moving wide strip of water in straight line on the direction of the slope. This strip is much wider than the River's width and easily covers the crescent land between meanders.

On the other hand, the man-made factors deal with human intervention in nature. First of these factors refers to deforestation for the sake of lumber industry's profit making endeavors. The consequences of this factor include faster soil erosion, lower water detention, greater amount of leftover twigs and tree trunks in shape of debris which obstructed the River's course at bridges' spans at the time of flooding, and faster water speed due to lack of natural barriers.

The second man-made factor deals with land development and building construction near and along the river banks. Throughout history, many settlements were formed along river banks since easy access to water has always been considered as an asset to city dwellers. In the City of Neka, however, the steady increase in land demand and the consequent rise in land prices during the past half a century had provoked people to build houses and shops all the way up to the River's very edge.

The third factor involves building bridges over the river. Dams are formed when the debris obstruct the bridges' spans between the columns, forcing water to rise to several meters over these obstructions, flowing over the bridges and into the city. For example, the steel railroad bridge with 35 meters in length and the height of 6 meters over the Neka River's bed worked as a dam when debris obstructed the spans. The bridge broke apart when a 50 ton concrete bunker, carried by water, crashed into it. After this barrier fell apart, water rushed out with great speed, creating a vacuum behind which, in turn, pulled in the buildings that were flooded. Structures failed and fell apart. The debris was carried to the next bridge, building another barrier and repeating the process over again.

As part of the methodology of this research, the SWOT analysis was used to look at the City's strengths, weaknesses, opportunities, and threats in the three categories discussed in the previous section. These include: 1- environmental sustainability, 2- physical and functional sustainability, and 3- social sustainability. The analysis required us to gather considerable amount of data on the City's environmental, physical, and demographic and social aspects for the years 1996 and 2006. The results of this analysis were then used to draft the goals and strategies as discussed later in this paper. All SWOT tables could not be shown here due to page limitations in this paper. However, examples for each sustainability category are shown below:

	Strengths	Weaknesses	opportunities	Threats
In regard to: Environmental sustainability	Ample rain and tree coverage in and around the City	River's steep slope starting from the Shah-Kuh mountian toward the City and meandering course through the City	The City's proximity to forests and mountains to the south and the Caspian Sea to the north	High flooding hydrograph and rapid soil erosion

In regard to: Physical/ functional sustainability	Availability of green open spaces along the Neka River within the City	Poorly sited and designed bridges over the River	The City's valuable vistas and landscaping as tourist attractions	Lack of control on building construction by the River

In regard to: Socio-cultural sustainability	Resident's interest in cooperating with local officials to find remedies for flooding	Poor urban management and governance in the City of Neka	Resident's interest in public participation	Lack of mechanism to involve public in the City's Planning and management

Results: Objectives, and strategies

The review of literature, theories, and experiences in this research provided us with three categories of sustainability. Then, the survey of data on Neka allowed us to gain a clear perspective of those categories within the City's realities through the SWOT analysis discussed above. Upon this perspective, objectives (and the strategies to attain those objectives) were drafted with the aim of empowering the City to face the Neka's flooding problem in the future. The objectives reflect the three categories discussed above. The strategies, based on the results of the SWOT analysis are as followed:

1- planning for environmental sustainability in Neka:

- Creating a balance between land use development and environmental protection along the Neka River within the City's border.
- Using the rich ecology of the River's buffer zone, especially the tree and plant cover, as a basis to unify the City's image.
- Considering characteristics in climate, such as sun, wind, rainfall, as well as flooding, toward planning for spatial organization of the City.
- Promoting interaction between environmental elements and disaster management.

2- planning for physical and functional sustainability in Neka:

- Creating a controllable buffer zone between the Neka River and buildings, where any kind of construction would be prohibited.
- Creating a functional hierarchy of public spaces from the River's banks to other parts of the City.
- Using the River's buffer zone to provide a unique identity for the City.
- Providing visual connection between the two banks of the Neka River.
- Providing tourist attractions by the River that do not require permanent buildings.
- Considering structural design of bridges in which the columns could rest outside the water's path to avoid obstruction by debris.
- Considering structural design of buildings that are constructed outside but near the buffer zone to withstand the pull and push of potential fluvial flooding.
- Using the River as an edge to create greater sense of place, legibility for the city dwellers, and more permeability into neighborhoods situated next to the River.

3- planning for socio-cultural sustainability in Neka:

- Providing practical measures for greater public participation in the City's planning and management.
- Providing for defensible public spaces in the buffer zone.

- Integrating the public spaces in the buffer zone with daily life of the City's residents.
- Providing for good governance in which the urban management could be held responsible for future developments.
- Using the buffer zone to promote social identity.

Conclusion

Urbanization in Iran is as old as its civilization, with an uninterrupted history of 2500 years. This paper, however, reflected upon the notion of sustainable urban development because the past century's unplanned developments in some of the Iranian cities have taken place with high costs to the present and future generations. The literature review has shown that the relationship between unplanned development along rivers and flooding disasters holds true, not only in Iran, but all over the globe. One such example is the urban development in the City of Neka's unplanned and unrestrained building construction and land use with little or no consideration for the environment. Such actions along the Neka River have caused substantial damages to life and property. It was hypothesized that such a development stems from lack of attention to the environment and meager urban management.

In this paper, data on three subjects, i.e. the City of Neka, the flooding of 1999, as well as the Neka River itself, were collected and analyzed. The analysis pointed to a number of issues divided into environmental, physical and functional, and socio-cultural categories. These were the three major areas upon which the notion of sustainability could play the role in drafting objectives and strategies for this City. It was determined that discussion of sustainable urban development in a city such as Neka could not be realized if matters such as Neka River's natural characteristics, the land use elements along the River, the behavior of structures over and near the River, and public participation and good governance were not well understood.

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POTENTIAL APPROACHES TO THE DEVELOPMENT OF EARTHQUAKE LOSS SCALING FROM A MACROECONOMIC PERSPECTIVE. THE USE AND THE INTERPRETATION OF GESKEE – DISASTER SCALE RESULTS

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Keywords

GESKEE Disaster Scale, Earthquake Loss, Seismic Risk, seismic vulnerability

Abstract

Seismic disasters can have a significant economic impact on both a short and a long term, with macroeconomic implications from a national level right down to individual households. Overall costs of natural disasters are growing. However, these higher costs are, to some extent, preventable. Consequently, there are specific macroeconomic approaches that need to be addressed regarding areas of high sensitivity, but also regarding those who have the capacity to adapt to these natural hazards. This, in turn, can lead to the development and implementation of appropriate risk management strategies. Direct costs relate to physical damage to capital assets, which include buildings, infrastructure, industrial plants, crops and storages of finished, intermediate and raw materials. Indirect costs refer to damage to the circulation of goods and providing of services such as lower output from damaged or destroyed assets and infrastructure; loss of earnings; and job losses. The complementary analysis concerns the impact of macroeconomic effects of a disaster on global economic performance, such as balance of payments, balance of debts and liabilities, debt levels, etc. The paper presents in a reduced form, from a macroeconomic perspective, the results and the interpretation of the GESKEE - Disaster Scale, based on the approach of Georgescu and Kuribayashi (Georgescu and Kuribayashi, 1996) which has been updated with another 6 earthquakes from 2010-2011.

Introduction

No matter where it takes place, in urban or rural area, a strong seismic event can cause different degrees of damage to building stock, causing injuries and deaths to people exposed and also economic losses. The costs of earthquake damage to local and central administrations and down to an individual level are usually considerable. In addition to the damage earthquakes can cause to building stock, infrastructure etc., there are also significant disturbances in production capacity, disruption of economic activity at regional or central levels, that represent a direct threat to countries' development strategies regarding regional or even national stages. Thus, in developing countries, one can have a situation in which even the limited resources that were allocated for the development of a city or a region can be

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diverted for intervention, recovery and rebuilding of what was damaged. Therefore, the funds spent on physical and economical recovery after an earthquake is actually money lost for economic development. In order to achieve sustainable development, countries should take effective measures to reduce their seismic vulnerability. The decision of investing in measures that can protect building stocks against damage from earthquakes is primarily an economic one and is in correlation with "state parameters" of the country, regarding the level of the awareness, the technological development and the economic power of countries.

Thesis

Following an analysis of the causes which are directly related to the seismic impact have to be properly correlated with those that can be caused by the country's economic circumstances, the specificity of area or the time period. For example, there is a common use of indicators related to the proportion of components of economic losses compared to the GDP (gross domestic product) of a country, although in reality only a part of the economic losses that have occurred have direct and immediate influence on the product, while other components have influence on the structure of the assets (fixed assets, respectively effects upon the national wealth) with medium and long term effects. Direct loss can be approximately equivalent to the loss of value, while indirect costs and side effects of the direct loss can be considered as loss of flow.

Experts' attempts to classify and to draw up specific approaches in this field have been limited by an inadequate conceptual development, due to the methodologies that can be used. These methodologies are non-unitary and too specific in terms of criteria and assessment indicators that can be applied, both in physical expression and, especially, in monetary value. In this respect, the vast majority of approaches in terms of socio-economic impact of seismic losses focuses on measuring the effects that occur after the earthquake and is neglecting, in this type of analysis, the conceptual issues that define the general state of de facto.

Historical data on the impact of seismic disasters are expected to provide a useful guide to precede the research of different types and levels of vulnerability and to determine a viable solution of quantifying this vulnerability through indicators. Thus, it is not sufficient to use only the data on past losses but, combined with probabilistic information on the intensity and the recurrence of the hazards, to assume physical loss in future events and calculate the specific indicators. Thus, a much deeper analysis of macroeconomic sensitivity is required, which should be based on the particular causes that led to a certain type of loss, thereby explaining the observed effects of the seismic event, in conjunction with correct and relevant information.

Related work

Especially in the last 2 decades, in order to express earthquake loss in terms of economic and social impact, several different studies have been conducted worldwide.

For example, The Earthquake Disaster Risk Index (EDRI composite index) detailed by (Davidson, 1997) describes the relative contributions of various factors to overall seismic risk, on a six-step development procedure. However, the EDRI index assesses a city's risk to earthquake disaster only relative to other cities and not on an absolute or general scale and does not take sufficient factors into account regarding the seismic history of countries and their post-earthquake behavior. In the methodology described by (Klyachko, 2008) there are some numerical criteria developed by the author regarding seismic risk and sustainable safety, but the policies and the strategies presented are not connected with the prospective social and economic development of the cities that had been studied. (Cardona et al., 2008) presented a Disaster Deficit Index (DDI) which measures a disaster country risk from a macroeconomic and financial perspective, according to possible future catastrophic events. Other authors (Chen et al., 1999) compiled a global seismic loss map using the relations between GDP and earthquake losses which have been formulated empirically for several intensity ranges, regarding only the published earthquake loss data during 1980–1995 and not taking into account the development of seismic practices and strategies across time in a specific region.

The methodology that we present in this paper, as an update of the previous version, fits in the field of macroeconomic approaches of Earthquake Loss Scaling and has some specific features that distinguish it from the rest of the studies. Given the necessity of using available data on losses, a seismic loss characterization scale - GESKEE (Global Econometric Scaling using Knowledge on Earthquake Effects) was developed by Georgescu & Kuribayashi (1994, 1996, 1998, 2002). At that time, as presented by (Georgescu and Kuribayashi, 1996, 1998) and by (Georgescu, 2002) the Scale contained the econometric data and graphic representations for 42 important earthquakes ranging from 1900 to 1998. Generally speaking, the GESKEE – Disaster Scale provides information about the level of vulnerability associated with the level of development and economic power of the countries, hazard estimation quality, the development of enforcement codes correlated with economic, social and political circumstances. The scale has been improved, completed, developed, adjusted and updated by Filip & Georgescu and republished in 2010 (Filip, 2010). It contains 63 earthquakes, from which 42 earthquakes were recalculated from the first version of the Scale (Georgescu, 1999) and 21 earthquakes from the period between 1999 and 2010 (including Haiti and Chile 2010 earthquakes). Among other things, the update involved processing a large amount of information and an accurate graphic representation in order to obtain appropriate results and useful interpretations. Thus, a computerized method to resolve all this issues has been developed (GESKEE database) and published in (Filip et al., 2010a, 2010b).

Application

In this study we propose a practical application that requires updating the 2010 version of the GESKEE Disaster Scale. In this regard, we introduced other 6 important earthquakes from 2010 to march 2011 (table 1). The selection of the earthquakes for the current update of the scale was made in regard to the effect of the impact and whether earthquakes are representative in connection with the available specific information. With each update, the goal is to analyze the recent earthquakes, those newly introduced in the scale, compared to the previous database in order to find out if there are any significant changes in the structure of the scale that eventually would change the scale or would require a different approach or even an introduction of new significant parameters for a more complete or complex analysis.

Table 1 List of earthquakes and their characteristics included in the current update (2011)

EQ Name	***Country Region***	***Date***	***M***	***Dead***	***Injuries***	***Homeless***	***Total loss range EL [$ mil]***	***Pref.Source***	***ILOR [%]***	***log NREL***
Christchurch	NZ	22.02.2011	6.3	168	NA	30.000	10000-12000	Govt, Insurers	8.69	0.96
Darfield	NZ	03.09.2010	7.1	0	102	4000	5000-7000	Govt, Insurers	3.62	0.59
Yushu	China	13.04.2010	6.9	2968	12125	100.000	8944	Govt., Ext.	0.15	-2.41
Mexicali	Baja California	04.04.2010	7.2	2	253	25.000	1100-1200	Reins, Govt.	0.11	-1.79
Kaohsiung	Taiwan	04.03.2010	6.4	0	96	NA	80-95	AON,News	0.024	-2.08
Elazig	Turkey	08.03.2010	6.2	42	137	3477	7,25	Estimate,TCIP	0,001	-3.69

As shown by (Georgescu, 2002) and (Filip, 2010), the GESKEE Disaster Scale describes a worldwide scaling approach of risk and disaster extent and patterns, for seismic events and groups of countries, using indicators of relative economic loss and casualties. The 2010 version of GESKEE Disaster Scale measures the relative economic loss using the GESKEE Indicator–Normalized Relative Economic Loss (NREL). This GESKEE component presented for the first time by (Georgescu and Kuribayashi, 1996) is used to assess the economic impact of earthquakes over different countries during the current and past century. The relative assessment of earthquakes' economic impact using this indicator relies on Ec. (1):

$$NREL = ILOR \times \frac{GDP_{ref}}{GDP} \qquad \text{(Ec.1)}$$

$$ILOR = \frac{EL}{GDP} \qquad (Ec.2)$$

Where: ILOR – Incremental Loss Output Ratio; GDP – Gross Domestic Product of a country; GDP_{ref} – Gross Domestic Product as reference (e.g. GDP of USA); EL – earthquake (economic) loss value

Findings

Scaling according to the GESKEE Indicator (NREL) led to the possibility of ranking the new seismic events according to the existing fund of the Scale. The results are presented in Fig.1, 2, 3.

Fig.1 GESKEE Disaster Scale part 1 (2011 GESKEE Database Report).

INPUT DATA		VARIATION AREA [log NREL]	OUTPUT DATA			
INDEX	TYPICAL VALUES / DEVELOPMENT LEVEL		RELATIVE POSITION ON DISASTER SCALE			THE PREDICTED ECONOMIC IMPACT AN ECONOMIC RECOVERY POLICY
GNP/capita	Low-income and lower middle-income countries or in difficult circumstances	0.7 → 3.5	3.37 2.80 2.27 2.23 1.70 1.33 1.25 1.18 1.10 0.96 0.87 0.73	Haiti Nicaragua El Salvador Guatemala Ecuador Yugoslavia Chile (var.2) Chile Chile (var.1) New Zealand Japan Japan	(2010) (1972) (1986) (1976) (1987) (1963) (2010) (1985) (2010) (2011) (1948) (1923)	THE IMPACT CAN BE STRONG IF CAPITALS OR LARGE URBAN CENTRES ARE AFECTED; A DECREASE OF ECONOMIC INDICATORS, AND ECONOMIC RECOVERY (IF IT IS IMPLEMENTED) MAY BE FELT AND MAY PROVE DIFFICULT WITHOUT INTERNATIONAL ASSISTANCE; DUTIES ASSOCIATED WITH FOREIGN LOANS FOR RECONSTRUCTION MAY HINDER THE DEVELOPMENT, IF THE LOCAL ECONOMY CAN NOT PROVIDE A DEFERRED DEBT PAYMENT AND LOCAL INVESTMENT
MAGNITUDE	5.5 – 8.0					
$ILOR = \frac{EL}{GNP}$	10 – 50 (%)					
$NREL = ILOR \times \frac{GNP_{ref}}{GNP}$	2 – 0.05 (%)					
INDEX THAT CHARACTERIZE DIRECT LOSSES AND THEIR IMPACT						

Fig.2 GESKEE Disaster Scale part 2 (2011 GESKEE Database Report)

INPUT DATA		VARIATION AREA [log NREL]	OUTPUT DATA			
INDEX	TYPICAL VALUES / DEVELOPMENT LEVEL		RELATIVE POSITION ON DISASTER SCALE			THE PREDICTED ECONOMIC IMPACT AND ECONOMIC RECOVERY POLICY
GNP/capita	Countries with midium and medium-high income, medium countries, tourism, oil exporting, centralized economy	-0.5 → 0.7	0.68 0.67 0.60 0.59 0.58 0.50 0.47 0.44 0.41 0.40 0.38 0.30 0.25 0.24 0.12 0.11 0.082 0.03 -0.15 -0.36	Peru Algeria Iugoslavia New Zealand Iran Pakistan Romania Indonesia Filipine Egipt Iran Greece Algeria Greece Venezuela Indonezia Romania Pakistan Mexic Japan	(2007) (1980) (1979) (2010) (1990) (2008) (1977) (2006) (1990) (1992) (2009) (1981) (2003) (1986) (1967) (2009) (1940) (2005) (1985) (1988)	THE IMPACT CAN BE STRONG IF CAPITALS OR LARGE URBAN CENTRES ARE AFECTED THERE MIGHT BE NATIONAL ECONOMIC DECLINE ECONOMIC RECOVERY IS POSSIBLE ACCORDING TO THE STRATEGIES AND ECONOMIC TACTICS ADOPTED, WITH FINANCIAL LOANS WHICH ARE WELL USED
MAGNITUDE	5.9 – 8.1					
$ILOR = \frac{EL}{GNP}$	3 –10 (%)					
$NREL = ILOR \times \frac{GNP_{ref}}{GNP}$	10 – 2 (%)					
INDEX THAT CHARACTERIZE DIRECT LOSSES AND THEIR IMPACT						

As general principles, the earthquakes that caused the greatest losses are found at the top of the table and this situation stands for countries with low levels of development, with difficult changing situations and for countries with low capacity to cope with post-earthquake recovery. As we get closer to the bottom of the table a decrease of the relative size of seismic disasters can be seen, including the cases of different earthquakes in the same country. The earthquake loss scaling from a macroeconomic perspective is essential for understanding the impact and the consequences of these earthquakes. It also has a predictive value for loss estimation of future events.

Fig.3 GESKEE Disaster Scale part 2 (2011 GESKEE Database Report)

INPUT DATA: INDEX	INPUT DATA: TYPICAL VALUES / DEVELOPMENT LEVEL	VARIATION AREA [log NREL]	OUTPUT DATA: RELATIVE POSITION ON DISASTER SCALE			OUTPUT DATA: THE PREDICTED ECONOMIC IMPACT AND ECONOMIC RECOVERY POLICY
GNP/capita	Industrialized countries, countries with high income or large enough to deal the impact by resource redistribution	≤ - 0.5)	-0.55	Turkey	(1970)	THE ABSOLUTE VALUES OF LOSSES CAN BE LARGE IF URBAN AREAS WITH MAJOR NATIONAL AND INTERNATIONAL ECONOMIC ROLES WERE AFFECTED, ECONOMIC INDICATORS MIGHT TEMPORARILY DROP IN THE AFFECTED AREAS ACCORDING TO NATIONAL AND INTERNATIONAL SITUATIONS, AND DEPRESSION MAY OCCUR ECONOMIC RECOVERY IS POSSIBLE WITH LOCAL / NATIONAL RESOURCES
			-0.57	Italy	(1980)	
			-0.70	Taiwan	(1999)	
			-0.90	Italy	(1976)	
			-0.92	Turkey	(1992)	
			-1.00	China	(1976)	
			-1.07	Turkey	(1999)	
MAGNITUDE	6.7 – 8.3		-1.08	Armenia	(1988)	
			-1.20	Turkey	(1976)	
$ILOR = \frac{EL}{GNP}$	0 –3 (%)		-1.26	Japan	(1964)	
			-1.40	Turkey	(1999)	
			-1.44	China	(2008)	
$NREL = ILOR \times \frac{GNP_{ref}}{GNP}$	≥10 (%)		-1.45	Japan	(1995)	
			-1.50	China	(2003)	
			-1.52	Italy	(2009)	
			-1.56	Turkey	(2003)	
			-1.79	Mexic	(2010)	
INDEX THAT CHARACTERIZEZ DIRECT LOSSES AND THEIR IMPACT			-1.95	Italy	(1997)	
			-2.08	Taiwan	(2010)	
			-2.09	USA	(1906)	
			-2.18	Japan	(1968)	
			-2.33	USA	(1994)	
			-2.37	India	(2001)	
			-2.41	China	(2010)	
			-2.54	Japan	(1978)	
			-2.82	USA	(1989)	
			-2.84	Japan	(1983)	
			-3.07	USA	(1964)	
			-3.19	India	(1993)	
			-3.32	USA	(1971)	
			-3.33	Japan	(1993)	
			-3.39	Japan	(2004)	
			-3.56	Japan	(1993)	
			-3.60	Japan	(2007)	
			-3.69	Turkey	(2010)	
			-3.73	Japan	(1994)	
			-4.28	Japan	(1994)	
			-4.34	Japan	(2007)	

Graphical representations (Fig.4, 5) achieved with GESKEE Database allow highlighting, in a suggestive manner, of the levels of magnitude on which these indicators can be found.

Fig. 4 The capacity to cope with earthquake economic impact, as a correlation between log NREL, range of magnitudes and level of development (GESKEE database Report 2011)

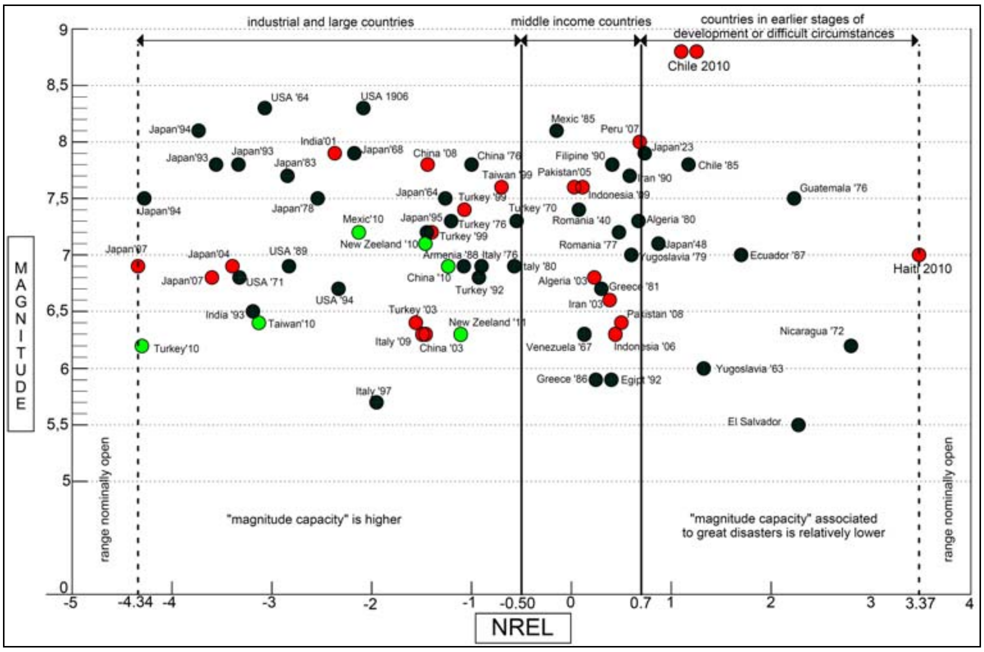
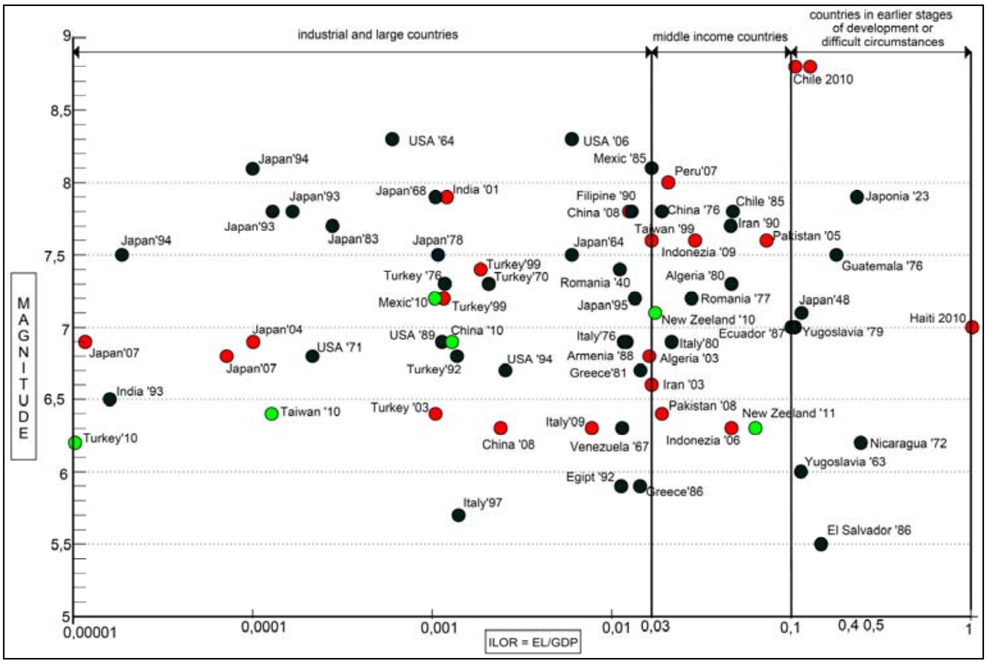


Fig. 5 Predictive correlations between the level of losses from previous earthquakes, magnitude and countries' economic stage of development (GESKEE database Report 2011)



Discussion

As described by (Chai et al., 2010), the disaster of Taiwan Kaohsiung Earthquake was concentrated on the residential and school buildings, with only two buildings collapsed, thus limiting the nationwide amount of direct and indirect loss. But an important aspect to consider, that will comport important further studies, is the fact that about 340 schools had different degrees of damages, resulting in financial losses estimated to 1 million US$ (Hsu et al. 2010). For this seismic event, the position in the scale (Fig.3) as well as the positions in Fig. 4 and Fig. 5 confirms the fact that the economic loss is relatively limited and the lack of casualties is related to the small number of collapsed buildings. Taiwan has a small area and a population over Romania's, but it is a GDP making machine with a GDP 3 times higher than New Zeeland's. This seismic event can be considered an opportunity for specialists, to study the geological structures of Kaohsiung region, which lacks earthquakes.

Regarding the last earthquake that hit China, Yushu in 2010, the position occupied by this seismic event in Disaster Scale (Fig. 3) seems to be correlated rather with the country's size and its economic power (express here through the GDP) than the amount of loss, which actually is important. The position in the Fig.4 is within the other value of China's earthquakes and in Fig. 5 is expanding the envelope of China earthquakes in the domain of industrial and large countries, despite the registered loss, but in correlation with the level of GDP achieved through the continuous growth from the past years. This situation denote, in correlation with other factors (i.e. more efficient rescue operations, a higher economic power and fresh memories of the last powerful earthquake, Sichuan), that the officials have made a step forward towards an improvement of reactive management in case of disasters, but are still having serious problems with the unsecured building stock and in generally with proactive measures. Nevertheless, it can be pointed out, according to the reports of numerous sources, that the nation's progress in reactive strategies shown in these given circumstances was built on lessons learnt from past events and especially after the 2008 Sichuan Earthquake. In Yushu's rescue and recovery process, The China Earthquake Administration has adjusted its response plans and increased its rescue team numbers which had been equipped with better technology and equipment. As in the case of Kaohsiung Earthquake, as well as Sichuan Earthquake, there had been problems with numerous schools that had collapsed. The inspectors, who conducted the investigation of school-building quality after Sichuan

Earthquake, pointed out that many schools in rural areas were built in a rush with a very low quality. This will be a future problem for the Republic of China that need to be solved, in order to not have such particular catastrophic situations in the future.

The earthquake that hit Turkey in Elazıg province in 2010 confirmed once again, if needed, that many of the losses in earthquake regions arise from non-compliance with earthquake building codes and therefore makes it possible that severe damage can be caused by relatively small earthquakes. Now, as before, high numbers of casualties have been blamed on traditional or sub-standard buildings, meaning that safe building practices are essential in such earthquake-prone areas. Taking into account that this earthquake occurred and impacted lightly populated rural lands, where the most damaged buildings were built with local materials, the economic loss and country size generated a high ranking position of this earthquake in the Scale (Fig. 3). But in this case, it does not precisely reflect the current, real level of seismic protection of the country, it just presents an isolated situation, only considering the economic impact of this earthquake. Regarding seismic preventive strategies that could be taken into account in the last two decades, the general impression is that Officials have not learned enough from past seismic events and especially after the last huge disaster, Izmit, 1999. The problem is that next time it could be no longer an isolated impact, if the earthquake will hit an urban area. The places that Elazig Earthquake occupies in Fig.4 and Fig. 5 are the result of a low-medium magnitude earthquake loss in comparison with the majority of the earthquakes from the scale. It comes off from the envelope of the other earthquakes of Turkey due to the particularity of the impact and the effects of this earthquake which hit a rural area and caused relatively minor losses.

The Mexicali earthquake was of 7.2 magnitude, which makes it a strong quake. Despite the high magnitude and the intensity of ground shaking, in the Mexicali Valley the number of fatalities was only 2. One of the most significant features of this earthquake is the occurrence of widespread liquefaction over almost the entire Mexicali Valley (Meneses et al., 2010). For comparison, while this earthquake exceeded the numerical magnitude of the 7.0 earthquake in Haiti (2010), the damage to Haiti was far greater because the epicentre was near the heavily populated capital city, Port-au-Prince. Given the level of intensity in Mexicali region the most buildings behaved as expected, presenting severe damage and rarely collapse only in dispersed cases.

Among the latest earthquakes framed in the scale, the particular case of New Zeeland is noticeable. The positions that these two New Zeeland earthquakes have gained in the GESKEE Scale are not accidental and are justified in the following by several factors. The 2011 Christchurch Earthquake was a 6.3-magnitude earthquake that struck the Canterbury region in New Zealand's South Island on 22 February 2011 causing widespread damage and multiple fatalities (USGS, 2011). It followed nearly six months after the 7.1 magnitude 2010 Darfield Earthquake that caused significant damage but no fatalities.

The combined earthquakes from September 2010 and February 2011 had an enormous impact, beyond officials control or expectations. It seems that it will lead to a significant loss of output from Canterbury and in conjunction with the delay in reconstruction from the September Earthquake, will cause an enormous economic impact for the next years. The occurrence of two large and damaging earthquakes at the same urban city within a short period of time is clearly becoming a unique aspect of this set of events. Thereby a lot of emergency or post-earthquake shoring of damaged buildings that result from 2010 September earthquake were subjected and tested in the 2011 February Earthquake.

Although the latest earthquake was technically less severe than September’s (6.3 magnitude as opposed to 7.1 then) it was also shallower (5km rather than 10km), with an epicentre less than 10km away from the city centre – last time it had been 30 km away (USGS, 2011). The timing also had a terrible effect: September’s quake occurred at 4.35 am on a Saturday morning and the falling masonry hit empty streets conducting to a small number of injured for a 7.1 magnitude earthquake. At any other time the people would have been killed. In February

Earthquake, the streets were full of people. The main factor for having a small number of deaths in both earthquakes is the earthquake engineering, research and education activities undertaken in the last decades in New Zealand. The implementation of seismic risk mitigation strategies and the ERD building standards that conducted to a solid seismic performance of the new buildings showed in such earthquakes that there is not a matter of luck.

Christchurch is the country's second-largest urban area with a lot of very old buildings and especially heritage buildings. So, the city was vulnerable due to the building stock which is specific to a lower level of development and protection against earthquake. But probably the high real estate value and the tourist value due to the rank of the city resulted in this situation.

Regarding the February earthquake, of the 166 confirmed dead, 94 were found in the Canterbury TV Building and 15 in the Pyne Gould Corp Building. Both buildings suffered soft-storey pancake failure, with visible damage in the beam-column joints. The 6 storey PGC Building was a 1960’s vintage one and had been subjected to seismic acceleration about 2 or 3 times higher than the previsions of the seismic code from building time, to which can be added other deficiencies for which we still do not have an official explanation. Officials said, according to (The Telegraph, 2011) that 70,000 people – about 20% of Christchurch's population have left the city temporarily as a result of the quake and that there are about 10,000 houses that have to be demolished, including 3,300 that were damaged on the September 4th Earthquake. There are some parts of Christchurch that can't be rebuilt on, due to the great liquefaction and land damage. Potentially there are some areas of Christchurch which will need to be abandoned and the authorities will have to provide other alternatives for living spaces. The second earthquake, which occurred in March, incorporated in an implicit or explicit manner the remaining physical effects from the first earthquake or at least some hidden damage. In Christchurch, New Zealand's stringent building codes limited the disaster.

The positions of New Zeeland Earthquakes in the Fig. 4 and Fig. 5 are confirmed by the fact that the February earthquake combined with the September event will cost NZ ~10-12% of its GDP and most of the bill will be related to the expensive ground restabilization work in the liquefaction zones. It looks as this double event will be the 2nd or 3rd worst insured loss from an earthquake worldwide (competing with the 2010 Chile earthquake for the second place). Unlike other countries, the situation is very different in New Zealand, where property is well insured against earthquakes. Certainly, the case of New Zealand it is not a classic one.

The actual positions of the New Zealand’s earthquakes in our scale are due to the high level of loss in correlation with country's GDP, which is quite low. But the level of GDP per capital is high (for example, if we compare with Romanian’s GDP and GDP per capital, the New Zealand's GDP is lower, but its GDP per capital is almost 5 times higher). This will certainly give a positive impact on the speed of recovery. Thus, we are expecting that New Zealand will recover quite fast, quicker than other countries that were hit by earthquakes, obviously depending on the quality of policies that will be applied.

The earthquake-related recovery provides a large boost to investment. The damage estimate is $15 billion (The Treasury, 2011) across the two main earthquakes, but it is unlikely that all this work will be completed within their four-year forecast period. Except for important infrastructure, this recovery will mainly occur from 2012 because of the planning required and the extent of the damage.

The position of Haiti Earthquake in the scale is not surprising al all. Haiti is the poorest country in the Americas that will recover after the 2010 Earthquake only to the limit of survival, with massive foreign aid. Haiti will be struggling from a hurricane to another, not to mention the case of another earthquake.

Also Chile is not a classic case of low income country, because Chile is on the road of sustainable development, but any other shock can change this situation. For now they had reserves that they put into scene after the earthquake.

Conclusion

The concentrated form of the GESKEE Disaster Scale (Fig. 1, 2, 3) as well as the GESKEE representations (Fig. 4, 5) and all the assumptions and the considerations that could be formulated on their behalf confirmed once again that this macroeconomic approach can be useful in explaining the relationship between magnitudes, loss magnitude, the country's economic level of development (i.e. economic power), the earthquake disaster prevention policies, the disaster impact and the patterns of post-disaster recovery, geographic setting, with promising results and predictive value. It is clear that it's just not enough to have only high-performance seismic standards, as long as there are additional factors such as economic, social and cultural issues that are playing a decisive role in the development of seismic risk mitigation strategies and also in the implementation of disaster proactive management and rigorous emergency measures. First of all, it is about a long-term process, based on hard work and respect for education, science and engineering, mainly in the studies of the consequences of previous earthquakes and then in the socially controlled application of design, planning and building measures at the urban level. Therefore, considering the multiplicity and the range of these complementary factors that can significantly influence the extent of an extreme situation, it is necessary to posses as much data as possible on the general framework of a region where a powerful earthquake can hit, i.e. determining the level of vulnerability of elements at risk from all perspectives of influence. Only using a full and complementary approach can we identify and correctly interpret the seismic impact on a community and the effects of hazards which become disasters.

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COUNTERTERRORISM POLICY; A GAME THEORY APPROACH

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Preemption, deterrence, counter-terrorism, game theory

Abstract
Counter- terrorism strategy is a cumulative analysis of politics, action, perception, and ability. In creating counter- terror policy and strategies the unpredictability of the opponent is paramount. In an effort to estimate what enemy actions might be taken, game theory is used to understand counter options.

Game theory is a branch of applied mathematics used to capture behavioral predictability. The use of game theory in counter-terrorism includes three dominant variables: the conflict, adversarial reaction and interaction, and outside forces. The choices that states and terrorists make are interdependent. Game theory analyzes the potential response from the adversarial perspective. Within game theory there are generally two categories of counter-terrorism strategy that states may employ: 1) defensive or 2) proactive measures, which can also be aligned with deterrence or preemption. This paper will respectively explore the deterrence vs. preemption quandary using Arce and Sandler's model applied to an asymmetrical forces situation. Utilizing this game-theoretic framework, decisions of national safety are adequately analyzed and strategies are played out.

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Introduction

Given the contemporary global political environment, governmentsare forced to face the realization that there is an immediate need for a dexterous counterterrorism policy. With increased access toglobal connectedness, limitless resources and purpose, terrorist organizations and their sponsors are able to expand their access to targets that may have been unreachable in the past. Terrorism has evolved in scope and terrorists are concentrated on maximal causalities and damage, making counterterrorism policy essential to the safety of people, critical infrastructure, and general national morale. If counterterrorism policy is important to the safety of nations, then choosing the best counterterrorism policy is absolutely fundamental.

Game theory is a concept of strategy that is mathematically based and calculated, affording states and players the opportunity to choose the most advantageous counterterrorism policy. Through the use of game-theoretic frameworks, decisions of national safety are extensively analyzed and strategies are played out. Game strategy allows players to frame a beginning to end plan in advance of the play, as opposed to making decisions at each present move (Dresher, 1981). Therefore, a game of strategy is necessary in determining and analyzing all possible contingencies that may arise in the choice of counterterrorism policy. Throughout the process of play, games of strategy maintain three essential characteristics: a conflict, adversarial reaction and interaction, and outside forces. The participants or 'players' in game theory will essentially be at "cross-purposes or have opposing interests," which then actualize into a conflict (Fricker, 2006). Secondly, the interaction of chosen strategies and the reaction of the adversary indicate that states and terrorists have a degree of influence over the development and outcome of the conflict through the decisions they make. Thirdly, the game or conflict is subjected to and altered by outside forces that may be determined by chance or are unknown (Fricker, 2006). In each individual real-world game, the strategic game characteristics are legitimized and with the application of a game-theoretic framework, the interdependency of state and terrorist choices is exposed.

Game Theory Participants

The choices that state and terrorist actors make are interdependent and game theory extensively captures these interactions of strategies(Arce & Sandler, 2005).Due to the interdependent and significant nature of such choices, states utilize game theory to analyze the potential response from an adversarial perspective. The state is able to place itself in the position of its opponent, thereby effectively analyzing the parameters from an alternative perspective before deciding on an appropriate strategic response (Arce & Sandler, 2005). It would be highly disadvantageous to initiate a counterterrorism policy decision blindly and without taking into account the reactionary response from both the adversary and other players. Furthermore, the interdependency of state and terrorist choices is ever the more present as a result of increased globalization. As global space shrinks, modern international terrorism is increasingly able to secure access to chemical, biological, radiological, and nuclear weapons, the global media, and maintain a comprehensive network of financial and information resources (Kurth-Cronin, 2003). The enhanced access, resources, and incentives will only increase the possibility of a terrorist attack. Moreover, as the likelihood and actualization of attacks increase, so does the interdependent nature of the choices states and terrorists make through increased interaction or perceived anticipation of interaction. With shrinking global space and an interdependency of strategic choices, states must rely on exhaustive analysis to make counterterrorism policy decisions.Ultimately, game theory creates a rich environment of policy choices, where states can model and play out their proposed policy choices to determine the most advantageous strategy.

In a game-theoretic model, there are generally two categories of counterterrorism policies states may choose to execute. Counterterrorism choices fall into the categories of either defensive or proactive measures, a choice of preemption or deterrence (Sandler & Rosendorff, 2004). Preemption is a proactive, offensive, and highly effective policy where terrorist organizations and their assets are attacked in order to suppress terrorist attacks against the state(s). Deterrence is passive or defensive, and imposes high levels of public cost. It aims to deter a terrorist attack by making the perpetrators success more difficult or through increasing the negative consequences to the perpetrator should they decide to initiate a terroristic attack (Arce & Sandler, 2005). States will naturally have a proclivity to depend on a safe counterterrorism policy of deterrence.However, when states utilize the policy of deterrence, they often end up displacing the terrorist attack to other target locations, countries, regions, or modes of attack where targets are "softer" (Arce & Sandler, 2005). States can fortify targets, but adversaries will surely find other weak targets or ways to circumvent defensive measures. If states decide to proactively attack terrorist players and their assets, they are able to ultimately protect all potential targets from an attack, thus providing public benefits contrastingly to the mounting public costs of deterrence policies.

Applied Game Theory Modeling

The critical decision for states to choose a strategy of either preemption or deterrence can be illustrated by using the values assigned in Arce and Sandler's "Deterrence versus Preemption" game-theoretic model. In the game, the two targets for a terrorist attack are the United States (U.S.) and the European Union (EU) and both must chose either a counterterrorism policy of preemption or deterrence or they may choose to stay at the status quo. Mirroring the real world, terrorist organizations will attack the perceived weaker opponent. In a 2 x 2 preemption game matrix, each preemptive action is assigned a public benefit of 4, with the preemptor receiving a benefit of 4 as well as the other free-riding state. This public benefit of 4 comes at the private cost of 6 to the state who preempted. In theory, if the U.S.executes a preemptive strategy, both the U.S. and the EU would receive a public benefit of 4, but it would come with a private cost of 6 for the U.S. and the EU would free-ride with a cost of 0. The U.S. receives a net benefit of -2 (= 4-6) and the EU acquires a net benefit of 4 (= 4-0), with the payoffs being reversed if the roles are transposed. Furthermore, if the U.S. and the EU both decided to implement a strategy of preemption, they each receive a net gain of 2 as the private cost of 6 is deducted from the gains of 8 (= 4x2). This game of preemption is a prisoner's dilemma (PD) game, as state inaction becomes the dominant strategy since 4 > 2 and 0 > -2, despite the net benefit of 2 if both states chose to cooperate and preempt (Arce & Sandler, 2005).

The 2 x 2 deterrence game matrix is modeled once again with the U.S. and EU players and with the assigned values from Arce and Sandler's game-theoretic model. A public cost of deterrence is set at 4 for both the deterrer and the other state. The cost of 4 is affixed to the deterrer, since they have succeeded in deterring an attack, but have deflected the attack to a "softer" target (e.g., American citizens vacationing in the Middle East or American embassies overseas). The other player state is subjected to a cost of 4, because the attack is refocused on them after the initial state chose a strategy of deterrence. Choosing deterrence affords a private gain of 6 before costs are deducted. If the U.S. chooses a deterrence strategy it receives a net gain of 2 (= 6-4), whereas the EU is fastened with a cost of 4 for being the new, enticing target of choice. As expected, payoffs are switched when the strategy roles are reversed. If neither acts, net benefits are set at 0. With mutual deterrence, total costs of 8 are subtracted from a private gain of 6 with each state receiving a net payoff of -2 [= 6-(4x2)]. Like the preemptive modeled game, a prisoner's dilemma is apparent as the action of deterrence becomes the dominant strategy (Arce & Sandler, 2005). The choice of state players to execute a strategy of deterrence leaves them both with a cost of 2, whereas if they chose to execute a strategy of preemption they would receive a net benefit of 2. The costs of deepening defenses and deflecting attacks to more attractive targets outweigh the public benefit of deterrence. States unfortunately chose the safe game of deterrence with tentative benefits, rather than the high-rolling game of preemption, which bears conclusive benefits.

Preemptive counterterrorism policies are extremely concentrated in their purpose, providing definitive public benefits with lesser long range public costs than deterrence policies. States utilizing the strategic policy choice of preemption are able to protect the entirety of targets by taking an offensive approach to eliminate the perpetrator, making everyone safer (Arce & Sandler, 2005). The proactive strategy to initiate an offensive counterterrorism policy approach will succeed in damaging the targeted terrorist organization, but it may also inadvertently and unavoidably help to increase terrorist activity, recruitment, and legitimacy (Sandler & Rosendorff, 2004). The dilemma for states in the war on terror lies in the degree of their counterterrorism operations. Taking little or ineffective action may create an image of weakness, uncertainty, and generate an increased risk to the public and critical infrastructure. However, a heavily preemptive counterterrorism policy would create an image of excessiveness, tyranny, and would promote both terrorist recruitment and legitimacy.It should be noted, a heavy-handed preemptive policy only needs to appear to be so in order to have the negative and undesired effect of inflamed tensions, amplified recruitment, and solidified legitimacy. The U.S. attack on Iraq can be perceived as such a situation. Arguably, the U.S. led strategy may have not been heavy-handed through to the core, but it was perceived as such and that perception is just as effective for terrorist organizations in regards to recruitment and legitimacy. The U.S. strategy inadvertently facilitated al-Qaeda recruitment and afforded them safe places to hide (Van Evera, 2006). Additionally, the perceived oppressive U.S. counterterrorism strategy set off an insurgency crusade. As a result, U.S. forces in Iraq have been forced into a counterinsurgency campaign that is both costly and disastrous (Van Evera, 2006). A clumsy or oppressively perceived preemptive policy is significantly worse than inaction due to the extensive detrimental consequences.

States take a substantial gamble when they choose a preemptive counterterrorism policy. Thus, states rely heavily on the safer and weaker act of deterrence when crafting counterterrorism policy. To maximize the effectiveness and minimize the costs of a deterrence policy, a statistical analysis approachshould be applied in tandem with a game-theoretic model in order to exhaustively analyze the most advantageous counterterrorism policy.

Model Appropriateness

Game-theoretic models are laden with uncertainties and could benefit from an influx of statistical input. Statisticians are very familiar with addressing the problem of uncertainty and quantifying it, thus a statistical approach to game theory would be both well-suited and very useful in analyzing advantageous defensive counterterrorism strategies. Although game theory is a discipline with calculable results and a mathematical basis, the strategies and their subsequent payoffs are "defined in an ad hoc manner using expert judgment" (Fricker, 2006). This is not to say that players have not benefited from this ad hoc manner, but an infusion of a statistical approach could utilize past data and other applicable knowledge to better infer the game from the terrorist perspective. Furthermore, the game theoretic model could be analyzed by how well it fits previous observed data. Uncertainty is a detrimental issue in game theory, as players can calculate their adversary's strategy, but the certainty of that calculation is in question until the adversary shows his hand by way of actions taken or not taken. Game-theoretic models would benefit immensely by infusing a statistical analysis that examines the uncertainty in the model design and in the payoffs that correspond to sets of strategy decisions.

Game-theoretic models can be further developed to address the glaring difficulties of real world observed data and the quantification of uncertainty, by allowing statisticians to examine (1) how well the models fit the observed data and (2) how the uncertainty of the game theoretic models can be quantified (Fricker, 2006). Terrorist attacks are extreme events and being such, there remains little empirical data for a thorough analysis. A reliability analysis traditionally utilizes decomposition, to break down complex engineering and infrastructure systems into individual components where a larger amount of data is readily available (Bier, 2006). This concept can be applied to homeland security measures to maximize the examined data used in combination with game-theoretic models. Moreover, the ad hoc nature and uncertainty of strategic choices can be quantified by using a statistical risk analysis approach. In this manner, the statistical risk analysis is primarily used to approximate the likelihood of unwanted events and the costs of such an undesirable event (Banks & Anderson, 2006). Risk and reliability are important to a contemporary understanding of strategic security choices; however they are limited in their thorough applicability to security measures(Bier, 2006).

Being that state players have a proclivity to rely on deterrence counterterrorism and defensive security measures, an improved and more effective strategy should be implemented so as to reap the most public benefits with the least public costs. A game-theoretic approach, supplemented with a risk analysis would give state players the ability to initiate deterrence and security strategies that are more effective against a terrorist attack. It would be able to adequately assess the risk of an attack and the costs of defensive counterterrorism strategies. Using risk analysis in tandem with game-theoretic models adds an additional element to counterterrorism policy choices and would ultimately allow state players to move in the direction of solidified public benefits with minimal private costs. Security threats launched by terrorists can span a wide range of targets and states are forced with the realization that not all targets may be adequately reinforced enough. By using the results of risk analysis, states are able to concentrate efforts to those targets subjected to a most likely and most severe threat (Bier, 2006).

Conclusion

With the propensity for states to rely on defensive security measures that are deterrent in nature, states will benefit immeasurably from using an additional statistical analysis by way of a vulnerability analysis. Through vulnerability studies states are afforded the opportunity of identifying and analyzing the vulnerability of infrastructure state governments deem as critical. In this capacity states have an increased awareness of critical infrastructure, which has been analyzed through applied vulnerability probabilities. Moreover, any minor disruption, either randomly or deliberately initiated, will degrade the infrastructure system, inflict economic losses, and corrupt the public's confidence in governments (Brown, Carlyle, Salmeron, & Wood, 2006). The U.S. Department of Homeland Security considers the following infrastructure sectors to be critical to the United

States; banking and finance, chemical industry, defense industry, emergency services, energy, food, government, agriculture, information and telecommunications, postal and shipping, public health, transportation, and water (Brown, Carlyle, Salmeron, & Wood, 2006). If the vulnerabilities of these critical infrastructure sectors are identified and addressed, then the resiliency factor of U.S. critical infrastructures increases. To reject the importance of a continuous analysis of the vulnerability of U.S. critical infrastructure systems would result in poor planning and preparedness. Paired with a game-theoretic approach, a vulnerability analysis affords the state an opportunity for preparedness, with the game-theoretic framework supplementing those defensive measures consequent from effective statistical analyses.

States are tasked with the very important responsibility of protecting the homeland, the people, critical infrastructure, and the national confidence level. Terrorist organizations as intelligent and adaptable adversaries are a direct threat to the well being of states. Terrorists and their sponsors exploit the increased access to global connectedness and limitless resources, to expand their scope of attack to targets that states have previously thought to be unreachable and invulnerable. With an intelligent and adaptable adversary, states must adopt counterterrorism policies that are multidimensional and resolute. States must look to contemporary counterterrorism strategies that are able to succeed on both the offensive and defensive fronts. Moreover, as we rush towards an ever more connected world, only state cooperation and collaboration will succeed in the interdependent conflict arena that hosts interactions between legitimate state governments and terrorist organizations.

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BIOTERRORISM - THE NATURE OF THE THREAT AND HOW WE COULD PREPARE FOR IT

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1. Keywords

bioterrorism, terrorism, bio-preparedness, recommendations, emergency planning

2. Abstract

This paper is aimed to draw attention to a specific type of a threat. It provides an overview of the nature of bioterrorism and suggests some recommendations for the crisis managers they should consider in emergency planning. In conventional warfare there are usually rules and accepted norms (prohibition of the use of biological warfare agents, outlaw of reprisals against non-combatant targets, etc.). On the other hand terrorism (as an instrument) does not recognize these rules and followers of various groups breach them on an ordinary basis with the aim to achieve their objectives. Moreover the international community describes concerns over indications that various individuals are interested in acquiring biological agents. In case of a well prepared biological attack, the number of casualties would increase extremely quickly and the call for hospital beds, personnel, vaccines would likely be insufficiently low.The preparedness for a biological attack by malicious groups could lead to a situation for which no state is prepared.

Fortunately, measures to lower the devastating consequences exist – such as a quick attack detection, identification of the agent used, rapid and joint cooperation activity between public health, emergency responders and the law enforcement community among others.This paper provides an introduction to the issue based on research and teaching activities of the author. It provides an overview of the identified important issues to consider for each country to be successfuly prepared for a bioterrorism attack. Each country should follow this ‘check-list of

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measures‘ and assess if it is prepared for this type of a threat. Unfortunately many countries are not for such an attack.

Introduction

Various indicators show rising concerns within the international community about the potential use of biological agents for terrorist purposes. Until now, there has been a low occurrence of these incidents[2]. Moreover with the exception of 2001 anthrax attacks they have not been largely discussed in the media. Despite this, there have been indicators that terrorists are interested in biological agents and some claim that they are already in possession of them[3].

Furthermore, we have to consider the historical examples of epidemics and pandemics in the history. The most notorious examples include the Black Death in 14th century which wiped over a 1/3 of the European population, the 1918 Spanish flu A (H1N1) which was responsible for approximately the same amount of casualties as the Second World War[4]. Recently we have been shown the power of diseases in the cases of SARS, avian flu or swine flu which disturbed the population in many countries. These hints could give us a broad notion about bioterrorism.

Unfortunately, we believe that the present environment – especially with the developed medical research – would mean an effective response for the attack. On the contrary, the characteristics of the modern society make it more vulnerable for this type of a threat. This is due to a number of factors, but especially because of the rapid disease spread due the international travel and interconnected markets. Moreover, the psychological impact of this type of a crisis situation would be amplified nowadays more than ever. The panic would be fast-spreading. Within few minutes, the information (true or false) reaches an audience on the other side of the world. The impact is not only psychological but could also cause economic disruption. Additionally, the information about the intentional nature of the attack would increase the panic situation.

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[2] Philips, Michael, B. 2005. Bioterrorism: A Brief History, available http://www.dcmsonline.org/jax-medicine/2005journals/bioterrorism/bioterrorism_history.pdf

[3] Baciu, A. , Presentation on the Interpol Bioterrorism Prevention Program, Available: http://www.interpol.int/Public/BioTerrorism/bioC/presentations/BWC200612BioTPrevProg.pdf

[4] Taubenberger JK, Morens DM. 1918 influenza: the mother of all pandemics. Emerging Infectious Diseases 12(1) 2006, Available http://www.cdc.gov/ncidod/EID/vol12no01/05-0979.htm

The recent bioterrorism attacks for example include the 1984 Rajneeshee bio-terror attack in Oregon in 2001[5], the anthrax letters sent across the USA which caused five deaths and infected 22 people and the 2003 London Ricin plot. The use of biological agents is not that extensive and we must bear in mind that although the conventional weapons are much easier to be acquired and used while supporting the terrorist goals, the biological dimension of an attack discerns it from all other conventional or unconventional attacks. One sole successful attack could lead to an unimaginable situation.

3. Theory, Methods and Results

To introduce the topic closer one must also understand the nature of biological agents and toxins, the routes of exposure, the acquisition (natural origin – outbreaks, environment, theft from laboratory, purchase from supplier, self-production), dissemination (mail/packages, spraying devices, air conditioning, food and water, injection, suicide host), spread patterns or the disease, epidemiology and many other areas of interest of various stakeholders.

This paper describes the overview of the concerned measures important for the preparedness for a bioterrorism attack. It describes the nature of the threat, the risk and threat assessment and the underestimated psychological side of an attack. The paper gives mostly the law enforcement point of view; however it stresses the importance of a multiagency cooperation.

Main Identified Areas of Interest

This paper highlights the main points of interest regarding bioterrorism in order to make its points more succinctly. These mainly focus on legislation, crisis communication/ cooperation and psychological dimension of bioterrorism, as these are the main areas usually insufficiently covered in countries.

As there is no international agreed definition of terrorism there is no international definition of bioterrorism. One of the appropriate (out of many) is the INTERPOL's definition. It states that *Bioterrorism refers to the intentional release of biological agents or toxins for the purpose of harming or killing humans, animals or plants with the intent to intimidate or coerce a government or civilian population to further political or social objectives*." [6]The majority of agencies are not able to act efficiently without an appropriate legal base. The capability of the law enforcement agencies is crucial: to act proactively and react effectively,

[5] Carus W. Seth The Illicit Use of Biological Agents Since 1900, August 1998 (February 2001 Revision)

[6] Bioterrorism Incident Pre-planning and response guide, ICPO – INTERPOL, 2007

they must be set up according to national and international penal codes. As a legal research proved (which the author participated on[7]) in some countries there are still not effective counter-terrorism laws or laws concerning illegal development, production, transfer, acquisition, retention or possession of biological agents. Each government needs to identify if there is a specific legal measure on biological terrorism in the country.

Most of the legislation for bioterrorism needs to be acquired based on a precautionary principle what involves acting to avoid serious or irreversible potential harm, despite lack of scientific certainty as to the likelihood, magnitude, or causation of that harm. Especially in the case of biological terrorism –in case we wait until we are certain about the threat – it could already be too late. In other words bioterrorism is considered a low probability/high impact incident. Although the chances are low, the responsibilities of each and every government are to protect the citizens and so they are morally obliged to employ all the necessary measures. As mentioned above the problem sometimes stems from the fact the bioterrorism is not largely discussed and evoke a vision of its non-existence.

It is important to bear in mind that too rigid and overwhelming legislation would not be effective. Moreover it could slow down the research and development and burden many other areas with unnecessary laws. Based on author's research many have stated they perceive the bioterrorism-related legislation in the EU Member States as an unclear picture[8] and it could be presumed the situation is not better in other countries. From the police point of view has to be mentioned that flawed regulations and laws will mean additional costs for enforcement. It is crucial to find the balance between the negative and positive impacts and be flexible to react to the momentary situation.

The legislation should reflect upon all the areas of biological preparedness such as general counterterrorism measures, Biosafety (working safely), Biosecurity (keeping the work safe), Handling/Storage and Inventory, Transportation, Sale, Use, Disposal, Quarantine Procedures, Recovery and Prosecution. The measures should also reflect the international legislation specifically the Biological Weapons Convention and International Health Regulations[9].

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[7] JLS/2008/ISEC/PR/005-F1 A study on evaluation of legislation, regulations, standards and other instruments of regulation and their practical implementation covering the area of biological preparedness

[8] JLS/2008/ISEC/PR/005-F1 A study on evaluation of legislation, regulations, standards and other instruments of regulation and their practical implementation covering the area of biological preparedness

[9] Article 7 Information-sharing during unexpected or unusual public health events

Each country needs to do a constant Threat Assessment and Risk Assessment. Threat assessment means to identify the intentions and capabilities of the adversary. There are specific questions to be asked which help to assess the intention as well as capabilities. One type of threat assessment is strategic, which evaluates what kind of threat a group or individual poses and is usually based on intelligence. The second type is operational, which evaluates the current situation (white powder at the post office) to assess if there is a credible threat. As there is are set of questions to be answered while conducting the threat assessment, there are also questions to be asked during the risk assessment process. Each state must based on these information develop a priority list to close any gaps and vulnerabilities.

One of the biggest problems is with the delays during this type of an incident. In other terrorist attacks the knowledge about the incident is immediate, while in bioterrorism incident it could be days and week. In case we face a covert attack, the detection that something has happened starts when people get ill and come to seek a doctor[10]. This could take days or weeks. Delay in diagnosis because of the rare disease is followed by laboratory confirmation of specific agent. This all gives enough time to the disease to spread around into a large area. Emergency responders must be prepared to react in later stages of the incident, in a situation with huge amount of uncertainty, danger. The responding personnel must have an appropriate equipment and training.

Often there is a substantial underestimation of the psychological dimension of the event. Effective control of the psychological reaction at all levels is fundamental for the success. Failure to control the psychological side of bioterrorism would influence all the other employed measures. For this reason it is crucial to cooperate with the population as if they were a reliable partner and not a herd without brain and potential as Glass and Schoch-Spana emphasize in their article[11]. It is important to set the cooperation prior the attack as during the attack could be already late and it is important to invest into local and national strategies for crisis communication. During the attack is fundamental to cooperate effectively with the

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If a State Party has evidence of an unexpected or unusual public health event within its territory, irrespective of origin or source, which may constitute a public health emergency of international concern, it shall provide to WHO all relevant public health information UNSC Resolution 1540 (2004) (WHA 58.3, 2005)

[10] Shea Dana, A. & Lister Sarah A. (2003) The BioWatch Programme: Detection of Bioterrorism, Congressional Research Service Report No. RL 32152, http://www.fas.org/sgp/crs/terror/RL32152.html

[11] GLASS Thomas A., SCHOCH-SPANA Monica. *Bioterrorism and the People: How to Vaccinate a City against Panic*. Clinical Infectious Diseases. 34(217), 2002, 217-223

media[12], provide valid information (in case you do not, the media would make their own). After the attack is important to focus on restoring the confidence and help the victims[13] and their relatives.

Probably one of the most labelled failures in countries is the lack of communication within various agencies. The more all the various agencies participating in the response are prepared in advance for the threat, the better. Most crucial is the cooperation between Public Health, Law Enforcement and Intelligence. In case it is not functional, it is nearly impossible to effectively respond to a bioterrorism incident. Each agency should have updated emergency plans – for each separate agency and for multiagency cooperation. These plans also in advance help to identify the businesses and people involved with CBRN in the country (material, expertise). In order to support interagency cooperation it is important to have a memorandum of understanding and cooperation agreements. These all have to be tested via joint trainings and investigations. Although a practical exercise never substitutes fully the real event, it could still reveal severe gaps within the system.

The most important points identified

In general the important (and usually underestimated) points for countries to assess are below. The international exercises[14] such as Global Mercury (2003), Atlantic Storm (2005), New Watchman (2006), Common Ground (2006) also proved the lack of preparedness in these issues related to the main question - are we prepared for a large scale bioterrorism attack?

- Could we be prepared better and how?
- How could we sensitively raise the awareness of the threat?
- Approve all the necessary legal measures (for prevention, protection, response mechanisms[15])

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[12] More information available in the official WHO guide - WHO Effective Media Communication During Public Health Emergencies, 2005, http://www.who.int/csr/resources/publications/WHO_CDS_2005_31/en/

[13] LOYE Dominique, COUPLAND Robin, Who will assist the victims of use of nuclear, radiological, biological or chemical weapons – and how?). International Review of the Red Cross, 89 (866), 2007, 329-344

[14] http://www.ghsi.ca/documents/ExerciseGlobalMercuryreport.pdf, http://www.atlantic-storm.org/, http://ec.europa.eu/health/ph_threats/com/watchman.pdf, http://ec.europa.eu/health/ph_threats/com/common.pdf

[15] As an example an overview of all the relevant areas of concern exists for the EU - JLS/2008/ISEC/PR/005-F1 A study on evaluation of legislation, regulations, standards and other instruments of regulation and their practical implementation covering the area of biological preparedness

- Identify gaps and vulnerabilities
- Develop emergency plans specifically focused on bioterrorism
- Develop a multiagency information sharing mechanism
- Develop countermeasures to detect future threats
- Identify designed agency/ies responsible for all the issues
- Assess if these agencies fully equipped and trained
- Secure incident health and safety procedures
- Have trained personnel to work in contaminated environments
- Have proper amount and tested protective personnel equipment
- Prepare information sharing protocols and procedures
- Establish public health reporting mechanisms prior to an incident occurring[16]
- Establish guidelines for notifications to public health, law enforcement and customs
- Identify the amount of vaccines available
- Do not underestimate the psychological dimension of bioterrorism
- Do not underestimate the public – rather take it as a reliable partner[17]
- Set up a positive contact with media
- Develop local crisis communication strategies[18]
- Develop Coordination and Communication Strategies involving the Media [19]

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[16] Coordinated with the official WHO International Health Regulations

[17] GLASS Thomas A., SCHOCH-SPANA Monica. *Bioterrorism and the People: How to Vaccinate a City against Panic*. Clinical Infectious Diseases. 34(217), 2002, 217-223

[18] As an effective guide serves: COPPOLA, Damon P., MALONEY, Erin K. Communicating Emergency Preparedness Strategies for Creating a Disaster Resilient Public. New York : Taylor and Francis Group LLC, 2009. 267 s. ISBN 978-1-4200-6510-7

- Practically assess functionality of all measures – table-tops, exercises
- Be prepared for the worst and hope for the best

4. Discussion

The author's knowledge of the bioterrorism issue is based on an extensive research, specifically while co-authoring a successful study for European Commission JLS/2008/ISEC/PR/005-F1: *A study on evaluation of legislation, regulations, standards and other instruments of regulation and their practical implementation covering the area of biological preparedness.* Since that time she has participated on trainings, preparations for law enforcement agencies in the country and also in the INTERPOL Train-the-Trainer Session in order to learn how to provide a valuable training in the area of bioterrorism. Moreover in her PhD studies at the Police Academy of the Czech Republic she focuses on psychological dimension of bioterrorism with the aim to support the decision making process of agencies involved in the bioterrorism response. With other colleagues in the field we aim to further strengthen the national capacity to face bioterrorism by training appropriate agencies and provide analytical, educational and professional support. For this reason we are establishing a Bioterrorism Training Centre which is planned to become active on 1st of May 2011.

The conference paper is built as a quick unclassified training for crisis managers in other countries. Although the probability of a bioterrorism attack is low, it is necessary the officials are prepared for it. The less they are taken by surprise, the effectively they act, help to reduce the public disturbance, lower the casualties and minimalize the impact of such event. Based on the research background the point of view mainly reflects the law enforcement side of interest; however emphasizes the multiagency cooperation – specifically with the public health sector.

The main problems with training for biological terrorism are the sensitive nature of the issue and the fact that the bioterrorism incidents are usually not media covered what evoke that this type of a threat does not exist. In case we would like to train the responsible officials and public for this type of a threat it would bring certain benefits. The public health personnel would be able to recognize symptoms much quicker and more certainly and the public would

[19] More information available in the official WHO guide - WHO Effective Media Communication During Public Health Emergencies, 2005, http://www.who.int/csr/resources/publications/WHO_CDS_2005_31/en/

be prepared to cooperate with the perfectly trained officials. On the other side the training brings a number of negative effects. Probably the most important is a possible guidance to the malicious groups or individuals. In this case it could apply that the lower the publicity the lower the amount of incidents. Another negative effect could also be the fomentation of panic within the population. Just a look at pictures infected with various bacteria, viruses or toxins could raise a disturbance for an individual. The individual panic could further lead to a panic reaction in any occurrence of a white powder and could lead to a stigmatization of people sick with ordinary flu. The fundamental question is then **-** To teach or not to teach?

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Useful websites:

http://www.interpol.int/Public/BioTerrorism/default.asp

www.unog.ch – BWC Implementation Support Unit of the UN Office for Disarmament Affairs (UNODA)

6. Author Biography

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SEISMIC RISK MANAGEMENT OF CIVIL BUILDINGS IN ROMANIA BASED ON THE INCREMENTAL SEISMIC REHABILITATION CONCEPT

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Key words
Rehabilitation, incremental, damage, maintenance

Abstract
A general study was recently carried out on the evaluation of the seismic risk in Bucharest, including the diagnosis of buildings vulnerability. Based on this study a database of vulnerable constructions was developed, that identifies a number of 392 buildings classified in the seismic risk class I, corresponding to the most vulnerable situation. The conclusions of this study point out the urgent need for a general strategy of intervention towards the seismic protection of buildings in Bucharest. In particular, a management approach for rehabilitation and reinforcement of the more vulnerable buildings must be established taking into account the technical knowledge and the financial restraints.

Considering the financial and technical difficulties faced by authorities in Romania when investing in seismic rehabilitation, the present article proposes the implementation of the incremental seismic rehabilitation (ISR) method to Romanian damaged and/or vulnerable buildings that present a higher risk of collapse in case of a major earthquake. A tool was developed based on the Critical Path Method to assist the implementation of the ISR methodology.

Incremental seismic rehabilitation approach of civil buildings proposes the integration of a series of rehabilitation works into a maintenance and improvement long term program. The previous definition of the partial seismic reinforcement techniques to be carried out in different periods allows deferring the investment costs for a longer period without losing the technical coherence and effectiveness of the overall intervention.

Introduction

Bucharest is one of the 10 most vulnerable cities in the world, from a seismic point of view [1]. Buildings under seismic risk class 1 [2] are the most vulnerable. Though these buildings are in urgent need of consolidation there are various obstacles in effectively using the

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available funding. Although Romania is one of the few countries in the world where the most part of this type of works is financed by the Government, one of the problems which arise in such cases is the discontinuation of building functionality, which paralyzes the process from the outset, i.e. since the idea of rehabilitation is born.

The present study proposes the implementation of a rehabilitation concept that is less used in the world and not used at all in Romania, based on the idea that rather than do nothing until the next big earthquake, it is preferable to start the rehabilitation of constructions of high seismic risk with small but concrete steps.

Incremental seismic rehabilitation (ISR) method is particularly applied in the U.S. and represents a seismic rehabilitation approach whereby a series of discrete actions are integrated in maintenance and capital improvements activities underway, taking place over an extended period of time. The process involves a series of planned projects in addition to regular scheduled maintenance, repairs or renovations works, and it is preferable that they coincide with periods in which occupancy or functionality is reduced [3].

Initial cost and disruption of normal use of the building were considered as the main obstacles for investments in seismic rehabilitation. The concept of incremental seismic rehabilitation is designed to overcome these two obstacles. The underlying assumption is that the integration of seismic rehabilitation works in the normal maintenance cycles significantly reduces the cost and the disruption of building's functionality as scaffolding and other construction equipment are in place, work surfaces are exposed, the occupants have already moved and interruptions are already announced and accepted.

Romania currently develops a thermal rehabilitation program which consists in building enveloping works, with the objective of reducing thermal energy losses of residential buildings of 1950-1990 period.

Description of incremental seismic rehabilitation process

Elements of an incremental seismic rehabilitation program are developed from the acquisition phase to implementation of a typical project management process phase. Common elements of a seismic rehabilitation program include:

- Analysis, verification and evaluation of project feasibility;
- Guidelines for seismic risk reducing;
- Initial possibilities of integration in the maintenance process;
- Seismic evaluation;
- Seismic protection;
- Developing a risk reducing policy;
- Planning seismic rehabilitation for different types of buildings;
- Prioritizing the increments of seismic rehabilitation;
- Establishing the budget;
- Establishing the funding;
- Project management of seismic rehabilitation.

Most of these items are generally applicable in building maintenance management processes for all categories of occupancy. However, occupancy levels have special elements that must be taken into account.

Incremental seismic rehabilitation offers the opportunity to overcome obstacles as high budget availability and building functionality disruption for seismic rehabilitation. It offers flexibility in the sequence and timing of rehabilitation activities and may be more effective in terms of cost than a late rehabilitation project with a single step. Engineering practices associated with common procedures for projects with a single phase are applicable for incremental seismic rehabilitation. In some cases, however, engineering services may require more effort to be implemented in the context of incremental seismic rehabilitation. The overall approach of incremental seismic rehabilitation involves the existence of a maintenance program, the need for capital improvements and a decision-maker familiar with the concept of incremental seismic rehabilitation. All these are beneficial for effective communication with stakeholders about the seismic rehabilitation opportunities and encourage prevention of seismic risk.

Applying the method – case study

For a better understanding of incremental seismic rehabilitation concept a practical example of implementation was elected. This involves the rehabilitation of a structure with unreinforced masonry supporting walls with no stiffness in horizontal plane (floor with wooden or metal beams, brick arches and domes) (Fig. 1) that was evaluated by a technical expert and assessed to be into seismic risk classes [2] according to Fig. 1. The building had the function of high school and is to be in a residential building with several apartments. The building was built between late nineteenth century and early twentieth century, ageing more than 100 years. Lately, the building has not been used as it is in an advanced state of degradation.

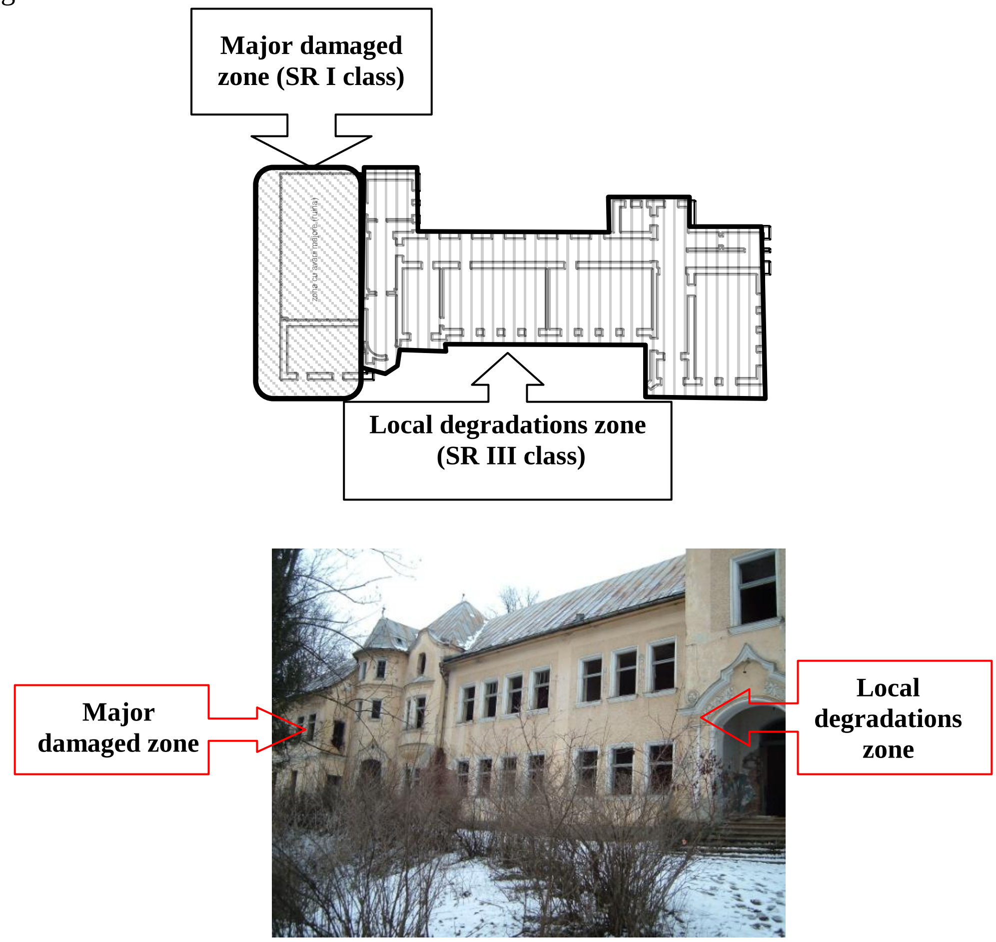

Fig. 1– Assessing of seismic risk classes of different buildings zones

The investigation found a number of pathologies (Fig. 2) for which rehabilitation solutions have been proposed as follows:

1. Partial demolition needed to remove the south-east area included in seismic risk class I being in danger of collapse;
2. Consolidation of soil on which building is situated and its surroundings;
3. Foundations consolidation: enlarge, waterproofing and replacing damaged parts, solving situations where they are at different levels and if necessary underpinning;
4. Repair and restoration of masonry walls in degraded/damaged areas: shotcrete, injection, mechanical or chemical anchors, where necessary partial replacement (zone 1, 3 and 4, Fig. 2);
5. Construction of reinforced concrete belts for walls confinement;
6. Replacing wooden beam floors with rigid floors that form horizontal diaphragms to ensure the wall cooperation in horizontal actions (e.g.: steel-concrete composite floors);
7. Replacement of the interior non-structural masonry walls with ones made of light material (plasterboard)
8. Interventions in circulation areas, stairs (replacing them with lightweight material, wood or metal) (Zone 2 and 5 Fig. 2).
9. Roof structure and cover restoration;
10. Development of a drainage system;
11. Restoration of electrical installations;
12. Rehabilitation of sanitary installation;
13. Installation of other networks (HVAC, optic fibre installations PSI, etc.).

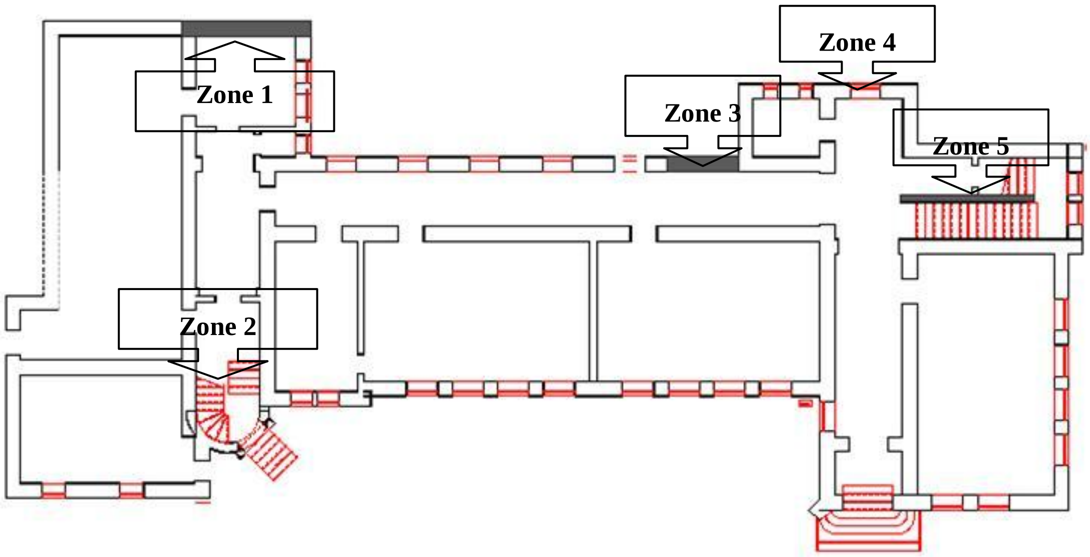

Fig. 2. Areas where the structural elements will be rehabilitated

The planning of the rehabilitation works must take into account the technical and budgetary restraints. The technical planning must consider the precedence between different activities and their beneficial effects on seismic protection while financial planning must consider the budgetary availability in each period. For an overview of the works and to define the stages in which work can be done so that they do not leave the structure more vulnerable than before intervention, prioritizing activities and then rehabilitation stages were performed by applying the critical path method (CPM).

Critical Path Method (CPM) is a powerful tool in planning and managing all types of activities. This method appeared in the late '50s and consists in a representation of a project plan through a network or a schematic diagram describing the sequence and interdependencies between project components and a logical analysis and manipulation of the network towards determining the best works development program. CPM allows assessment and comparison of alternative work programs, rehabilitation construction methods and types of equipment [4].

Using CPM and considering the interventions proposed in the technical report, the activities network was built (Fig. 3) with interdependencies between them (Table 1). The CPM method was not originally developed to take into account the execution of the overall intervention in different phases. In this study an adaptation of the CPM method was developed to include this feature so the method can be applied in the case of ISR. For such purpose, Table 1 includes column “Contemporary task” that indicates the tasks that have to be carried out in the same phase. For example, foundation reinforcement and floor substitution may take place in different phases while the rehabilitation of a roof structure and the reposition of its cover must take place in the same phase. In the adapted CPM network the task are grouped according to these considerations, which is a fundamental data for financial planning.

Table 1. Interdependencies between activities

Task	**Previous task**	**Contemporary task**
1	-	2, 3
2	-	1, 3
3	2	1, 2
4	3	5,11,12,13
5	4	4, 11, 12, 13
6	13	7
7	6	6
8	4	-
9	5	10
10	9	9
11	5	4, 5, 12, 13
12	11	4, 5, 11, 15
13	12	4, 5, 11, 12

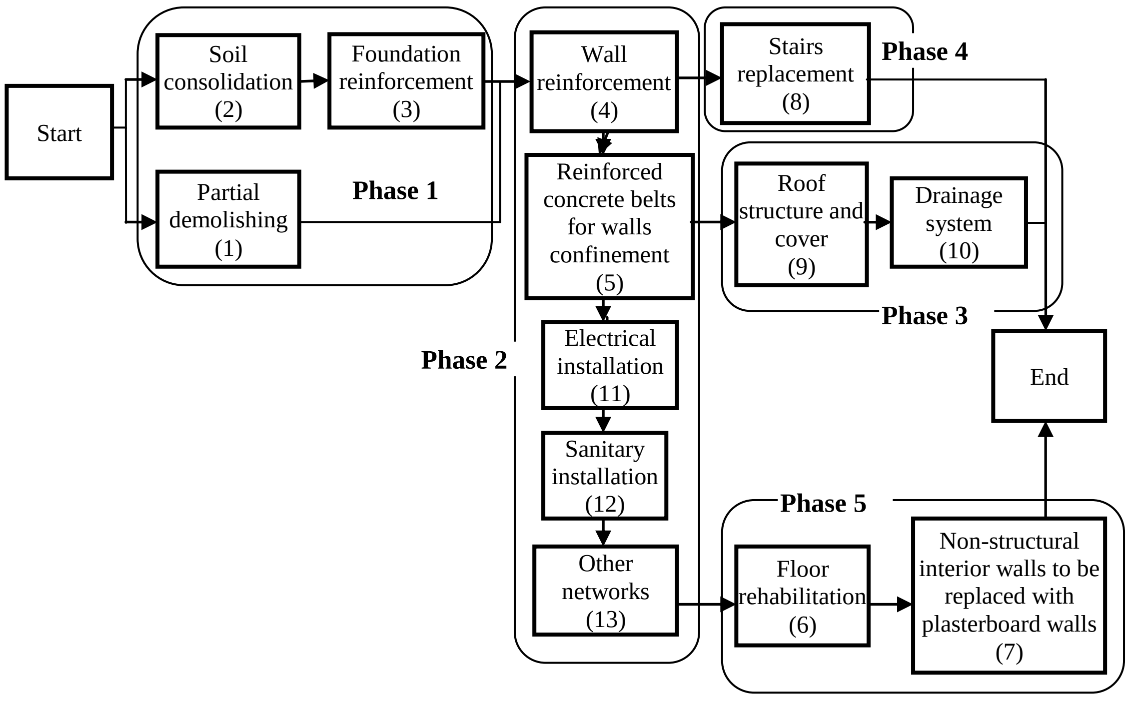

Fig. 3. Network of rehabilitation project activities with interdependencies between them

The network above shows the demarcation of possible phases in the rehabilitation process, based on the data included in Table 1. This diagram is valid in this particular case, in which degradation allowed prioritization of activities like in Fig. 3. It is worth mentioning the unique character of the rehabilitation and construction works, not allowing the application of this scheme in other arbitrary building rehabilitation case. In some cases the phase of rehabilitation works planning within several stages could theoretically lead to the conclusion that rehabilitation cannot be divided into phases because of the tasks interdependence and contemporaneousness.

An important phase in planning a rehabilitation intervention is the breakdown into activities of the rehabilitation works. Depending on the level of details for every activity, the overall process can be more controlled and planned as needed.

Demolition of building part assessed to be into seismic risk class I is considered necessary in an initial stage to allow walls restoration works at the same time with strengthening walls in the adjacent building part.

In this case, as it can be seen, the entire assembly can be divided into five phases (each is represented with circled area). The time planning of such phases is to be performed by the decision-maker of the building and depends on budgetary evaluation.

Possibilities to implement incremental seismic rehabilitation in Romania

The key to successful implementation is validating the basic concept of incremental seismic rehabilitation. Engineers and authorities must be convinced of the feasibility of the incremental approach. It is necessary to define safety regulations and limitations to avoid unintended reduction of seismic resistance to the rehabilitated building, and the owners must be convinced that an incremental approach of rehabilitation offers appropriate benefits in terms of cost and building functionality to make seismic protection attractive in financial and operative terms.

Public authorities, although concerned about the safety of damaged buildings and people living in them, face various obstacles in implementing rehabilitation programs. The main impediments are the cost of such a program and building functionality interruption on the works period supported by the building owners and users that, therefore, most often obstacle authorities' initiative to rehabilitate the building where they live/work.

It's not easy to balance the seismic safety with political, social and economic factors. Incremental seismic rehabilitation offers solutions regarding the main issues that arise when the rehabilitation works of existing buildings and can be an effective method worthy of attention by the authorities.

The application of this method in Romania requires the previous resolution of some problems. First of all it is necessary to align Romania to international conduct regarding buildings maintenance policies. It is known that, at an international level, authorities insist on building maintenance, particularly on their outer appearance, e.g. in case of deterioration of the facade, the owner is obliged to rehabilitate it. In Romania this aspects usually suffer from a lack of attention. Buildings maintenance is provided in new buildings, through Construction Technical Book, but for the old ones this document is usually lost or nonexistent. Of course, even for an old building, this program can be achieved, even if later. Assuming that a maintenance program exists, stages of rehabilitation works can be inserted into it, in which the occupants are disturbed anyway, and the impact of a rehabilitation work is less than if they were disturbed for it only.

Though the owners are not used to make regular investments for repairs and improvements to the building, gradually, aligning with EU requirements will oblige them to take such measures. Seismic rehabilitation should be understood as being in the long term owners' best interest, especially given the high seismicity in Romania, mainly produced by Vrancea earthquake source.

Economic and technical studies are needed to validate the incremental seismic rehabilitation. Further development and acceptance will be based largely on experience in using the method. Some recommendations for encouraging the use of the method are as following [2]:

- Support from owners' association;

- National support by modifying the design and execution codes of rehabilitation works;

- Political support for starting construction safety policy;

- Create a portfolio of case studies with incremental seismic rehabilitation;

- Develop educational programs for professionals in the investigation and construction management of the rehabilitation works field;

- Organizing seminars, conferences, workshops where the results of research and executed works applying the incremental seismic rehabilitation can be disseminated and discussed;

- Gather information about economic viability of the method.

Incremental seismic rehabilitation vs. Single stage seismic rehabilitation

Traditional rehabilitation projects, with a single period of execution, generally have a short period of development. Incremental seismic rehabilitation supposes that the works extend over a period of several years, within several stages.

Owners and users should be aware that the planning of incremental seismic rehabilitation involves more effort than traditional single stage rehabilitation projects. Development of an incremental rehabilitation plan, project evaluation and approvals, making the necessary ancillary services necessary for the execution, coordination with leasing activities and tracking and completion of works, all involve special efforts [3].

Making of an incremental seismic rehabilitation plan includes the anticipation of all rehabilitation phases and their ranking according to priority. Such a plan is not found in a traditional rehabilitation project. The plan efficiency consists in integrating the rehabilitation works in maintenance works program, which may vary depending on the type of building functionality.

Professional design is required to understand the management of building’s utilities specific to its functionality and the decision-making processes to identify best opportunities for integration.

Analysis and design tools used for incremental seismic rehabilitation are the same as those used for traditional projects.

Due to the premise according to which incremental rehabilitation assumes that the building will be consolidated regarding the possibilities along a period of time, there will be intermediate stages in which the building is partially rehabilitated. This requires designer’s understanding of potential consequences of prioritization and breaking the works into stages.

The most important principle to be taken into account in the incremental rehabilitation is to "do no harm" to building. Each stage of rehabilitation must improve overall seismic performance of the building and not leave building in a more vulnerable state than it was in the previous phase. To understand the consequences of effective sequencing and prioritizing of rehabilitation steps towards improving building’s performance further seismic analysis of the partially renovated building and multiple iterations in the design process will be needed [3].

An important chapter in the achievement of rehabilitation works is bureaucracy. For incremental rehabilitation there are two possibilities to prepare the documentation: a) separate documents for each stage of rehabilitation, and b) a single set of documents that clearly defines each phase of rehabilitation.

Separate sets of construction documents have advantages in terms of authorization and setting construction stages. Each stage is separately authorized and each authorization expires at the end of each phase. This gives greater flexibility in managing time and completing the next steps of the rehabilitation works, but is also less likely that all stages to be completed. One set of documents reduces the flexibility forcing work to be carried out during the period in which the single authorization is valid.

Establishing appropriate steps that "do not harm" the building, and then scheduling and completing future works stages is made together with decision makers of the building.

As an incremental seismic rehabilitation plan is being implemented over time, possible changes due to variable sources can affect the parameters that led to the plan. Both owners and designers should be aware of the potential need to re-evaluate the seismic rehabilitation plan elements and make changes in the design and implementation plan, if necessary.

Changes in codes and design standards reference or changes in the condition of the building may require redesign of parts of the incremental seismic rehabilitation works in the coming years. An evolving financial climate may change cost/benefit analysis of planned works. Changing existing owners or owner's priorities may affect the implementation of future stages of rehabilitation works.

In prioritization and setting of the rehabilitation phases, the designer must consider the possibility of delays in future work. During the interim phase, when the building is in a partial state of consolidation, designers can be put in a position to advocate for an eventual completion of rehabilitation works. This is particularly important when the owners or other decision makers may not have as a priority, always, seismic rehabilitation.

Implementing an incremental seismic rehabilitation plan over time will be more successful than a single stage project if the design and construction documentation is more thorough and easier to change. With appropriate documentation, detailed knowledge of a specific project will not be influenced by the turnover of the building’s designer, and plan changes will be easier to evaluate and implement.

Conclusions

Incremental seismic rehabilitation (ISR) offers an opportunity to overcome obstacles imposed by cost and functionality interruption in terms of seismic rehabilitation. ISR provides flexibility in scheduling activities and may be more technically and financially efficient than a delayed single phase rehabilitation project.

In the present article an innovative planning method is proposed, based on the Critical Path Method, allowing the identification of the tasks to be carried out in different intervention phases.

The incremental rehabilitation plan proposes the rehabilitation of buildings with small but concrete steps, eliminating both the situation where nothing is done to make the building safe because the lack of funds for major rehabilitation works, and situations when the rehabilitation works stop before conclusion for financial reasons, indefinitely interrupting the functionality of the building. This system can be applied establishing the necessary rehabilitation works and executing them one at time, after establishing the order, depending on urgency, importance and how they improve building performance for earthquake actions. These works should be included in the regular maintenance program of the building to reduce activity disrupting periods.

Acknowledgements:

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RETROFIT STRATEGIES AND GUIDELINES FOR PUBLIC SCHOOLS AND HOSPITALS IN ISTANBUL, TURKEY

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Keywords

Istanbul public facilities, Seismic retrofit, Retrofit guidelines, nonductile concrete and masonry buildings, performance based engineering

Abstract

A task committee comprised of local structural engineers and earthquake engineering experts from abroad was formed to assess the seismic performance of public schools in under auspices of this group; a guideline has been developed better assess the existing conditions and develop retrofit options for school and hospital buildings in Istanbul. The project is financed by World Bank (WB). The Istanbul Project Coordination Unit was responsible for implementing the project and has developed a retrofit Guideline is based on provisions of the ASCE 41 and Turkish earthquake code and is purposed to address the seismic design requirements for hospital and school facilities in Istanbul and recommends effective retrofit measures. Many such buildings were constructed prior to adoption of seismic codes and use non-ductile concrete moment frames and unreinforced masonry walls to resist earthquake loading. Recent earthquakes have shown that this type of construction is particularly sensitive to earthquake damage and even complete collapse due to the inadequate design and construction practices. The engineer is charged with condition assessment, followed by analysis and determination of deficiencies. Both conventional and state-of-the-art retrofit measures have been implemented. It is hoped that the implementation of this project will drastically reduce the level of damage and loss of life in the public buildings during the next earthquake.

Introduction

The government of Turkey and the International Bank for Reconstruction and Development (IBRD) has entered into a loan agreement implementing the Istanbul Seismic Risk Mitigation and Emergency Preparedness Project (ISMEP). The goal is to improve the city of Istanbul's preparedness for a future earthquake. Seismic retrofit of school and hospital buildings vulnerable to earthquake damage is of great political and social importance in Turkey. The last two major earthquakes in the region have shown the vulnerability of these buildings in particular and of the built environment in general.

As part of this effort Guidelines for seismic retrofit of schools and hospital facilities in Istanbul, (hereafter referred to as the Guidelines) has been developed. The aim of the proposed is to implement a procedure that leads to safeguarding Istanbul school and hospital buildings against a future earthquake in the area. The project scope is intended to protect as many buildings as possible, use cost-effective methodologies, produce on-schedule and high-quality construction, and ensure that the buildings meet their performance

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objectives. Fully implemented, the Guidelines describe retrofit methods that would significantly improve the seismic performance of school and hospital buildings in Istanbul. To remain cost-effective, a certain level of building damage is considered acceptable for school buildings, but Immediate Occupancy and Life Safety performance is highly likely. In this Guideline, supplements to Turkish Earthquake Code (herein referred to as TEC2007) are proposed for use specifically under the scope of ISMEP. These supplements are intended to increase confidence that collapse is prevented and damage is limited. The overall objectives are to minimize the retrofit cost, achieve acceptable earthquake performance, and to allow more buildings to be evaluated.

Motivation for the project

The 1999 magnitude 7.6 Izmit (Kocaeli) and magnitude 7.2 Duzce earthquakes caused extensive damage. Fatalities exceeded 18,000 while casualties exceeded 50,000, with a direct financial loss of over US $6 billion. High ground accelerations were recorded. Many vulnerable structures collapsed or were severely damaged during these earthquakes (and all other recent and strong Turkish earthquakes). Post-earthquake surveys (Elwood et al, 1999(indicate that many of the types of structures that were damaged in the Sichuan earthquake also performed poorly during the 1999 earthquakes in Turkey. For example, as shown in Figure 1, soft story collapses occurred when the stiffness of the bottom floor was lower than that of upper floors and URM buildings or infill walls collapsed (NISEE 2011) , as shown in Figure 2.

Figure 1. Soft story collapse in the 1999 earthquakes

Figure 2. URM infill collapse

Figure 3 depicts a vulnerable building in Istanbul taken during a recent site visit and condition-assessment survey. For this building, the walls terminate above the first floor to allow for parking. This introduces a soft-story mechanism at this level and can lead to collapse in a future earthquake. Once such dangerous buildings are identified, it is important that steps be taken to address the vulnerabilities.

Many thousands of school, hospital, and government buildings in Istanbul use reinforced concrete moment frames. There are over a dozen sub-groups within the same design group. The main differences between the various subgroups are the layout of the frames, geometry of the structures, and presence of URM walls. The most common type (see Figure 4) is a three or four story, regularly configured building, with a basement, and an emergency staircase attached to the short sides of the structure.

Figure 3. A vulnerable structure

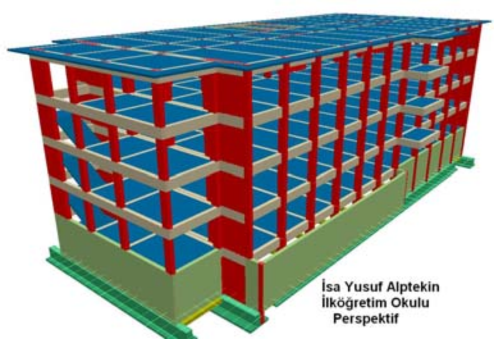

Figure 4. Schematics of a typical building

The historic city of Istanbul is Turkey's largest city. More than 20% or the country's population lives in Istanbul and the metropolitan area generates a large portion of Turkey's GDP. The city has grown substantially since the 1999 earthquakes. It is located in an active earthquake region. Its seismicity is comparable to California and Japan. Similarly to these areas, there is a high probability of a major earthquake occurring in the next 20 to 40 years. Without extensive building strengthening throughout the city, such an earthquake will result in high casualties and tremendous economic losses. These factors served as the background for the World Bank project described here.

ISMEP (Project) scope and organization

To address the earthquake vulnerability of public buildings in Istanbul and to prevent the devastation that could occur in the next major earthquake, the World Bank and the government of Turkey initiated the Istanbul Seismic Risk Mitigation and Emergency Preparedness Project (ISMEP). The first engineering assessment and preparation mission was conducted in October of 2002. The World Bank financed and supervised project (WB, 2007) is implemented through the Istanbul Special Provincial Administration (ISPA). The Istanbul Project Coordination Unit (IPCU), established under the ISPA (Kazzam, 2007), is responsible for implementing the project. The ISMEP project started on 1 February, 2006, and is expected to be completed by the end of 2014. The total World Bank loan amount is estimated at US $600 million (Kazzam, 2007). The primary goals of the project, as listed by IPCU (Kazzam, 2007), are summarized here. This paper is primarily focused on task 3 - the process for the evaluation and retrofit work for public buildings.

- Strengthening institutional and technical capacity of emergency management
- Increasing emergency preparedness and response awareness
- Retrofitting/Reconstruction of priority public buildings
- Vulnerability inventory and project design for cultural and historical heritage assets
- Taking supportive measures for the efficient implementation of development law and building codes.

Retrofitting and Reconstruction of Public Buildings

Task organization

In order to ensure the successful implementation of the project, a collaborate effort between domestic and international consulting engineering companies was required and established. This arrangement took advantage of the strength of both groups. The local engineers are familiar with the in-situ designs and construction practices and can readily identify vulnerable structures. The international consultants, mostly from other well known earthquake-prone countries, are well-versed in the science and art of seismic rehabilitation and can more readily identify deficiencies in proposed retrofits, given their expertise and extended background in earthquake engineering rehabilitation practice. The international consultants also typically have extensive earthquake retrofit experience around the world and are familiar with the latest and most cost-effective retrofit techniques. Academics from Turkey were also involved in the review of the completed designs, as well as assisting in the development of criteria and guidelines for the work.

Rehabilitation Guidelines

The objectives of this project are to identify, evaluate, and retrofit/reconstruct as many vulnerable structures as possible with the available funding. To ensure that the project would strengthen and/or rebuild cost-effectively as many structures as possible, the project participants developed guidelines for selection and rehabilitation of vulnerable structures. The guidelines (IPCU 2007) are based on the provisions of the Turkish code (TEC 2007) with input from ASCE 41 (2006) and other relevant publications from around the world. While the Turkish code is written for new construction, the Guidelines are intended for retrofit work. In order to ensure that the project would encompass as many structures as possible, the Guidelines are less stringent than the current Turkish code. Certain levels of damage are deemed acceptable in the provisions. The key provisions of the Guidelines are as follows:

- Condition assessment. Data are gathered in sufficient detail to identify structural and nonstructural components that participate in resisting lateral loads, and potential seismic deficiencies in load-resisting components. As-built condition evaluations should utilize construction documents and testing, among other resources.

- Seismic deficiencies. Common structural deficiencies, such as irregular configuration, non-ductile reinforcement detailing and URM infill walls are identified.
- Seismic hazard. The seismic demands are defined in terms of design response spectra or suites of acceleration time histories. The hazard due to earthquake shaking is defined on either a probabilistic or deterministic basis.
- Analytical procedures. Acceptable procedures, ranging from simplified static to nonlinear dynamic analyses, is allowed based on structural configuration and retrofit..
- Structural performance levels. Various performance levels are defined and the level of damage for each level is described. The appropriate performance level for a given earthquake intensity is identified. More detail is provided below.
- Retrofit. Both conventional and innovative techniques are described. Innovative, but generally accepted methodologies are encouraged.

The Guidelines strenuously attempt to address and correct the weaknesses of recent and current general Turkish earthquake engineering and construction practices while incorporating state-of-the art practices from around the world, and particularly from countries that have conducted extensive and systematic strengthening of structures in earthquake regions over many years. This also includes considerations related to other systemic issues, such as engineering education and licensing. Many of the buildings that have already been strengthened were constructed relatively recently.

<u>Key differences between the guidelines and TEC2007</u>

The Guidelines has been developed to assist structural engineers in seismic retrofit of vulnerable school and hospital buildings in Istanbul, Turkey. TEC2007 primarily addresses new construction. Similar to other building codes worldwide, TEC2007 is prescriptive and is intended to provide life safety. By contrast, the Guidelines heavily rely on performance-based engineering. The Guidelines include eight (8) major modifications to TEC2007. These items are elucidated below.

- In the Guidelines, the latest database of geotechnical knowledge is used to prepare seismic hazard.
- TEC2007 requires that the computation of seismic mass include 60% of the live load acting on the structure. In the Guidelines, the inertial mass from live load is reduced to 30%.
- The Guidelines only addresses concrete structures. Hence only concrete infill walls are considered with their corresponding r factor from Table 7.4 of TEC2207.
- The Guidelines provides a comprehensive detailing package for seismic retrofit in its appendix. The Guidelines also requires that the new interior walls be placed with an offset with respect to the existing building frames to avoid brittle and premature failures.
- Compared to TEC2007, the Guidelines allows a 10% higher limit for the percentage of primary beams and columns in a damage zone and meeting the performance target.
- The Guidelines defines an rs factor of 3.0 for foundations. TEC2007 does not specify a factor
- The Guidelines retains the drift requirements of TEC2007 and in addition, requires that the existing concrete columns be checked for deformation compatibility.
- The Guidelines provides a detailed discussion on the rs values of TEC2007, but instead uses m factors for demand to capacity ratio computations

<u>Specified performance levels</u>

A key feature of the provisions is the use of performance based engineering (PBE). In PBE, three structural performance levels are considered: Immediate Occupancy (IO), Life Safety (LS), and Collapse Prevention (CP). These performance levels relate to damage states for elements of lateral-force-resisting systems and have specific drift limits as shown in Figure 5. The IO limit state implies that only limited structural damage has occurred. The basic vertical- and lateral-force-resisting systems of the building retain nearly all their pre-earthquake strength and stiffness. The LS damage state implies that significant damage to the structure has occurred, but some margin against either partial or total structural collapse remains. The CP performance level implies that the post-earthquake damage state of the building is on the verge of partial or total collapse. However, all significant components of the gravity-load-resisting system continue to carry their load. Although the retrofit objectives are project specific, typically it is expected that the retrofitted buildings will attain IO, LS, and CP, for the service, design, and extreme earthquakes, respectively. Such performance levels are expected from the rehabilitated (strengthened) public buildings in Istanbul.

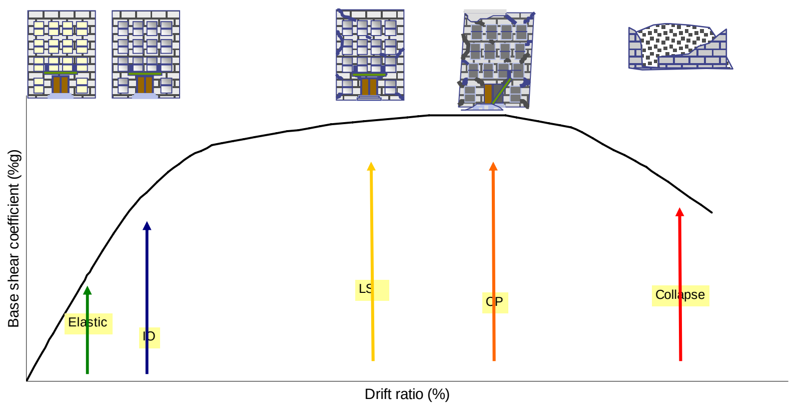

Figure 5. Performance Levels

Retrofitted buildings would satisfy the LS performance level if both of the following conditions were met.

- Not greater than 40 % of the primary beams should be in the "Severe Damage Zone" for any direction of earthquake loading. If at least 75% of the total base shear force for any direction of loading can be carried by shear walls, the performance of the beams can be ignored.
- The ratio of the sum shear force carried by the columns and shear walls in the "Severe Damage Zone" to the total shear force at any storey for any direction of loading should be less than or equal to 0.4 for the top storey, and 0.2 elsewhere.

Retrofitted buildings would satisfy the IO performance level if both of the following conditions were met.

- Not greater than 20 % of the primary beams should be in the "Severe Damage Zone" for any direction of earthquake loading. If at least 75% of the total base shear force for any direction of loading can be carried by shear walls, the performance of the beams can be ignored.
- All the columns and shear walls should be in "minimal damage zone" for any direction of earthquake loading.

<u>Retrofit schemes for vulnerable concrete buildings</u>

Key deficiencies and retrofit procedure for reinforced concrete structures and their main components are summarized in Table 1.

Table 1. Seismic deficiencies and retrofits for RC buildings

Seismic deficiency	Retrofit options
Inadequate lateral strength	Add new RC walls
	Add new braced frames
	Shotcrete members
	Reduce seismic mass
	Seismic isolation
	Supplementary damping
Inadequate lateral stiffness	Add new RC walls
	Add new braced frames
	Increase size of beams and columns
	Supplementary friction damping
Soft or weak story	Add strength or stiffness to story

Torsional irregularity	Add balancing walls, braced frames, or moment frames
Inadequate collector	Add steel or concrete beams
Weak beam-column joints	Jacket or prestress joints
weak column- strong beam	Jacket columns, reduce beam strength
Inadequate shear strength	Fiber composite wrap
Lack Confinement or short splices	Fiber composite wrap Concrete/steel jacket
Inadequate shear capacity of floor diaphragms	R/C topping slab overlay
	RP overlays

Implementation

To successfully implement the project and to transfer as much technology as possible, the international consultants work closely with the local engineers. To ensure that the retrofits are properly designed and constructed, international consultants review both the design and construction phases. They also often participate directly in the engineering designs. Their findings are submitted to IPCU as individual project reports. In the design phase, structural plans and calculations are reviewed to ensure that the retrofit is effective, it does not introduce structural irregularities, a clear load path is defined, and the response of the existing structural members is accounted for. In the construction phase, the consultants visit the site to survey the retrofit work first hand. During their site visit, they determine if the construction is following what has been prescribed in the plans, and whether the retrofit as proposed and implemented is robust enough.

In addition to the reviews at the design level, two additional design reviews are conducted. A World Bank earthquake engineering consultant reviews the general quality and direction of the project work while an earthquake engineering consultant to the IPCU reviews further many specific projects. The IPCU spends much of its time assuring the quality of both the designs and the construction. This redundant system for quality assurance is a primary factor in the success of this complex and large project.

It is projected that by the end of calendar year 2009, over 700 structures will have been strengthened or reconstructed (completely rebuilt). As listed in Table 2 (Kazzam, 2007), the bulk of the effort has been concentrated on schools and hospitals. These type of high-occupancy and essential facilities have been vulnerable in the past and their poor performance has had tragic consequences. As such, they rightfully belong to the top echelon of the retrofit program. It is also noteworthy that roughly seven school buildings, for example, can be strengthened for every single building that is rebuilt completely.

Table 2. Projected list of completed projects at the end of 2009

	Schools	Healthcare	Administration	Social services
Retrofitted/Reconstructed	662	34	12	18

Retrofit case study

The addition of shear walls (schematics shown in Figure 6 and construction photograph for a school building is shown in Figure 7) is the most widespread retrofitting method for the Istanbul strengthening work. This technique is attractive because of its effectiveness, relative simplicity of construction, and cost effectiveness. The key reason for effectiveness is that the additional shear walls are designed to resist a large portion of the lateral seismic loads, which significantly reduces the demand on the existing frame members. This technique has been widely used to retrofit a significant number of public schools and hospitals in Istanbul, as well as in California, Japan, New Zealand, etc.

The IPCU independent consultants reviewed in detail a number of proposed retrofits with new shear walls. To ensure proper design and construction, they have recommended that the following be revised/incorporated in the final designs:

- The walls must be designed and detailed to have adequate ductility.
- Connections between new and existing structural members should be properly designed.
- The existing members should be analyzed to ensure they could resist the imposed loads.

- Diaphragms, collectors, and diaphragm anchorage to the new walls should be evaluated.
- Connections between existing and new concrete components shall be checked.

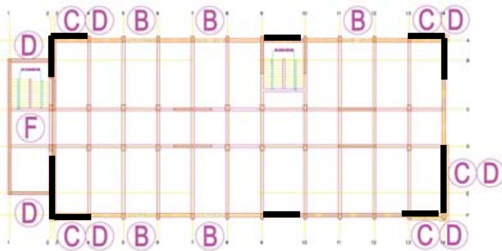

Figure 6. Example of retrofit with new concrete walls

Figure 7. Construction of exterior concrete walls for a school retrofit

Application of the Istanbul Project to Romania and Europe

Europe, especially Italy and South Eastern Europe, including Romania is not immune to powerful and destructive earthquakes. As shown in Figure 1 (ESMC 2010), besides Italy and Turkey, large events have occurred in Greece, Macedonia, Bulgaria, Romania, and elsewhere. The EU (ESMC 2010) classifies both Romania and Bulgaria (see Figure 2) as being very vulnerable to earthquakes and the resulting damage. Unfortunately, even far wealthier countries, such as Italy, have done little to nothing to alleviate the problem, as compared to countries such as California, Japan and New Zealand. That was spectacularly demonstrated in the recent L’Aquila, Italy earthquake.

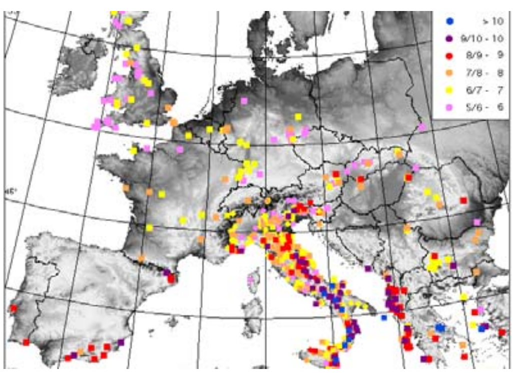

Figure 1. Historic earthquake intensities

Figure 2. Most seismically vulnerable new EU members

Romania is one of Europe's most seismically active regions mainly due to activity from within the Vrancea region. Romania has experienced past significant earthquakes. For example:

- It is believed that the 1802 earthquake of 1802 may have reached M=7.9 (?) and resulted in 3 fatalities and damage to the churches and houses in the region..
- The 1940 magnitude (M) 7.9 Vrancea, Earthquake resulted in over 1000 fatalities and 4000 injuries, mostly in Moldova.
- The 1977 Vrancea (Bucharest) Earthquake was magnitude 7.4 event. It resulted in over 1500 fatalities, 11000 injuries, and damage to over 35000 buildings. The total cost of this event was over $US2 billion. Many older buildings in Bucharest collapsed.

- The 1986 Magnitude 7.1 Vrancea, Earthquake, killed 2 people, injured 500. As a result, over 50000 buildings were damaged. This event was felt as far as Italy and Greece.
- The 1990 Magnitude 6.9 Vrancea, Earthquake also affected this area.

A repeat of one of these larger earthquakes today could result in catastrophic losses for buildings that are not engineered properly. Hence, it is important and time-critical to address the existing vulnerabilities and to undertake comprehensive programs to implement robust retrofits to protect life and infrastructure in Bulgaria's earthquake regions.

Conclusions

The Istanbul retrofit project developed under the auspices of the World Bank and ISMEP is intended to be used to mitigate earthquake hazard for schools and hospitals in Istanbul

- Istanbul provides an excellent example of cooperation between world and Turkish government agencies, local engineers, and world experts in mitigating earthquake hazards for essential buildings and for vulnerable structures.
- It is expected that when the project is fully implemented, it will significantly reduce damage from seismic hazard for the Istanbul schools and hospitals.
- The seismic guideline is primarily based on TEC2007. However, recent research data and knowledge from ASCE 41 is also implemented. The Guidelines can be used as an effective tool in assessing existing conditions, identifying vulnerable components, and devising cost-effective retrofits. The Guidelines used performance based engineering and hence can lead to a more realistic assessment.
- Given the high earthquake hazard present in southeastern Europe and the large number of suspect buildings present in these areas, it is important to keep the lessons of recent devastating earthquakes in mind and use the Istanbul project as an example and address the vulnerable structures in this part of Europe.

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A GIS-BASED SOFTWARE PLATFORM FOR THE SEISMIC RISK ASSESSMENT OF BUILDINGS IN ROMANIA:

CURRENT STATE AND PLANNED DEVELOPMENT OF THE ROSERIS PLATFORM

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Keywords

Seismic risk, seismic hazard, fragility curves, damage states, building stock, GIS

Abstract

The paper presents a software platform dedicated to the seismic risk assessment of buildings in Romania. Based on recent studies on seismic risk carried out by part of the members of the team, the platform is built around a geodatabase, which is structured at building level. The platform integrates the use of geographical information systems (GIS) and of risk assessment modules. The structure of the platform allows the independent use of component modules, such that operations can be performed by operators with different competencies and situated at different spatial locations. The current version of the software is presented, together with some planned future developments.

Introduction

The development of a software application for the seismic risk assessment of building stock is currently a major challenge for every country affected by strong earthquakes. Such applications can play an important role in the improvement of the efficiency and quality of pre- and post-earthquake decision process of authorities in charge with seismic risk management, as they can form the base for the development of seismic risk mitigation strategies, action plans, intervention measures etc.

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An integrated software platform for the seismic risk assessment of general building stock in Romania was developed in the framework of the ROSERIS (ROmania SEismic RISk) research project, financed by the Romanian Ministry of Education, Research and Youth.

The project consortium was formed by three partners: the National Institute for Building Research, INCERC (coordinator, currently URBAN-INCERC, INCERC Bucharest Branch), the Technical University of Civil Engineering, UTCB, and the Institute for Computers, ITC S. A.

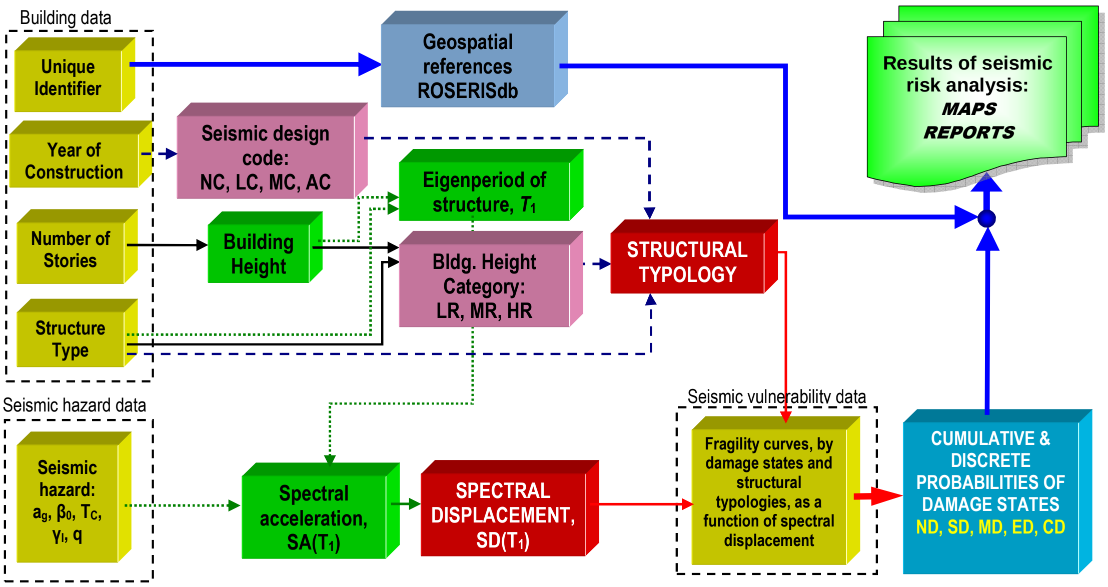
The project has largely benefited of the results of several studies performed during the last two decades by the participants, in the framework of national and international research projects.

Theory and Method

Methodology flowchart

The flowchart of the seismic risk assessment methodology implemented in the ROSERIS platform is shown in Fig. 1 (Craifaleanu et al., 2008a).

Fig. 1. Flowchart of the seismic risk assessment methodology implemented in the ROSERIS platform



Data input

The platform is built around a geodatabase (ROSERISdb), which is structured at building level. The geodatabase is used initially to store input data, as well as geospatial references. Following the seismic risk analysis, the geodatabase will also store output results.

The basic input data consists of the attributes of the analyzed buildings and of data on seismic hazard at each building's location.

The building data consists, basically, of three attributes: year of construction, number of stories and structure type. Additional attributes are also included, in view of the future developments of the platform. Each record in the geodatabase corresponds to a building, to which is assigned a unique identifier, used for geospatial reference.

The seismic hazard is specified in a simplified manner, according to the prescriptions of the Romanian seismic design code, P100-1/2006 (MTCT, 2006), which is harmonized with

Eurocode 8 (CEN, 2004). Seismic hazard data is defined based on the values of the code design spectrum. The spectrum values, corresponding to a mean recurrence interval of 100 years, are determined according to code prescriptions, considering the building location, structure type and importance factor. Alternatively, the spectrum function can be supplied by the user.

<u>Intermediate processing</u>

In this step, two key attributes, structural typology and spectral displacement, are determined, for each analyzed building.

In order to establish the structural typology, the severity level of the seismic design code that was used for the design of the building is first obtained, based on the year of construction, as shown in Table 1. The years in the table are specified according to the timeline of seismic design code development in Romania. The following notations are used: NC=No Code, LC=Low Code, MC=Medium Code, AC=Advanced Code.

<u>Table 1. Classification of buildings according to the year of construction</u>

Year of construction	*Seismic code level*	*Description*
<= 1963	NC	No Code
1964…1977	LC	Low Code
1978…1991	MC	Moderate Code
>= 1991	AC	High Code

Subsequently, the building height category (low-rise, LR, medium-rise, MR, and high-rise, HR) is determined, based on the number of stories, correlated with structure type. A typology matrix, specific to the characteristics of the building stock in Romania is used for this purpose (Lungu et al., 2002).

Finally, the structural typology is determined, based on seismic code level, building height category and structure type. A structural typology code is assigned to the building, by concatenating the codes of the basic attributes, as exemplified in Table 2.

<u>Table 2. Examples of the generation of the structural typology code</u>

Structure type	*Building height category*	*Seismic code level*	*Typology code*
M1.1	LR	NC	**M1.1-LR-NC**
M3.1	LR	LC	**M3.1-LR-LC**
S2	MR	MC	**S2-MR-MC**
RC3.1	HR	AC	**RC3.1-LR-AC**

For the assessment of the spectral displacement, the fundamental period of the building, T_1, is first determined, according to structure type and building height. Empirical formulas provided in the Romanian seismic design code are used for this purpose. The spectral acceleration corresponding to this period, $SA(T_1)$, is obtained from the design spectrum. Then, by using equation (1), the spectral displacement, in centimetres, is computed.

$$SD(T_1) = c(T_1) \cdot q \cdot \left(\frac{T_1}{2\pi}\right)^2 \cdot SA(T_1) \cdot 100 \,. \qquad (1)$$

In the above formula, q is the behaviour factor and $c(T_1)$ is a displacement coefficient that is determined, according to the prescriptions of the P100 code, as a function of T_1 and of the control (corner) period of the spectrum, T_C, by using equation (2).

$$1 \le c(T_1) = 3 - 2{,}5\frac{T_1}{T_C} \le 2 \;. \tag{2}$$

Assessment of Seismic Structural Vulnerability

The building vulnerability functions describe the conditional probability of being in, or exceeding, a particular damage state, *ds*, given the spectral displacement, S_d. According to the HAZUS Technical Manual (FEMA, 1999), the vulnerability functions are defined as:

$$P\left[ds \middle| SD(T)\right] = \Phi\left[\frac{1}{\beta_{ds}}\ln\left(\frac{SD(T)}{\bar{S}_{d,ds}}\right)\right] \tag{3}$$

where

$\bar{S}_{d,ds}$ median value of spectral displacement at which the building reaches the threshold of the damage state, *ds*,

β_{ds} standard deviation of the natural logarithm of spectral displacement for damage state *ds*

Φ standard normal cumulative distribution function.

Building vulnerability functions are specified, for different structural typologies, based on previous studies of some of the members of the project team (Lungu et al., 2002, Vacareanu et al., 2002a and 2002b) and on the specifications of the HAZUS methodology (FEMA, 1999).

Risk Analysis

The structural typology and the spectral displacement are used as input parameters with the building vulnerability functions, in order to determine the probabilities of the buildings of being in one of the following damage states: ND (no damage), SD (slight damage), MD (moderate damage), ED (extended damage) and CD (complete damage).

Based on the above probabilities, denoted by *P* and the subscript denoting the damage state, a mean damage ratio, GMA, is computed as:

$$GMA = 0\times(1-P_{SD}) + 1\times(P_{SD}-P_{MD}) + 2\times(P_{MD}-P_{ED}) + 3\times(P_{ED}-P_{CD}) + 4\times P_{CD} \tag{4}$$

The significance of the values of *GMA*, along with the corresponding colour coding, is shown in Table 3.

Table 3. Significance and colour coding of GMA values

GMA	**State of the structure**	**Colour**
0…0.5	No Damage	White
0.5…1.5	Slight Damage	Green
1.5…2.5	Moderate Damage	Yellow
2.5…3.5	Extended Damage	Orange
3.5…4.0	Complete Damage	Red

Software implementation

The structure of the ROSERIS software platform consists of a core GIS application (called GIS-ROSERIS), and of two “satellite” applications dedicated to building stock data collection and management (MAGDA) and to seismic risk analysis (EVARISX) (Craifaleanu et al., 2008a). Each application can be run independently on any computer, without requiring the installation of other platform components. The feature is aimed to ensure maximum flexibility in performing various operations on different computers, in order to allow contributions from multiple operators, having different areas/levels of competence and different spatial locations (Fig. 2) (Craifaleanu et al., 2008b).

Fig. 2. Dataflow and functionality of the ROSERIS platform

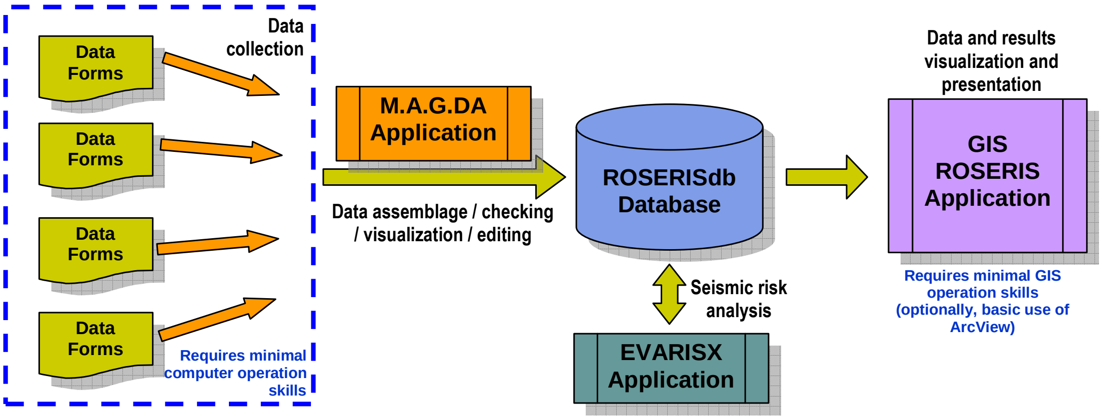


Fig. 3. Screenshot of the MAGDA application.

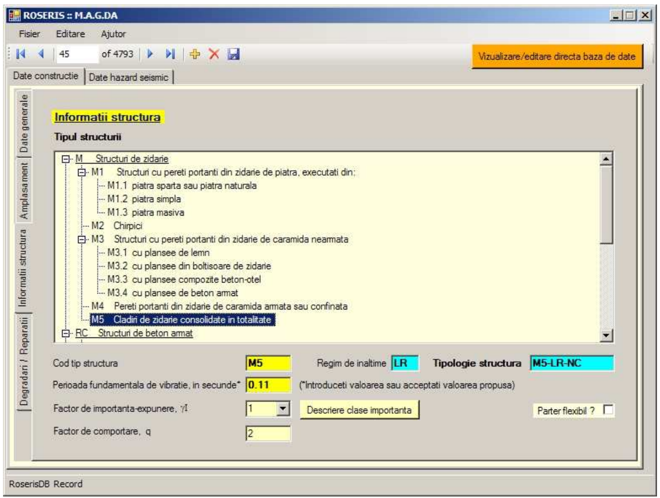
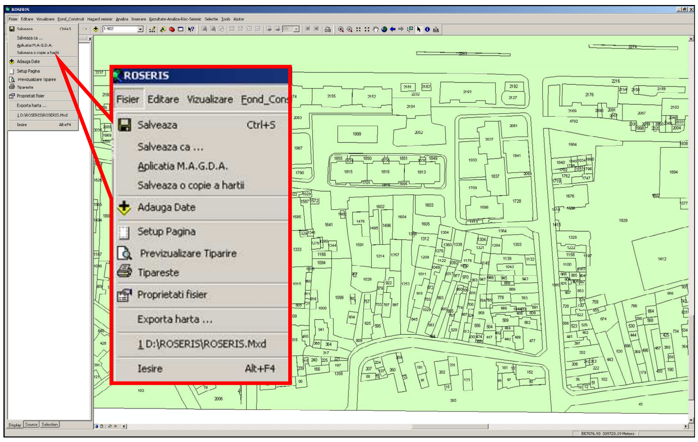


Figure 4. Screenshot of the GIS-ROSERIS core application



All the three applications mentioned before interact with the ROSERISdb geodatabase. The MAGDA and EVARISX applications also provide the capability of viewing and editing the records in ROSERISdb.

The GIS-ROSERIS application, based on the use of the ESRI ArcView software, allows the generation of maps and reports for all significant input and output data of the analysis, allowing a thorough and accurate understanding of the results. This capability has proven very useful in the communication between scientists and decision makers. A screenshot of the graphical user interface of the GIS-ROSERIS application is shown in Fig. 4.

Results

The ROSERIS platform was tested on a pilot zone in Bucharest, which was chosen both due to the diversity of the structural typologies and for its representativeness for the building stock in Romania (Fig. 5). Data from a number of 80 buildings was collected and input into the ROSERISdb geodatabase, by using the MAGDA application. The seismic risk analysis was performed with EVARISX and the results were displayed by using the GIS-ROSERIS application. The testing of the platform provided essential information for improving its functionality. Maps and reports generated for the pilot zone by using the ROSERIS platform are shown in Figures 5 and 6.

Figure 5. Structural typology of the buildings in the pilot zone

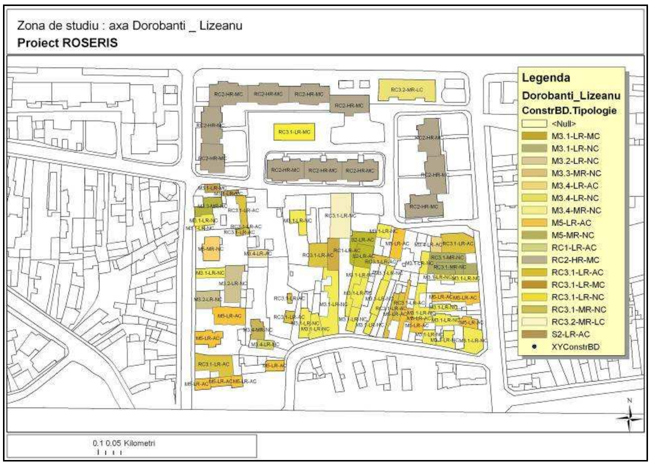


Figure 6. Mean damage ratios, *GMA*, for the buildings in the pilot zone

Discussion

Key features of the ROSERIS platform

The ROSERIS platform provides a basic tool for the assessment of seismic risk. Its structure is adapted to the seismicity of Romania, to the characteristics of the building stock and to the regulatory basis of the country.

The functionality of the platform allows for an efficient work procedure, by de-coupling the operations of data management, seismic risk analysis and presentation of results.

The main advantages of the ROSERIS platform reside in the simple and robust seismic risk assessment methodology and in the capacity of providing intuitive representations of the spatial distribution of significant input and output parameters (Craifaleanu et al., 2008a).

The ROSERIS platform can offer valuable information to central and local authorities, decision-makers with responsibilities in seismic risk mitigation and to the earthquake engineering research community.

Future developments

Planned future developments of the ROSERIS platform include: implementation of code changes introduced by the enforcement of Eurocode 8 as a national standard, implementation of the new fragility curves, resulting from recent research, for additional Romanian structural typologies, refinement of the computation procedure for the mean damage ratio, diversification and improvement of graphical user interface functionality and options.

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Steps and application of emergency management

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Abstract: Based on the truth of complex situations, it is absolutely vital that managers accept the perception that solving one problem requires stages that need to be completed, pre-application of methods and procedures at all hierarchical levels, in order to ensure optimization and effective interventions, and the best decision that will save the affected one. This paper outlines the stages of intervention for each of the disasters phases and standard operating procedures, understandable and easy to follow, which comprises in specific measures and actions.

1. Introducere

Dinamica schimbărilor socio-economice, cerințele progresului şi ale modernizării, precum şi integrarea în structurile Uniunii Europene, impun adaptarea la aceste obiective a angajării şi funcționării instituțiilor abilitate să asigure protecția cetățeanului.

Necesitarea eficientizării, sub toate aspectele, a serviciilor publice comunitare de apărare a vieții şi sănătății populației, a mediului înconjurător, a valorilor materiale şi culturale împotriva dezastrelor, precum şi realizarea măsurilor de protecție civilă, este şi trebuie să rămână un deziderat actual[1].

Nivelul unde se plasează limita între protecție şi asistență, nivelul şi natura riscurilor pe care acceptăm că nu pot fi acoperite mai bine, sunt factori care trebuie puşi la dispoziția organelor decidente.

Plecând de la realitatea gestionării unor situații complexe este absolut vital ca managerii să accepte percepția că în rezolvarea unei probleme este necesară respectarea unor etape şi aplicarea unor proceduri prestabilite la toate nivelurile ierarhice pentru a asigura nivelul optim de eficiență pe segmentul intervenției iar decizia luată să fie salvatoare pentru cei afectați .

2. Etape în Managementul Situațiilor de Urgență

Etapele apărării împotriva dezastrelor se pot împărți după modul de manifestare a riscurilor astfel: cu desfăşurare rapidă, şi cu desfăşurare lentă. De menționat este faptul că în ambele cazuri sunt parcurse succesiv fazele de ajutor, reabilitare, reconstrucția, reducerea efectelor, pregătirea , cu mențiunea că în

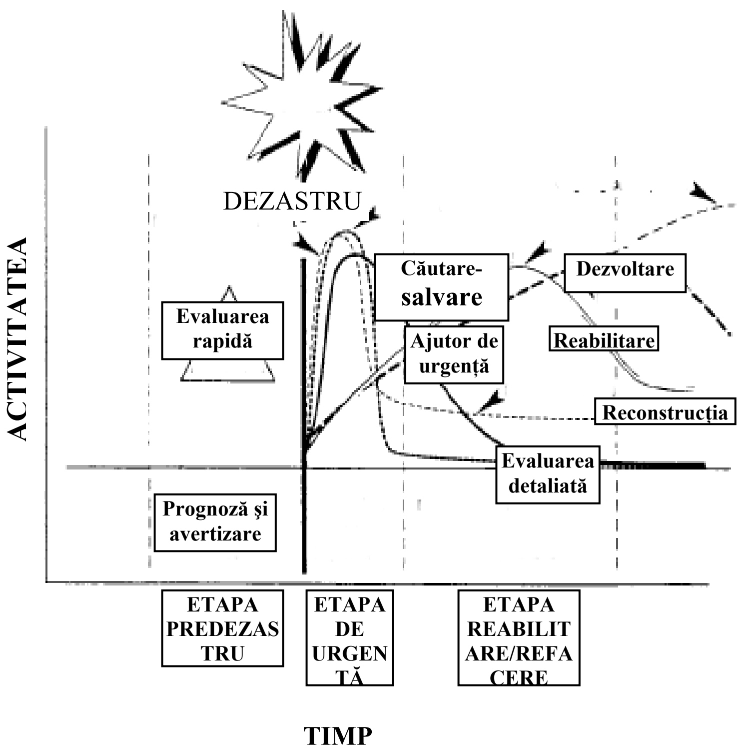

Figura 1. Manifestarea riscurilor şi evolutia activităților de gestionare

În ambele cazuri fazele de intervenție şi prevenție se desfăşoară după acelaşi algoritm:

Intervenția : - ajutor; reabilitare; reconstrucție.

Prevenția : - reducerea efectelor; pregătirea; înştiințarea, alertarea.

Etapele de realizare a măsurilor şi acțiunilor de apărare în cazul producerii dezastrelor sunt clasificate în funcție de natura, amploarea, locul unde s-a produs dezastrul şi măsurile şi acțiunile de protecție-intervenţie prevăzute în planurile de apărare şi pot fi[2][8] :

Tabelul 1. Etape şi acţiuni în M.S.U.

Etapa	**Măsurile şi acţiunile specifice**
Predezastru	Acţiuni de prevenire
Pe timpul dezastrului	Măsuri de protecţie a oamenilor şi animalelor; Încep primele acţiuni de intervenţie
Postdezastru	Acţiuni de intervenţie; Înlăturarea efectelor negative , restabilirea stării de normalitate

3. Algoritmi, proceduri şi metodologii pentru intervenţie

Pentru a înţelege cât mai bine modul de gestionare a unei situaţii de urgenţă am ales spre exemplificare procedura specifică riscului de inundaţie.

În ciuda faptului că la nivel zonal şi chiar local, în situaţiile de urgenţă generate de inundaţii acţionează subunităţi operative din organica serviciilor de urgenţă profesioniste, administraţia locală este, la rândul ei, însărcinată cu responsabilităţi concrete privind managementul situaţiilor de urgenţă prin legislaţia specifică adoptată la nivel guvernamental.

Ambele părţi, atât personalul operativ profesionist, cât şi cei din administraţia publică locală trebuie să ştie exact ce au de făcut pentru a combate cu succes efectele inundaţiilor.

În contextul prezentat, creşterea calităţii gestionării unor astfel de situaţii, poate fi realizată prin sprijinul conferit de punerea în aplicare a unui manual de management al inundaţiilor. La nivel internaţional, acestea se numesc “SOP”,(Standard Operating Procedures) adică Proceduri Operaţionale Standard[3] .

„SOP” se folosesc în întreaga lume pentru a comprima măsuri şi acţiuni relativ complexe într-un manual care oferă proceduri standardizate uşor de înţeles şi simplu de urmat.

În managementul situaţiilor de urgenţă timpul este un factor crucial, uneori minutele sunt cele care fac diferenţa între înfrângere şi victorie. Aceasta înseamnă mult stres şi teamă pentru factorii de decizie pentru că un eveniment de orice tip poate fi complex şi deciziile greşite pot costa vieţi omeneşti.

Sunt şi cazuri în care anumite situaţii de urgenţă trebuie gestionate de edili recent aleşi sau numiţi în funcţii şi care se confruntă pentru prima oară cu astfel de situaţii. SOP-ul oferă tot ce este necesar pentru astfel de lucruri. Mai mult, datorită formatului standardizat nu contează dacă o persoană implicată în managementul inundaţiilor a schimbat oraşul sau nu. Oriunde s-ar afla această persoană în România, poate fi sigur că va găsi toate informaţiile necesare în acelaşi capitol în care se aflau când le-a utilizat cu altă ocazie şi în alt loc.

Un „SOP” prezintă o multitudine de avantaje pentru factorii abilitaţi în domeniul managementului situaţiilor de urgenţă:

1. Oferă informaţii rapide, chiar şi în situaţii de stres, datorită formatului şi conţinutului standardizat.
2. Este structurat în acelaşi mod, indiferent de localitatea sau zona căreia i se adresează. În prima parte, utilizatorul primeşte informaţii de bază despre acţiunile pe care trebuie să le întreprindă în caz de dezastru. În partea a doua, poate consulta informaţii mult mai detaliate şi concrete, precum checklist-uri, tabele etc. cu date relevante pentru comunitatea deservită.
3. Toate acţiunile împotriva evenimentelor de dezastru sunt enumerate în SOP, dar nu SOP-ul va lua decizia, ci reprezentanţii administraţiei publice locale abilitaţi! SOP-ul doar va oferi răspunsuri la întrebări şi – dacă evaluarea riscurilor a fost efectuată corespunzător – va permite luarea deciziei corecte.

„SOP” pentru managementul dezastrelor la nivel local se compune din 2 părţi:

I Prima parte : Precizează metodologia procedurilor operaţionale standard şi detaliază modul de elaborare pe baza exemplelor;

II Partea a doua : Tratează fazele managementului dezastrelor (faza de pregătire a resurselor; faza de avertizare/alarmare; faza de intervenţie; faza de evaluare a intervenţiei)

Din punct de vedere operaţional, managementul inundaţiilor este influenţat semnificativ de diverşi factori. Planificarea tactică şi operarea forţelor desfăşurate depind în mare măsură de tipul inundaţiei.

Simplificând, putem împărţi diversele tipuri de acţiune în 3 scenarii:

1) Inundații pe suprafețe mari - la nivelul bazinelor hidrografice (tipice fluviilor sau râurilor mari)
2) Inundații asociate cu furtuni puternice (tipice zonelor costiere ale Mării Negre)
3) Viituri (tipice zonelor şi regiunilor montane)

Fiecare dintre aceste trei scenarii necesită o pregătire operațională diferită, planificare tactică, resurse umane şi materiale. Câteva lucruri sunt însă comune pentru toate scenariile, ca de exemplu utilizarea sacilor cu nisip.

Cu toată această diversitate privind locul şi modul de manifestare, managementul operațional al inundațiilor foloseşte proceduri operaționale standard, care permit asigurarea reacției adecvate.

De asemenea, un alt fapt foarte important şi demn de subliniat este acela că o serie de activități standardizate au caracter general valabil, fiind independente de tipul evenimentului şi, odată stabilite, sunt puse în aplicare identic pentru toate tipurile de inundații, cum ar fi, spre exemplu avertizarea şi alarmarea populației.

Un „SOP" trebuie analizat cu atenție, din toate perspectivele posibile şi structurat în conformitate cu necesitățile specifice de protecție existente la nivelul fiecărei comunități, pentru că altfel în practică va eşua din cauza aspectelor omise sau greşit interpretate.

Sub acest aspect, este necesară respectarea a trei reguli de bază pentru elaborarea optimă a unui „SOP":

a*) evaluarea corectă şi realistă a riscurilor***.**
b) *identificarea acțiunilor necesare*,
c) *ciclicitatea fazelor,*

Fiecare regulă este necesară! Ignorarea sau nerespectarea în totalitate a oricăreia dintre ele nu va conduce la rezultatele aşteptate.

4. Reacția la criză şi ciclul fazelor

Cunoaşterea "ciclului fazelor" este foarte importantă. Acest ciclu se foloseşte pentru a arăta că orice reacție la criză face parte dintr-un proces ciclic şi nu este o acțiune izolată (Vezi figura 2):

Figura 2. Ciclul fazelor

Pe baza rezultatelor analizei de risc, se elaborează analiza posibilelor amenințări şi se proiectează fazele gestionării situațiilor de urgență prin proceduri operaționale standard.

Măsurile specifice pentru fiecare fază vor fi detaliate pe acțiuni şi activități simple, punctuale, pentru a se elimina eventualele omisiuni sau erori de planificare.

O concluzie importantă este aceea că faza de pregătire (*predezastru*) joacă un rol decisiv în modul de desfăşurare ulterioară a acțiunilor din faza de alarmare şi cea de intervenție.

Aspectele neluate în calcul în această fază nu numai că vor determina greutăți şi disfuncționalități în ceea ce priveşte asigurarea unui răspuns prompt şi eficient, dar ar putea duce la pierderi de vieți omeneşti şi la pagube materiale semnificative.

5. Algoritmul analizei pentru decizie

Analiza se desfăşoară după un algoritm ce se va repeta până la finalizarea tuturor acțiunilor şi activităților conform figurii 3:

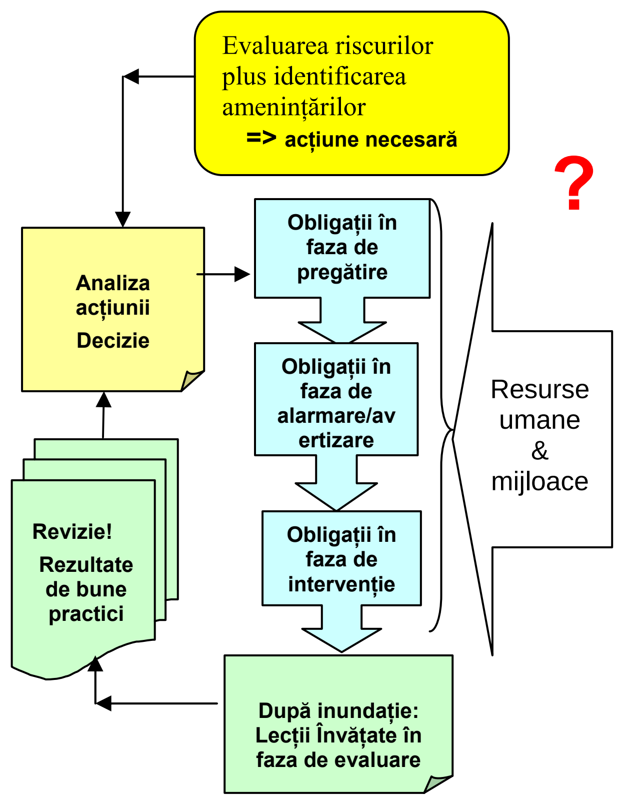

Figura 3. Algoritmul analizei

Sistemul pare mai complicat decât este în realitate. Utilizatorul trebuie doar să respecte paşii şi să-şi revizuiască lucrarea după finalizarea acţiunilor de reabilitare.

6. Divizarea acţiunilor principale

Un alt lucru ce trebuie avut în vedere este subdivizarea măsurilor în acţiuni şi activităţi. Aici există cel mai mare pericol de a se comite greşeli sau produce omisiuni, deoarece împărţirea este foarte importantă pentru identificarea resurselor necesare şi pentru munca de coordonare a operaţiilor[4].

Modul de evoluţie în timp al activităţilor desfăşurate pe timpul etapelor unui dezastru poate fi materializat astfel:

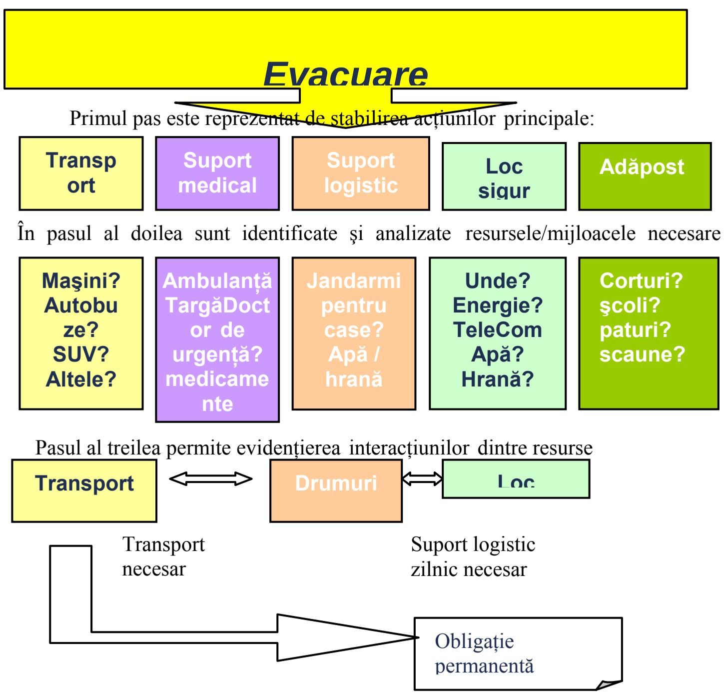

Figura 4. Evoluţia activităţilor de gestionare a unui dezastru

Efectuând analiza de mai sus pentru fiecare acţiune în parte, se pot identifica resursele necesare, precum şi durata de întrebuinţare a acestora.

Desigur că cea mai mare parte dintre aceste activităţi presupune punerea în aplicare a unor planuri[5], ca de exemplu:
- planul de analiză şi acoperire a riscurilor ;
- planul de apărare şi intervenţie pe tipuri de dezastre;
- planul comunicaţiilor ;
- planul de evacuare în situaţii de urgenţă ;
- planuri de cooperare cu forţele şi structurile care intervin în situaţii de urgenţă .

Dacă analizam cadrul legislativ, dezvoltat în special după inundaţiile şi alte situaţii de urgenţă care ne-au afectat teritoriul în perioada 2005-2010, concluzionăm că toate aceste prevederi sunt şi se vor a veni în sprijinul acoperirii responsabilităţilor ce revin celor însărcinaţi cu elaborarea cadrului legal.

O analiză atentă demonstrează ca prevederile cuprinse în numeroasele acte normative emise în ultima perioadă conţin elemente care ghidează cu dificultate autorităţile locale şi responsabilii lucrărilor în întocmirea planurilor şi luarea măsurilor de prevenire a dezastrelor.

În schimb, există încă multe semne de întrebare care se pot pune cu privire la eficacitatea acestor documente. Nu au fost prevăzute elemente care să întărească punerea în aplicare a acestora, cadrul legislativ este confuz încă şi necorelat la nivel strategic.

Se impune primarului să elaboreze planuri, când din păcate autoritatea locală nu are expertiza de a le întocmi şi nici fondurile necesare pentru angajarea unor specialişti.

De aici, rezultă planuri care nu au nici o eficienţă, nu sunt conforme cu realitatea, existând temeri privind aplicativitatea eficientă a măsurilor prevăzute.

7. Clasa de măsurare a riscurilor

Prin managementul riscurilor se analizează aspecte legate de probabilitatea de apariţie a potenţialelor accidente, se definesc frecvenţele de apariţie a acestor accidente conform datelor de proiectare, se stabilesc măsurile de control propuse pentru implementare, prin proiectare sau management, pentru a reduce riscurile de apariţie. Se stabilesc, de asemenea, şi măsurile de reducere a consecinţelor generale ale unor accidente majore.

Luate individual, probabilitatea de apariţie a pericolelor şi consecinţele acestora nu pot furniza o informaţie suficientă pentru stabilirea priorităţilor de acţiune[6]. Este necesar ca riscul să fie exprimat funcţie de doi parametri *probabilitate şi gravitate* şi comparat în cele din urmă cu riscul acceptabil.

Nivelul acceptabil de risc este în directă legătură cu posibilitatea de a salva vieţi sau bunuri.

Atunci când nu se pot salva vieţi se analizează riscurile la care sunt supuse forţele de intervenţie pentru a salva bunuri materiale.

Legătura dintre probabilitatea producerii unor evenimente şi gravitatea consecinţelor se poate reprezenta grafic astfel:

unde: P(a) = probabilitatea ca un eveniment (a) să se producă

L(a) = evaluarea monetară a lui E(a)

Managementul riscului este un proces ciclic, cu mai multe *faze* distincte: *identificarea riscului*, *analiza riscului* şi *reacţia la risc*.[7]

În *faza de identificare a riscului* se evaluează pericolele potenţiale, efectele şi probabilităţile de apariţie ale acestora pentru a decide care dintre riscuri trebuie prevenite. Practic, în această fază se identifică toate elementele care satisfac condiţiile (1) şi (2).

Totodată, se elimină riscurile neconcordante, adică acele elemente de risc cu probabilităţi reduse de apariţie sau cu un efect nesemnificativ. Aceasta înseamnă că pot fi neglijate acele elemente pentru care P(a) sau L(a) tind către zero.

Cea mai simplă metodă de cuantificare a riscurilor este aceea a *valorii aşteptate* (VA), care se calculează ca produs între probabilităţile de apariţie

CLASA DE PROBABILITATE	**NIVEL DE RISC**				
frecvent	**11**	**16**	**20**	**23**	**25**
probabil	**7**	**12**	**17**	**21**	**24**
rar	**4**	**8**	**13**	**18**	**22**
extrem de rar	**2**	**5**	**9**	**14**	**19**
improbabil	**1**	**3**	**6**	**10**	**15**
CLASA DE MĂSURARE A EFECTELOR	**minor**	**semnificativ**	**grav**	**foarte grav**	**catastrofal**

Figura 6. Raportul Probabilitate eveniment / Gravitate consecinţe

Din punct de vedere economic, *elementele de risc* sunt toate elementele care au o probabilitate măsurabilă de a devia de la plan. Aceasta presupune desigur existenţa unui plan. Pentru realizarea obiectivelor organizaţiei este necesară derularea unor seturi de activităţi. O activitate, notată (a), poate fi considerată element de risc dacă sunt îndeplinite simultan următoarele două condiţii:

$$0 < P(a) < 1 \quad (1)$$

$$L(a) = 0 \quad (2)$$

ale anumitor evenimente şi efectele acestora:

$$VA(a) = P(a) \times E(a)$$

unde:

VA(a) = valoarea aşteptată a evenimentului (a)

P(a) = probabilitatea de apariţie a evenimentului (a)

E(a) = efectul apariţiei fenomenului (a)

Alte metode de analiză a riscurilor sunt:

- tehnica simulării;

- arbori decizionali;
- reacția la risc;
- eliminarea riscurilor;
- diminuarea riscurilor;
- repartizarea riscurilor.

Regula generală de alocare a riscului este să se aloce riscul părţii care poate să îl suporte şi să îl controleze cel mai bine[9].

Un proces formalizat de management al riscului va da rezultate pozitive numai dacă se iau în considerare toate aspectele acestuia. Performanța în procesul de management al riscului este dată de calitatea managerilor şi a personalului implicat.

Managerii organizației trebuie să se asigure că echipa care realizează managementul riscului este competentă şi a găsit o cale de mijloc între tehnicizarea excesivă a procesului şi acțiunea pe bază de intuiție.

Concluzionez că atunci când ne referim la strategii privind rezolvarea unor situații de risc accentul trebuie pus pe: evaluarea riscului, strategii de controlare a riscului şi strategii de anihilare (sau diminuare) a consecințelor riscului.

Concluzie

O analiză atentă demonstrează ca prevederile cuprinse în numeroasele acte normative emise în ultima perioadă conțin elemente care ghidează cu dificultate autoritățile locale şi responsabilii lucrărilor în întocmirea planurilor şi luarea măsurilor de prevenire a dezastrelor. În schimb, există încă multe semne de întrebare care se pot pune cu privire la eficacitatea acestor documente. Nu au fost prevăzute elemente care să întărească punerea în aplicare a acestora, cadrul legislativ este confuz încă şi necorelat la nivel strategic. Se impune primarului să elaboreze planuri, când din păcate autoritatea locală nu are expertiza de a le întocmi şi nici fondurile necesare pentru angajarea unor specialişti. De aici, rezultă planuri care nu au nici o eficiență, nu sunt conforme cu realitatea, existând temeri privind aplicativitatea eficientă a măsurilor prevăzute.

Principalele probleme pentru mulți dintre factorii de decizie de la nivel local sunt reprezentate pe de o parte de faptul că nu desfăşoară activități specifice domeniului situațiilor de urgență în mod frecvent şi, prin urmare, pregătirea lor în acest domeniu nu este la nivelul unor veritabili profesionişti, iar pe de altă parte competențele lor în domeniu, în calitate de edili se exercită pe o perioadă determinată, corespunzătoare mandatului pentru care au fost aleşi şi care de multe ori s-a dovedit a fi insuficientă în raport cu vastitatea şi complexitatea evenimentelor şi a cadrului normativ ce le reglementează.

În contextul prezentat, creşterea calității gestionării unor situații de urgență, poate fi realizată prin sprijinul conferit de punerea în aplicare a unor Proceduri Operaționale Standard, proceduri care vor sta la baza activităților structurii propuse.

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Titlul lucrării: TEHNICI ŞI MODALITĂȚI DE APLICARE A MANAGEMENTULUI SITUAȚIILOR DE URGENȚĂ

Afilierea: UNIVERSITATEA TEHNICĂ CLUJ NAPOCA

Domeniul de cercetare : INGINERIE ŞI MANAGEMENT – CONTRIBUȚII PRIVIND MANAGEMENTUL SITUAȚIILOR DE URGENȚĂ

Information Sharing in Emergency Management for Sustainable Development and Resiliency

Author: Mr. Chuck Dolejs, ESi

Abstract: Sustainable development and resilience in any community cannot be achieved without a comprehensive emergency (disaster) management system. Furthermore, that system, in as much as is possible, should be in place and operational prior to any major investment in development that would be vulnerable to being significantly damaged by hazards that threaten that geographic area where the development is being carried out.

A community's comprehensive emergency management system is the first line of defense in protecting that community's residents, transient population, property, critical infrastructure, and its sustainable development against major disasters.

A community without a comprehensive disaster/emergency management system has no foundation to achieve any measure of resilience, and will continuously suffer major losses in lives and property, and that many times also equates to millions of dollars of development funding, time, and capability lost to the devastating effects of a disaster.

In regard to emergency management operations, information sharing is extremely important throughout all phases of disaster/emergency management; namely mitigation, preparedness, response and recovery, but becomes critically important during the response and recovery phase.

Information Sharing and Collaboration are key to mission success for all operations, but especially emergency management response and recovery operations where information is critical to success, but is of little value if not received in a timely manner whereby it can be acted upon immediately to save lives and protect grave property damage.

This presentation will speak to how to achieve that across all organizations and levels of government and industry on a common platform of communication. Numerous examples of success will be presented during the talk using a system that has been battle tested through just about every conceivable emergency and crisis/disaster scenario imaginable.

A SYSTEM INFRASTRUCTURE TO HANDLE LARGE DATA STREAM EXCHANGE AND COLLABORATION DURING EVOLVING ENVIRONMENT CRISES

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Evolving Crises, Collaborative ICT Infrastructure, Scalability, Failure Resilience

Abstract

During manmade and natural environment crises, it is very challenging to manage large scale data generation events and to be able to intelligently retrieve important information in time for decision-making. For example, in drilling operations, a large number of engineers, analysts and decision-makers from energy companies work collaboratively to monitor, plan and to forecast events for operational drilling systems. During tsunami events, a large number of technical experts and emergency decision-makers from intergovernmental agencies are involved in monitoring the real time occurrence of a tsunami. In these scenarios, the rate of data generated in real time is of the order of tens of Mbytes to Gigabytes per second. These large data streams are generated from real-time sensor networks, media and scientific phenomenological models and from multimedia human communication. Over the last decade, a broad range of types of distributed service systems have been deployed for decision-support applications. However, they fail to pass the criteria of scalability, robustness, services reusability and performance in real time collaborative environments, using large data streams. In this paper, members of the TRIDEC (Collaborative, Complex and Critical Decision-Support in Evolving Crisis) project will review and analyse the system requirements for collaborative, complex and critical decision-support in evolving crises. It will present a critical analysis of some existing designs and propose a novel approach for system design, focussing on the messaging infrastructure, to support the above characteristics.

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Introduction

As an integrated project intended to support ICT based management of environmental crisis situations, TRIDEC[3] focuses on new approaches and technologies that support acquisition of earth data, understanding environmental crisis situations and decision making with respect to the population under risk. With large amounts of data and high rates of information exchange between different modules of such a critical information infrastructure (CII), efficient use of resources for both data communication and data processing becomes a major challenge. The life cycle of an environmental crisis comprises six sequential tasks during three specific phases of the crisis, see Figure 1. Among these, the warning and response tasks in particular demand reliable and fault tolerance support (Buzna, 2007). There were cases that incorrect decision making led to wrongly setting off sirens and costly local population evacuations (Mutafungwa, 2009). Equally important is that critical as information for decision makers should be exchanged quickly.

Figure 1: Life cycle of an Environmental Crisis

Evolving crises and ICT support

The requirement for fast and accurate exchange of data is more challenging when the available resources are not static. An environmental crisis has a dynamic nature as far as its conditions and management are concerned. The observation, control, and warning system context can change over time during a crisis, e.g. size of region affected and the location of sensors and actors. Moreover, an infrastructure crisis management system may need to change or improve its behaviour during upcoming crisis events based on from past behaviour and any lessons learnt. Such evolving environmental and infrastructural contexts, if not considered, are threats to the efficient and reliable functionality of a CII (Ulieru, 2007). Mutafungwa (2009) classifies the consequences of realized threats to the information infrastructure in terms of destruction, corruption, or loss of information.

A communication infrastructure, on the other hand, may suffer from an interruption of service delivery. This may be caused by a failure in either nodes or links (flow) in a communication network (Karpinski et al, 2007). Therefore, for a CII system architecture to be prepared for evolving situations, it needs to be sufficiently flexibility and scalable as well as resilience against unexpected changes in system components (Ulieru, 2007). Design and implementation of CII are challenging in terms of the high degree of interconnection and interdependency between the components, as well as their geographical dispersion (Mutafungwa, 2009). The main concern in this paper remains on the approaches that could be taken in order to manage resilient handling of large data sets exchanged across the system. The outcome of this concern informs the middleware architecture of the CII that will be implemented in TRIDEC project.

[3] Web-site http://www.tridec-online.eu/

Related Work

A selection of relevant existing ICT solutions for environment management is surveyed here. These solutions support the provision of early warning mechanisms in some way. The characteristics and shortcomings of each solution will be contemplated in the proposed infrastructure.

DEWS

Distant early warning system (DEWS[4]) was an interoperable tsunami early warning system based on an open sensor platform (Wachter et al, 2009). In the DEWS project, open standard software were utilized to design and implement reliable hazard detection and effective warning dissemination. With respect to the communication issues between modules in DEWS, information dissemination component (IDC) was introduced as the system's service infrastructure. IDC relayed messages in a "channel dependent format" to users of the system through "registered channel gateways and servers" (Wachter et al, 2009).

In the architecture of the InaTEWS project, a derivative of the DEWS project, a component called a Tsunami Service Bus (TSB) provided a messaging interface service for the project's sensor system infrastructure layers (Haner et al, 2009). This service included a list of topics via which, data is routed towards different components for further processing. However, there is little reference to architectural components that support the system's behaviour in situations where amount of data drastically changes due to the (partial) failure of the network. It is therefore not clear if DEWS supports failure resilience, and if so, how effectively.

CHORIST

The CHORIST[5] system consists of three main modules to improve the effectiveness of information and early warning, (Setten, 2009). Module 1 concerns situation awareness. This observes the environment and provides a picture of the situation. Module 2 provides warnings to the population. Warnings to the population are transmitted in standard formats and dispatched to them via the appropriate media channels. Finally, module 3, a rapidly deployable Professional Mobile Radio (PMR) system, is responsible for the provision and reception of video and data services to field units. This module provides an inter-vehicular IP network with radio and routing protocols based on LTE/WiMAX and an emerging dynamic mesh network architecture. This ad-hoc mesh network allows a wide usage of video, image and data transmissions through dynamically allocating radio resources and routing decisions based on traffic identification. However, it is not mentioned how and to what extent, such auto-configurable core network behaves.

GENESIS

The GENESIS[6] project (Alegre et al., 2011) focuses on the support for a common information space for environment ICT services in Europe. This includes both data structure and the means to access environment data. Open standards are used to build a service-oriented architecture (SOA) based Web Service components. These include communication services that accept alerts and any other types of events from external systems and distributed them to any system that described to the service, discovery services, data access services, data processing services, orchestration services and a service portal. GENESIS does not seem to offer any specific support to handle data intensive applications or to support resilience.

Reliable GeoGrid

In GeoGrid (Zhang et al, 2009), a decentralized architecture for network communication services is provided to deliver location-based services. Scalability is supported in GeoGrid through providing replication and load balancing schemes. The applied replication scheme is

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[4] Web-site http://www.dews-online.org/

[5] Web-site http://www.chorist.eu/

[6] Web-site http://www.genesis-fp7.eu/

to cover the area of replica node selection to both short and long distant nodes. The scheme, in addition, controls the cost of replica management by creating and maintaining a constant number of replica nodes. The load balancing scheme was performed using replication. For this, the service processing capabilities of replication was measured through load-balancing relevant metrics. The GeoGrid service network was simulated using 100 randomly generated nodes in an area of 64 miles by 64 miles. The results of the experiments on both failure resilience and load balancing proved a great help to improve the system performance.

GEMOM

GEMOM[7] is a messaging platform whose objective is to provide reliable message delivery, self-optimization, self-healing, resilience and scalability (Abie et al, 2009). The GEMOM system architecture is composed of a set of nodes that act as message brokers, publishers, subscribers, and decisions makers at run time. In GEMOM, a message broker is a package consisting of an application server, plug-and-play objects, configuration files, and database schemas. Decision maker nodes communicate with the other nodes in order to decide on sufficient replication of paths, namespaces and groups, and clustering of topics into groups of one or more groups. Therefore, overloaded brokers and interruptions due to random and sudden fallouts, can be handled. In addition, decision maker nodes realize redundant components and provide switch-over functionality to preserve functionality in high message volumes.

Analysis Framework

Several communication network performance metrics have been used for evaluating, testing, and benchmarking communication techniques. For example, Misckei et al (2007) benchmarked the dependability of some implemented middleware by testing their robustness. Some other system metrics include availability, vulnerability, security, load per node, communication latency, average jitter, total received throughput, or control overhead (Zhang et al, 2009) (Karpinski et al, 2007). Due to the use of unrealistic workload patterns and simplified use scenarios in experimental performance evaluations (Karpinski et al, 2007), benchmarking the outcome of these evaluations within the context of environmental crisis management may not be meaningful. Instead, this work abstracts an evaluation of those characteristics and attributes of CII that are most associated with large-scale and resilient data handling.

Exchanging Large Environment Data Sets and Resilience Support

Typically an oil rig could monitors of up to 20 drill wells for each day with up to 50 sensors per well (up to 1000 sensors), sampled every 10 seconds, drilling, generating data up to 100 KB/s and about 10 GB/day. Typically in a tsunami region, e.g., the Indonesian-based tsunami warning system, GITEWS, has around 300 sensor stations are setup along the coast. The highest frequency sensors responses are of the order 50 Hz, each sampled at 100 B/s while the short-period seismometer (earthquake sensor with magnitude <5) measure signals mainly above 1 Hz. This generates data up to 10 MB/s and about 1.5 TB/day.

Here the focus is on the high performance and resilient data exchange rather than on high performance and resilient data processing because the naturally geographically distributed nature of environment monitoring and management applications where data acquisition, storage, processing and consumption are distributed, mean that the former rather than the latter is likely to be the bottleneck. Specific design strategies to handle data acquisition and exchange resilience include first reliable data exchange protocols including support for checksums, acknowledgements, buffering, and retransmissions. Second, it includes redundant application-level (and network-level) data exchange elements that can be switched between transparently during sessions to support load balancing or to switch away from faulty transmission channels. Specific design strategies to handle scalable data acquisition and

[7] Web-site http://www.gemom.eu/public/modules/mastop_publish/

exchange first include streamlining data exchange, including batched messaging exchange, message compression, and very efficient message exchange design and implementations. Second, it can include intelligent data pre-filtering, e.g., to exchange data only when specific triggers occur, i.e. only when significant changes occur. Third, contention can be reduced when using shared data resources, i.e., through prioritising message types, through using separate media channels etc. Note data exchange may be limited by lower-level network capacity rather than higher application–level exchange bottlenecks.

TRIDEC Messaging Design and Technology Choices

In order to support observations of evolving phenomena during an environmental crisis, from computational point of view, the architecture of an ICT system should maximize: encapsulation of data and functionality, loose coupling between system components, location transparency and distinctive features and concerns, by employing standardized services and components (Haner et al, 2009). Gelernter and Carriero (1992) assert that coordination mechanisms should be separated from computation mechanisms. Poslad (2009, pp. 95-105) summarises the different architectural styles for distributed information systems based upon how service and computation are specified and based upon how systems interact. Of these SOA and MOM-based designs are considered to the most pertinent in this application domain.

<u>SOA, Grid-Computing, Cloud Computing</u>

Service Oriented Computing (SOC) or Service Oriented Architecture (SOA) focuses on services as computational or information processing components that are autonomous and that can be heterogeneous. Web Service (WS) based systems are perhaps the most common rendition of an SOA. SOAs consist of many possible Web service protocols depending on the application and service requirements. XML is used as the basis for interoperability but extensions such as SOAP are used to support more specific types of messaging such as synchronous, request-response and other extensions such as BPEL4WS, the Business Process Execution Language for Web Services.

Generally, during SOA interaction, information about the state of the sender is transferred to the receiver. In the Representation State Transfer (REST) model, the receiver is seen as a set of resources identified by URLs. Only representations of the resources are exchanged, not any state information. SOA is commonly used in environment information systems to support post data acquisition services and to support distributed processing including distributed work-flows.

Grid computing refers to distributed systems that are geared towards high-performance processing of geographically distributed resources, service interactions based upon WS-SOA and utility-based models that support accounting and charging for the use of specific resources. There is no specific support for fault-tolerance and support for highly dynamic ad hoc interaction.

Cloud computing is regarded as a next generation Grid computing model but with greater virtualisation, e.g., to run applications within Virtual Machines (VMs) efficiently that isolate applications from the underlying hardware and other VMs, and the customization of the platform to suit the needs of the end user, and greater support for resilience.

<u>EDA, MOM and ESB Models</u>

One common way to decouple coordination from computation is an event-driven system which supports very loose coupled control or coordination between event generators or producers, and event receivers or consumers. This is also known as publish-and-subscribe interaction. One or more nodes publish events while others subscribe to being notified when specified events occur (Poslad, 2009). There are two main types of distributed EDA design: message-oriented Enterprise Service Bus (MO-ESB or MOM) versus a service-oriented SO-ESB. A SO-ESB supports messaging, Web service discovery, orchestration, data transformation and service-based routing. A message-oriented middleware (MOM) design supports asynchronous messaging, message transactions, message queuing, publish–subscribe interaction styles and application-level routing. Generally, MOM and ESB models tend naturally to support more data intensive and scalable data interchange rather than WS-SOA models. Tests of standard open-source individual MOM nodes, also called brokers, can support message rates of about 5K messages / sec, e.g., for Apache Qpid[8] in non-persistent messaging mode. Commercial, performance tuned MOMS can handle throughputs of the order of 10 times this number. Depending on how multi-sensor data and multiple measurements are batched, MOM based designs can support scalable data exchange and resilience for CII applications. MOMs can be designed to support message priorities, automatic client failover using configurable connection properties, queued data and metadata that is replicated across all nodes that make up a cluster, retry logic in the client code and persistent published data queues and subscriptions.

Hybrid SoS Design

In the realm of environment monitoring and management during environment crisis management, the constituent systems may be distributed over a large geographic area, e.g., across a nation or even spanning multiple continents – the distributed systems interaction forming a System-of-Systems (SoS). Sensor event data of high volume and control commands of critical importance need to be transported between distributed sensors and actuators and backend enterprise servers for complex event processing and integration with business processes. Sensor data and control command are often time-sensitive in that the correct data and command may become the wrong ones, if they cannot be delivered in time. For mission critical applications such as environment crisis management, failing to meet such stringent time constraints may lead to massive error in control decisions or even catastrophic consequences.

Messages between the systems often have to travel a long communication path, incurring much larger delay than local-area messaging, hence the need to support message-oriented rather than service-oriented interaction. It is also harder to maintain a stable Quality-of-Service (QoS) and high availability because a long-haul communication path increases the number of nodes and links along the path. Further, the systems are likely to be deployed and operated by separate organizations, which result in different security properties and degrees of trustworthiness to be associated with these systems. Many SoS applications requiring messaging capabilities with certain assurance on a range of QoS metrics including latency, throughput, availability and security.

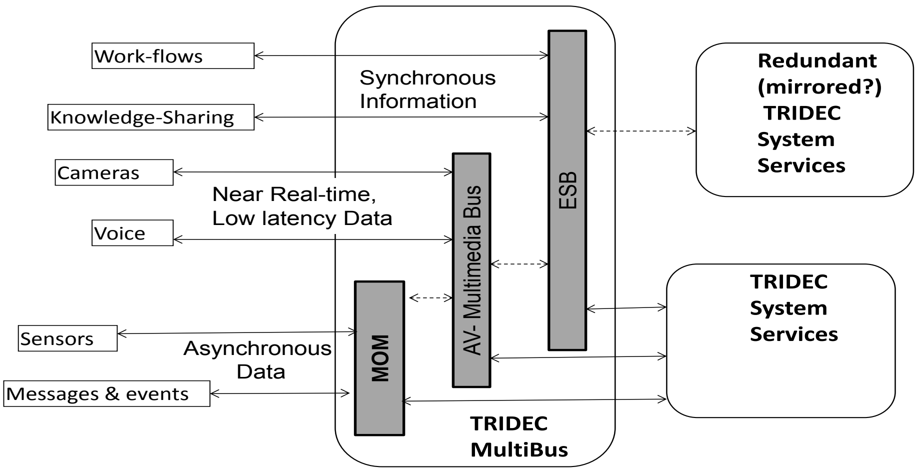

Figure 2: Multi-bus SoS MOM Model to support scalable and resilient data exchange during environment crises.

For TRIDEC, a hybrid MOM / SOA design is used to support a SoS model, see Figure 2. First, sensitive Thematic Pilot Site Processes & Data can be isolated and protected so that

[8] See http://qpid.apache.org/ .

there is no unauthorised access to data that they have invested heavily in collecting sensor data. Sub-systems can be configured to support disconnected mode designs, e.g., delayed-write & read-ahead service and information caches, for autonomous distributed system operation. The system can scale back to local operation if remote access is limited.

Second, a multi-Bus SoS Architecture is proposed. Pure Conventional SOA ESB Infrastructures are too limited e.g., ESB can become a huge bottleneck in a high-demand, crisis situation. There is a need for multimedia exchange during a crisis and the difficulty in optimising versus overloading any single communication channel with different application and multi-media interaction patterns. This can dynamically adapt to QOS. There is a need to separate a control channel (ESB) from content channels for alpha-numeric data events and from multi-media. This aids scalability through a separation of concerns for latency, time-criticality, high throughput messaging & transactions.

The TRIDEC SoS approach also supports resilient service and resource Access and redundancy by design through: P2P – any node can act as server, router etc., highly resourced nodes can act as super-node etc. Key resources can be shadowed and mirrored to prevent key resource failures causing the whole system to fail. Note MOMs may mandate a specific application level or transport protocol which may mean gateways are needed to convert between these and to switch TRIDEC message buses to improve resilience and scalability.

TRIDEC Data Exchange Formats

In addition to messaging (service) design, the specification of the data exchanged needs further attention. Three types of data sources need to be supported: service invocation, sensor data acquisition, and human multimedia messaging. Typically, XML and its extensions tend to dominate as a universal data exchange format at external data exchange interfaces in SOAs. However, there is the issue of what the semantics of the data or content are. XML as a representation is not in itself semantically rich although extensions such as RDF, RDF-S and OWL could be used, else the semantics of the data exchanged must be specified out of band. The metadata about eh semantics is typically only exchanged at the start of a session. The downside in using XML as a message exchange format it is quite verbose and human word-oriented. Hence, internally and for higher throughput data exchange, either more efficient XML encodings or proprietary, possibly application-oriented data encoding are used.

More recently, some more generic data encodings have been proposed for use in data-intensive systems. The Network Common Data Form (netCDF) libraries support a machine-independent, self-describing, and scalable data format for representing scientific array-oriented data. The netCDF project is actively supported by the University Corporation for Atmospheric Research (UCAR). Currently, three different versions of netCDF exist. The latest version, netCDF-4, corresponds to HDF-5 with some restrictions. Hierarchical Data Format (HDF) is a set of data formats and corresponding software libraries addressing the storage and organisation of large amounts of numerical data. HDF5, the latest version, received an R&D 100 Award in 2002, which acknowledged HDF5 as one of the 100 most significant research and development advances. It is designed for efficient I/O and for high volume, complex data. HDF was originally developed by the National Center for Supercomputing Applications (NCSA) and is now maintained and advanced by the HDF Group whose mission is also to ensure long-term access to HDF data. The design issues for human multimedia data processing and supporting multiple data formats have been covered in a previous section.

Conclusion

Technological failures, communicative redundancy, vulnerability, and lack of an overall perspective are known challenges for communication in crisis management (Garnett et al, 2007). Lack of external validation of the claimed results of implemented communication infrastructures (Mendonca et al, 2008) is partly due to the unavailability of the real measurements from real cases (Karpinski et al, 2007). This increases the importance of the challenge to implement CII's resilience to failure and can support scalable data exchange to handle large data volumes.

The TRIDEC project focuses on an analysis of system designs for CII based upon data intensive systems rather than on data processing or service oriented systems and the need to support resilient and scalable messaging. At the heart of this system design is a hybrid System-of-Systems model whose core is based upon a MOM design that is considered to be best able to support resilient and scalable messaging.

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Information Systems Architecture for Supporting Fire Emergency Response

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Keywords

Emergency response (ER), Human Computer Interaction (HCI), Information System (IS) , Information Systems Architecture (ISA), first responder, information requirements

Abstract

For better emergency response during a fire and rescue operation, an information system providing timely access to comprehensive yet relevant and reliable information is essential for the members of the first responder incident command hierarchy. There is very little literature on the higher-level systems architecture of an Information System (IS) for fire Emergency Response(ER); which is well understood by both the owners of the system as well as the systems architects. Information Systems Architectures (ISAs) proposed in previous studies are not comprehensive as they focus on a few selected needs of the end-users or a few technologies. Most of the architectures depict only the view of the systems architects and developers. Therefore, currently there is lack of understanding on the essential components of an IS supporting fire ER and their functionality. To overcome these gaps in literature, this paper proposes a conceptual architectural view of an IS for fire ER. This architecture exclusively addresses the needs for supporting firefighters Situation Awareness (SA) during their response operations in high-risk built environments. The proposed ISA is formulated based on validated information requirements and the HCI needs gathered from the core members of the first responder hierarchy.

Introduction

There are several attempts to develop ISAs to exclusively support the ER operations. Madey et al. (2006) developed a Wireless Phone Based ISA to provide traffic forecasts and emergency alerts for engineering, public safety and ER personnel. However, the scope of this architecture is limited to the technological capabilities of mobile phones. These also include “WORKPAD” (de Leoni et al., 2007), a layered communication architecture to support decision-making during ER operations. However, this architecture does not address the individual needs of different type of responders. Moreover, Meissner et al. (2006) presented an integrated mobile information and communication systems architecture: “MIKoBOS” for ER operations. This architecture only addresses the needs that are common to generic emergency situations. Therefore, it does not comprehensively represent an ISA specific to supporting a particular type of emergency or responders of a particular type of emergency service. Apart from the above explained generic ER ISAs, there are also some ISAs that focus on supporting a particular type of emergency conditions or domains (Kwan and Lee, 2005; Hwang et al., 2007; Lorincz et al., 2004). However, none of this work directly supports response operations of the Fire and Rescue Service (FRS).

In contrast to the above work, the work of Wilson et al. (2005) and Wilson et al. (2007) on the “Fire” project, Jiang et al. (2004a) on the “Siren” project, Jiang et al. (2004b) on the Large Displays for ICs and Klann (2008) on the “LifeNet” project are significant efforts in developing firefighter related ISs. All these systems support the fire ER operations in built environments. However, these works do not focus on the systems architecture, but focus on the actual prototype or product development limited to single or few needs of firefighters. Therefore, these previous works are very much less comprehensive in describing the architecture of an IS supporting fire ER. The conceptual systems architecture proposed by the "FireGrid" Project (Upadhyay et al., 2008) appears to be the only significant architecture, which exclusively support the response to fires in built environments. Although this architecture recognises the diverse needs of technology to capture the contextual information, it does not identify the technological diversity required for the successful presentation of information to various types of firefighters due to the differences of the firefighter job criteria, their behaviour and context of operation. Therefore, the architecture proposed is not fully capable of addressing the different needs of different firefighter job roles.

The above discussion clearly indicates the lack of a comprehensive ISA addressing the needs for supporting fire ER. With the aim of addressing the above identified gaps in the literature related to the knowledge of ISA for supporting fire firefighter during ER, this paper focuses on specifying a suitable ISA exclusively supporting firefighters. At first, this paper explains the methodology for specifying a suitable ISA. Thereafter paper outlines the composition of the ISA. This is followed by detail discussion on each layer of the ISA. Finally, the contribution and the conclusions of the study are explained in a summarised manner.

Methodology

The ISA proposed in this paper follows an approach based on the work related to defining a framework for ISA (Sowa and Zachman, 1992). In a previous study authors carried out a study focused on large buildings having a high-risk of fire and four key fire fighter job roles: Incident Commander, Sector Commander, Breathing Apparatus Entry Control Officer and Breathing Apparatus Wearers to identify information requirements essential to enhance their SA (Yang et al., 2009a). This was based on the extensive data collected from the FRS brigades of three counties in the UK. The requirements elicitation process was guided by a Cognitive Task Analysis (CTA) tool: Goal Directed Information Analysis (GDIA), which was developed specifically for capturing firefighter requirements (Prasanna et al., 2009). Initially appropriate scenarios were developed. Based on the scenarios, 44 semi-structured interviews were carried out in three different elicitation phases with both novice and experienced fire fighters. Together with field observations of fire simulation and training exercises, fire and rescue related documentation; a comprehensive set of information needs of fire fighters were identified. These were validated through two different stages via 34 brainstorming sessions with the participation of a number of subject-matter experts. As the outcome of this study a validated set of Goal-Decision-Information (GDI) diagrams consisting of the comprehensive information needs of four firefighter job roles with the link to their decision-making needs were obtained. In a subsequent study authors further explored the appropriate presentation methods of information with the support of a prototype made up of several human computer interfaces (Yang et al., 2009b). These were evaluated via 19 "walkthrough" and "workshop" sessions, involving 22 potential end-users and 14 other related experts. As a result, many of the methods used in the prototype were confirmed as useful and appropriate and several refinements proposed. The in-depth understanding of the information requirements and Human Computer Interaction (HCI) needs of fire emergency context laid a strong foundation to propose a comprehensive architectural view corresponding to the "Owner's View" (Sowa and Zachman, 1992) or "End-user's View." The ISA proposed in this paper primarily focuses on prescribing the three types of conceptual description: *data*, *function* and *network* (Sowa and Zachman, 1992).

ISA Composition

Having compared the capabilities and capacity of previously presented ISAs in light of the specific information needs and corresponding HCI needs identified for different types of fire emergency responders, this study proposes an ISA consisting of four layers: 1) Data Capture & Networks, 2) Data Manipulation, 3) Function Modules and 4) Human Computer Interaction (Figure 1).

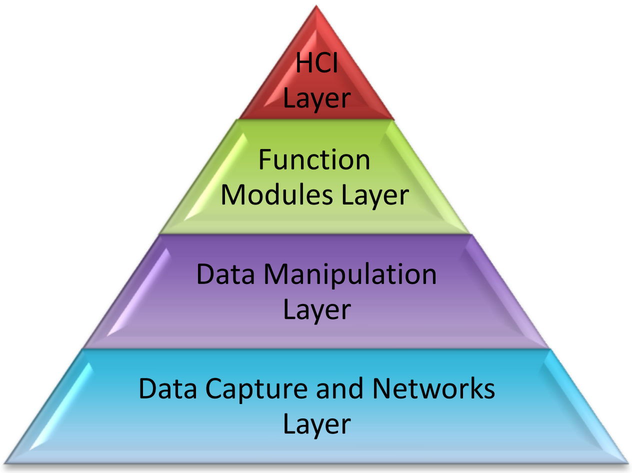

Figure.1: Primary Layers of the ISA Proposed for fire ER

Data Capture and Networks Layer

At the bottom of the ISA is the Data Capture and Networks layer. This layer is concerned with collecting data from a wide variety of sources, a range of different networks to which these sources and end-users of the system are connected and a common communication service to connect different types of networks. Essentially, this layer builds the communication infrastructure of the IS. The data collected in this layer are passed onto the Data Manipulation layer for the initial processing. When considering various needs of firefighters identified in previous studies, data capturing requires the input of both electro-mechanical and human sources; especially the information input of different type of firefighters. It is crucial to capture these information needs from many different types of information sources located in and around the incident premise, and maintain communication among 1) various contextual information capturing devices, 2) different types of firefighters located inside and outside the incident premise, 3) display devices proposed for the use of different firefighter jobs fixed inside the fire engines and various locations in the incident premise, 4) FRS control room, 5) fire stations, 6) information sources belonging to other support services such as ambulance service, police and the local government and 7) third party information sources such as weather, media and traffic. Further, investigations carried out showed that a single communication technology alone is not capable of fulfilling the requirements of the end-users of the proposed ER IS. It is identified that by integrating various technologies into one platform and by using them flexibly and interchangeably, the various communication alternatives can complement each other. In this way, availability of communication can be guaranteed without incurring extensive costs. Based on these considerations, this study proposes a high-level architectural layout for the data capture and networks layer as shown in Figure 2. The success of the IS proposed depends on the ability of various network platforms to work in combination to form heterogeneous networks consisting of various types of sensors and protocols. If this cannot be achieved, it may seriously hinder the feasibility of deploying the type of IS proposed. To maintain communication between various heterogeneous networks and to transmit data across different networks, it is decided that the IS proposed should have an extensive support of a common communication service that should run on top of all the networks. This communication service makes a common tunnel, independent from the network, whether it is IP based or RF based and connected through different types of terrestrial or non-terrestrial communication technologies. This service should run across all the technologies that are discussed so that the data from various sources could be processed with the use of other services and later to be passed on to the next level of the architecture. Therefore, networks communication service is important as it provides a consistence interface between other upper level modules of the architecture by transporting data regardless of the differences of underlying networking technologies, networking protocols or communication technologies. The networks communication service takes the responsibility of converting data to a compatible format so that it can be transported across multiple technologies.

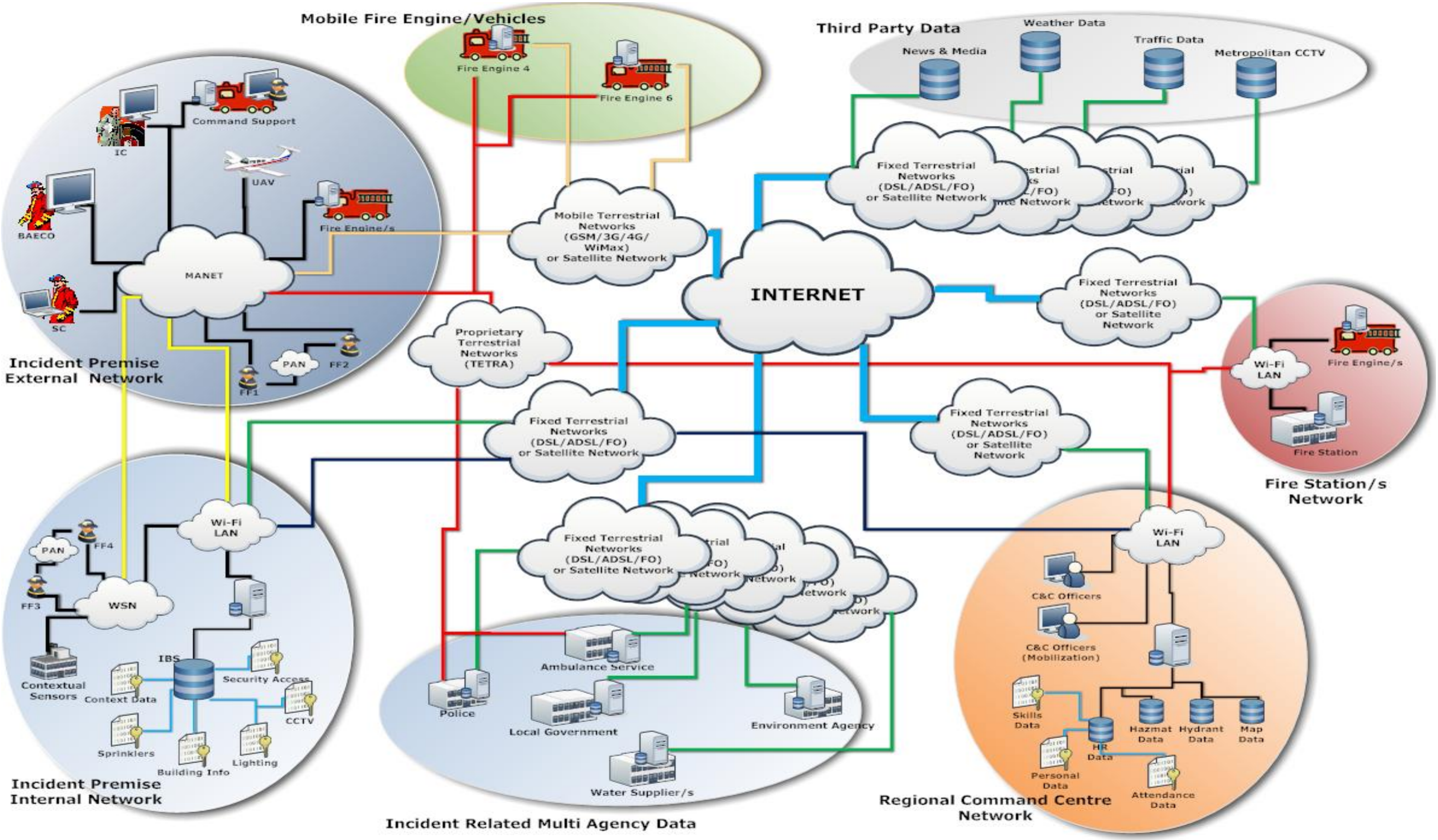

Figure 2: Data Capture and Networks Layer of the ISA

It is also responsible for alerting changes in communication status, width allocation management and adapting the data stream to available communication conditions according to associated policies like "priority".

Data Manipulation Layer

The data captured from sensors and various other public and proprietary databases attached to various types of networks are passed up to the next layer labelled as the Data Manipulation layer. This layer provides the support services necessary to carry out common data manipulation such as storing, filtering and processing so that more value added data can be passed on to the next layer to carry out higher-level functions unique to fire ER. To carry out such services this study proposes the following as the main constituents of the Data Manipulation layer of the ISA proposed:

- Data Management
- Data Fusion
- Method/ Model Base

The following sections explain the reasons for the selection of each of the above service and their uses in implementing the Data Manipulation Layer of the ISA proposed.

Data Fusion

A need for data fusion for an IS supporting firefighters is essential because data related to the same element or entity may come from different types of human and mechanical sensors (for example data on casualty) and from spatially dispersed data sources. The system proposed in this paper focuses on enhancing firefighter's SA in three increasing levels namely Level 1: Perception, Level 2: Comprehension and Level3: Projection (Endsley's, 1995). Therefore it is important to carryout data fusion in such a way that it promotes SA in three increasing levels as mentioned above. Over the years, more than thirty fusion models have been proposed. However, no model has become as influential in data fusion as the JDL (Hall and Llinas, 1997) model (Salerno et al., 2004). Having considered the output of the Level 1, Level 2 and Level 3 data fusion of the JDL Model, Blasch et al. (2006) identified its close corresponds to the Level 1, 2 and 3 SA requirements of Endsley's (1995) SA model. Authors of this paper recognize the ability of JDL fusion model to implement the three levels of SA that is essential to support firefighter decision-making during their ER operations. Thus, this study strongly recommends adopting JDL fusion model to appropriately carry out the Level 1, Level 2 and Level 3 data fusion at the data manipulation layer of ISA proposed. The following paragraph explains a conceptual fusion process useful to achieve data fusion for the proposed IS as recommended in the JDL model.

During their previous work (Yanging et al., 2010), authors identified the need of ad-hoc sensor networks containing a variety of contextual and location tracking sensors. Such sensor networks essentially require the capability of processing large amounts of heterogeneous sensory data and information from spatially dispersed sources. It is identified that comparatively lower data rates and higher costs prevailing in mobile networks may create severe bottlenecks in centralised data fusion (Pavlin et al, 2004). Thus, this paper strongly recommends the need of distributed data fusion compared to centralized data fusion supported by a multi-agent system (Wooldridge, 2009) in which each agent should take care of partial fusion. Furthermore, considering the data processing capabilities of the modern day sensor motes, this study proposes "tiered" data fusion (Mullen et al., 2006; By adopting the partial data fusion guidance of Maris and Pavlin (2006), the proposed Data Fusion service should be able to combine the support of various *Sensor agents* and *Fusion agents* to fuse the data captured from various data sources and store them in the fusion database. Data sources can be a combination of 1) local sensors associated with a data fusion system (Example: sensors physically associated with the data fusion system or organic sensors physically integrated with a data fusion system platform), 2) distributed sensors linked electronically to a fusion system and 3) other data such as reference information, geographical information, hazmat information, information stored at various supporting databases and the fusion databases itself, 4) output of fusion agents located at various levels of the tiered data fusion architecture. It is expected that Sensor and Fusion agents appropriately connected in tiered data fusion architecture would be able to fuse the data into three increasing levels of inference as described in the JDL fusion model.

Method/Model Base

This service stores various Methods, Models and Procedures that support various fusion agents to enhance the fusion process. It is an impossible task for the IS proposed to meet the Level 2 and Level 3 SA needs of firefighters unless data fusion service is supported by the services of appropriate Methods and Models. Thus, the service of appropriate collection of Methods and Models are essential to implement the IS proposed. This service should provide the essential support for:

- The agents to phrase and clean data so that resultant becomes increasingly meaningful.
- Discover new knowledge, predict or alert the end-users by combining the data available in fusion data bases and other support databases.
- Control various functionality of the system. For example, Speech Recognition to control the Head Mounted Display (HMD).

Depending on the information needs of the firefighters, Methods and Model Base could include the services of various algorithms such as Kalman Filters, Alpha-beta Filters, Covariance Error Estimation and expert build models such as Computational Fluid Dynamics (CFD) models for propagation of fire or cloud of hazardous gas. In an actual process of implementation of the IS proposed, it is important to select the most appropriate methods and models, or to develop new methods and models capable of addressing the identified needs of firefighter.

Data Management

The Data management service should be able to facilitate access to, and management of, data fusion databases and all other supporting databases. Data management include the services 1) Data retrieval, 2) Storage, 3) Archiving, 3) Compression, 4) Relational queries, and 5) Data protection. The type of data stored in these databases can be dynamic, static or historic. Moreover, these databases are highly distributed and can be located at:

- The incident premises; related to the IBS and the sensor network.
- FRS's control room.
- Data terminals fixed in the incident command vehicle and fire engines.
- Mobile computers deployed in various parts of the incident ground.
- Any other third party databases containing various supporting information such as traffic, weather, hazmat and Human Resource; located at other remote locations away from the incident.

Database management of the proposed IS will be particularly difficult because of the large and varied data managed (i.e., images, signal data, vectors, textural data) and the data rates both for ingestion of incoming sensor data, as well as the need for rapid retrieval (Hall and Llinas, 1997).

Function Modules Layer

By combining various basic services in the immediate lower-level layer, modules in this layer should be capable of carrying out the necessary processing required to produce essential functionality at the HCI layer. This particular layer is a transparent layer to the end-users who interact with the system via the HCI layer. This layer should be able to process data to perform various functions in relation to the information to be delivered. Thus, such processed data embedded with various common functionalities could be presented at the HCI layer according to the unique presentation requirements of the end-users representing various job roles. Having considered the end-user needs related to the information, this study proposes the following modules to carry out the necessary processing of the data before it is presented via various human computer interfaces at the HCI layer.

Physical and Human Resource Management: This particular function module carries out the necessary functions relevant for ordering, monitoring and deploying of both physical and human resources. The physical resources managed by this module range from Dry Welfare Rations, Air Cylinders required for the use of BA Wearers to much bigger installations such as high volume water pumps and decontamination units. Human resources managed by this module primarily include the officers directly belonging to the FRS and who work in designations ranging from the ranks of firefighters, safety officers and chief fire officer of a brigade to regional chief fire officers of the FRS. Apart from managing human resources directly belonging to FRS, this module should also be able to coordinate the human resources from other organizations such as Police, Ambulance Service attending at the incident premise. It should also look after the functions necessary for the welfare and relief of firefighters operating at various jobs. Resource related monitoring should include the functions necessary to locate and monitor the status of various physical resources belonging to the FRS, incident premises and other third party such as water suppliers.

Sector and Cordon Management: This function module should be able to carry out the necessary functions relevant to create, change and remove the sectors and cordons in and outside the incident premise.

Hierarchy and Job Management: This particular functional module should be able to carry out the necessary functions to build and continuously maintain the incident hierarchy. This module is directly responsible for the creation and management of jobs at different levels of the hierarchy.

Location Tracking and Navigation Management: This module should be able to look after the functions relevant to real-time movement of people, including casualty located in an around the incident ground. Furthermore, it should look after the function of navigation of firefighters. In addition to humans, this module should look after real-time location tracking and routing of various vehicles belonging to the FRS. This module should also be responsible for the location tracking of various assets belonging to an incident premise. This could include assets such as artefacts and valuables in a heritage site or LPG and Acetylene Cylinders in an industrial site.

Context Monitoring: This functional module should look after the functions necessary to monitor the location, movement, spread and levels of various contextual risks and hazards in an around the incident dynamically. In addition, this module should carry out the functions necessary to monitor other contextual conditions such as weather and traffic. This module should also be capable of carrying out necessary functions to monitor the operating conditions and functionality of various equipment, installations and infrastructure located in and out around the vicinity of the incident premise.

In addition to the main function modules, there can be several other secondary modules such as Geographical, Data Input Support, Alarm/Alert/Message Generation and Report/Log. Importantly, both primary and secondary functional modules either directly support the end-users with the necessary processing or support them indirectly by improving the processing capability of other functional modules. For example, the end-user request related to monitoring of the spread of a chemical plume around the incident building may need the processed output of both the function modules *context monitoring* and *map module*. Similarly, *Sector and Cordon management* module may always need the support of the sub function module *Data input* to carry out the sectorisation requests of end-users received via the HCI layer. These examples indicate that while it is important to have communication with the components of the HCI layer it is equally important to arrange all the main and sub function modules in such a way that each module can communicate with any other main or sub module to entertain the requests generated within the function modules.

Human Computer Interaction (HCI) Layer

This study focuses on the specific needs of the four core job roles of the incident command hierarchy. These four members were selected with the expectation that their needs would represent the needs of the other members of the incident command hierarchy directly or indirectly. Therefore, the HCI layer of the ISA proposed should consist of HCI modules for each of these core firefighter job roles. Module for each job role will comprise of the human computer interfaces (Yang et al., 2009b) implemented with the support of appropriate technology capable of providing necessary human interaction to access each specified interface. In addition to the four main job roles, in actual circumstances it will be important to provide access to the IS for all other remaining members of the IC hierarchy. Therefore, it is essential for HCI layer to carry modules consisting of human computer interfaces suitable of supporting other job roles of the IC hierarchy (Prasanna et al., 2007). All the remaining firefighter job roles can be assumed to fall into any of the above type when designing the HCI Modules.

Depending on the end-user's operational environments and their level of mobility, these interfaces may need to configure to run on different hardware platforms with customized functionalities (Prasanna et al., 2007).

Overall View of the ISA

The Figure 3 shows a graphical illustration of the overall comprehensive architecture of the IS being proposed and summarises all the points made previously.

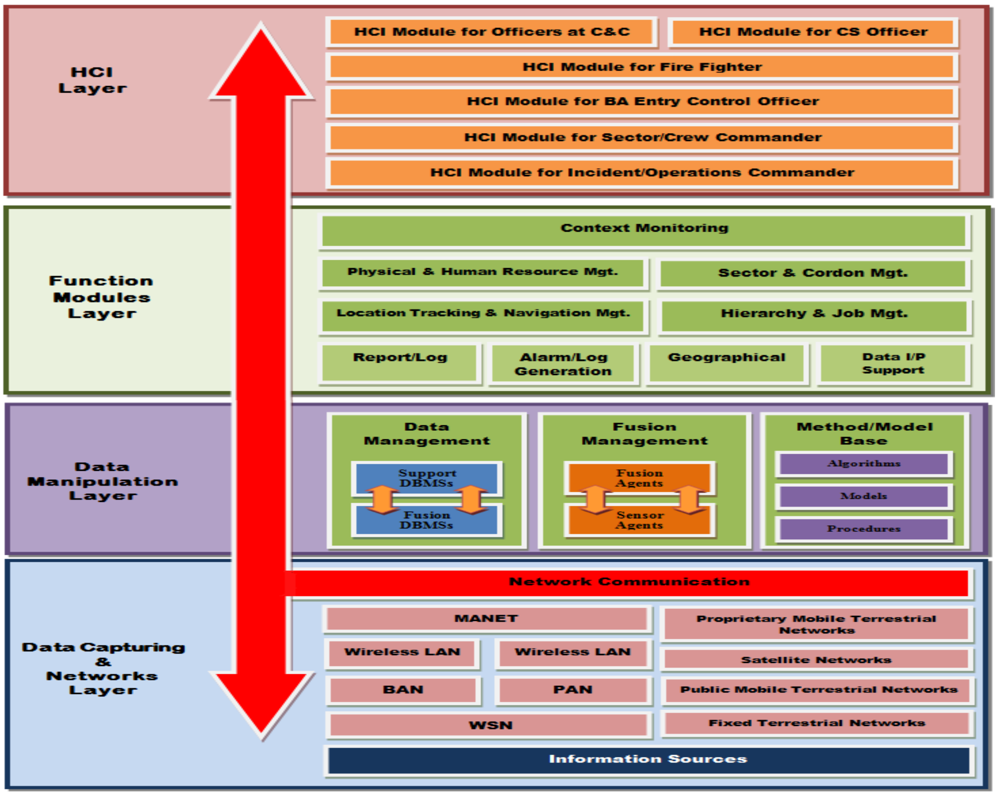

Figure 3: Conceptual ISA for Fire ER Operations

This figure illustrates the components of the architecture presented and explained in the previous sections of the paper. It represents the conceptual architecture of fire ER IS for high-risk built environment fires. As explained earlier, it assumes to correspond to the "Owner's View" of the IS proposed.

Challenges and Recommendations for ISA Implementation

During the initial investigation authors of this paper identified that sensors should be able to capture and transmit various location and contextual information related to the environment and firefighters (Yanining et al., 2010). However, when go through the specifications and characteristics of popular commercial sensors and sensor-based networks, it is evident that their practical application in the context of fire emergency faces some immediate challenges and barriers.

One of the main practical issues of implementing the proposed type of ISA is the cost implications related to pre-installed building sensor networks. Although it is accepted that there is a need of devices such as sensors and Radio Frequency Identification Device (RFID) tags to capture various information, from the FRS point of view, the cost of installation of any such devices should come under the budget of the building or premise owner. However, there is a doubt whether this is viable. On a positive note, there is a possibility that sensors suitable of supporting fire fighters could also provide some useful information to maintain operations related to day to day services of the buildings and building maintenance and therefore, have the potential of becoming a part of the Building Management System (BMS). So these benefits may motivate building owners to bear some cost elements. In addition, most of the firefighters believe that sensor networks may cut down insurance premiums and therefore, could become an attractive option for Owners of the buildings. Currently, there is a trend that insurance companies encourage building owners to enhance the support of state-of-art technologies that could increase the safety levels of buildings during a fire by slashing the insurance premiums by significant percentages. Thus, the implementation of proposed ISA may need the indispensable participation of three major stake holders; that is the FRS, the Owners of the buildings and the insurance companies which provide fire related safety insurance for high-risk buildings.

Although the cost of sensor motes and accessories related to popular Wireless Sensor Network (WSN) platforms based on popular networking protocols such as Zigbee has come down considerably, still its cost is considered to be one of the main barriers to make it an attractive option for the end-user. Impact of the cost implications could be severe when consider the large number of sensor motes required to provide the level of support expected by the firefighters. Therefore, if sensor motes are to become a viable and attractive device in the fire emergency context there is an immediate need of further research to find solutions to reduce their manufacturing costs. The running costs of the sensors could also make WSN an unattractive solution for the clients. Primarily the running cost of sensors is the cost of replacing its power source. This could be a high percentage of the overall cost, when consider the number of sensors required. Currently, this is one of the most active areas in sensor related research. This includes research in energy-scalable algorithms and protocols (Sinha and Chandrakasan, 2001) and alternative power harvesting or scavenging methods (Kompis and Aliwell, 2008) with the support of regenerative sources such as solar power, vibration and wind power to power up the sensors for a longer period. Most of these works are focused on the application domains such as military, aviation, manufacturing and building services (Methley et al., 2008). However, there is very little evidence available whether these researches address the needs of the context discussed in this study.

One other main limitation is the physical size and the weight of the sensor motes. The currently available physical characteristics of most of the sensors could become a major obstacle when consider the application of sensors for the implementation of ISA proposed. When a WSN is attached to the buildings, it can create implications ranging from physical appearance of the buildings to installation of sensors. In addition, when consider the sensors of the Body Area Network (BAN) of the firefighters and deployment of sensors carried by firefighters, there could be serious issues related to the flexibility of handling them. Although this is an active research area, the progress made so far to obtain the support of the sensors in contexts similar to fire emergency is negligible.

Apart from future research to minimize the above limitations, this study proposes to seek the possibility of merging with other low-cost devices and technologies to form more heterogeneous sensor networks rather than depending on a one particular platform. For example, RFID and WSN based on sensor motes are two important wireless technologies that have a wide variety of applications, which provide unlimited future potentials. RFID technology facilitates detection and identification of objects that are not easily detectable or distinguishable by using current sensor technologies (Liu et al., 2008). The size and weight of

RFID tags makes it much easier to handle. In addition, RFID is a very low-cost technology compared to any other ad-hoc sensor mote platforms (Zhang and Wang, 2006). However, it does not provide information about the condition of the objects it detects. In contrast, sensor motes can provide information about the condition of the objects as well as the environment. In addition, operational range of sensor motes is comparatively much bigger than the RFID tags due to its flexible mesh networking ability (Sumi et al, 2009). Hence, integration of these two technologies will expand their overall functionality and capacity. Although RFID is not an actual contextual sensor, it can be proposed to integrate with sensor motes to form a low-cost heterogeneous network. This network will be capable of location tracking and contextual sensing compared to a network, which is exclusively comprised of sensor motes. Hence, from the building owner's point of view, especially for the exclusive purposes of location tracking, the use of RFID could be much cheaper and appropriate compared to a sensor mote. One classical example is to tag artefacts of an art gallery or a museum. Also from the FRS's point of view RFID tags could be much preferred as it is less expensive and easier to handle if firefighters have to carry them. Therefore, it will be very important to consider merging wireless sensors with RFID together in the same network.

Currently, none of the commercially available sensors are capable of withstanding the high temperatures expected in a progressive fire. Hence with current capabilities, firefighters may not benefit from the network for long durations. This will be one of the main challenges faced by the sensor manufacturers in the future. To overcome the above challenges, in relation to this particular study, the following can be proposed to consider as new areas of research.

- Research related to sensor manufacturing is necessary to increase the life time of the sensor motes so that they can withstand much higher temperatures expected in fire grounds.
- Research is necessary to develop algorithms, which are capable of correcting or adjusting the accuracy of the readings of sensors that deteriorate its sensitivity and accuracy due to harsh environments.
- To a certain level, the profile of the sensor deterioration itself can be used as information to indicate the contextual progress. Hence, it will be useful to investigate such concepts to utilize the services of deteriorating sensor motes for longer durations in the contexts of fires.

As well as problems related to operating in the extreme environments, there is also a doubt whether the commercially available sensor devices are capable of providing the level of accuracy expected by the firefighters even when they are operated under the normal circumstances. However, as discovered in the evaluation part of this research the accuracy required for a selected piece of information can vary from job role to job role, incident progress and type of operation. Hence, it is evident that appropriate use of sensors could provide considerable support during a fire emergency with their current level of performance. For example, with the current level of performance, sensors are capable of detecting the start of an actual fire. This is identified as early information vital for the firefighters who are first to arrive at the incident. However, this is not true for all the information needs. For example, the level of accuracy of the outcome of previous research such as "LifeNet" (Klann, 2008), Gambardella et al. (2008) and "CADMS" (Walder et al., 2009) do not meet the level of accuracy expected by the frontline firefighters to navigate them during their operations. Thus, there is a need for further research to improve sensor related algorithms and communication protocols, if they are to reach the accuracy expected for some of the information needs of firefighters.

The selection of Zigbee as a communication protocol is not a surprise or new as some of the previous research such as "Fire" Project (Wilson et al., 2007) recommended the use of Zigbee to form the WSN and even to form the BAN of firefighters. However, the lower data rates of Zigbee based sensor devices may create a bottleneck in forming the BAN of firefighters where it may have to embed with devices such as wireless thermal image cameras or HMDs to display higher amount of graphical data. Data speeds required for these possible wearable audio and visual display components of the BAN may require higher data rates within the BAN as well as communicating with other External Servers. For example, although previous similar research such as the “Fire” project proposed the use of HMDs embedded with the devices supported by Zigbee protocol, it is not clear the amount of graphical data it could handle. The argument is that if this data is to be transmitted from an outside device to the BAN of an individual firefighter then the data rates of Zigbee based devices may not be sufficient. Therefore, it is crucial to find a solution to overcome such constraints. These requirements suggest that some improvements and further research related to the data speed and bandwidth is essential to satisfy the expectations of the end-users. As an initial step towards a solution for Zigbee based networks, this study proposes following options for future consideration.

- Pre-install the relevant map data in a wearable computer attached to the BAN of the moving firefighters and continue with Zigbee to 1) form the BAN communication, 2) communicate with external servers and 3) WSN. Use a protocol such as Bluetooth or Ultra Wide Band (UWB) to communicate between audio, video devices and the Central Processing Unit (CPU) of the Wearable computer if data speed or bandwidth needs to exceed the capabilities of Zigbee. By processing graphical data locally at the BAN, Zigbee capable motes can be used more effectively to capture various contextual information generated within the BAN (Example: Heart rate and Body temperature of a firefighter). In addition, Zigbee enabled CPU of the wearable computer will be able to communicate with computers outside the BAN and the WSN to acquire contextual and location information. In addition, information storage and processing capability of Zigbee motes may also improve the information processing at the CPU of the BAN.
- To have a BAN, working on the Wi-Fi platform with much higher data rates to communicate with the outside servers via pre-installed wireless routers fixed inside the building or located at the bridgehead. High bandwidth Wi-Fi protocol allows dynamically transmitting and receiving graphical and contextual data from the outside servers. Therefore, with this option map data can be installed in a server located outside the BAN rather than installed in a device belongs to the BAN. Similar to the previous option, communication within the BAN can be via either Zigbee or combination of Bluetooth/UWB and Zigbee in combination. However, this particular option brings additional challenges of connectivity. For example, with the incident progress, most of the pre-installed routers may fail due to harsh environments.

Discussion and Concluding Remarks

Inevitably the ISA proposed consists of few components similar to the components of ISAs such as “WORKPAD” (de Leoni et al., 2007) and “MIKoBOS” (Meissner et al., 2006), which are specified for supporting generic ER. However, the ISA proposed in this chapter is much more comprehensive compared to those architectures that could only address several common needs expected during an emergency and different to those ISAs as it consists of components focus on supporting the needs exclusive to the firefighters. Furthermore, the ISA proposed is unique compared to other ISAs such as “FireGrid” ,exclusively supporting fire ER, since it is capable of addressing the needs of different types of firefighters rather than addressing generic needs common to fire ER. The ISA proposed constitutes of some specific components capable of achieving the identified needs of different firefighters that may enhance their SA. It is suggested that the above architectural view is well understood by both the owners of the system as well as the systems architects to use as the basis or foundation in identifying and defining the components of their future ER ISs. Importantly, it provides a common discussion platform for end-users, system architects and designers to understand and improve the essential components of an IS supporting fire ER. It will also act as a conceptual benchmark for both clients and designers 1) to compare a system already available or 2) to develop the most appropriate system. This proposed ISA will become the *blueprint*, especially for the system’s architects to design much more comprehensive and technical architectural views suitable for themselves and the system developers in developing an IS for fire and rescue services.

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ASSESSMENT OF DISPERSION MODELLING AND GIS MAPPING TOOLS TO SUPPORT EMERGENCY RESPONSE OPERATIONS

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GIS, emergency response, consequence modelling, dispersion models, chemical accidents, industrial fires

Abstract

The present study provides a review and an assessment of the strengths and weaknesses of existing approaches of linking (chemical) dispersion models and Geographic Information System (GIS) visualisation tools, in order to provide recommendations to improve such tools in their use in Emergency/Disaster Response situations with chemical accidents. Four different software tools that provide dispersion modelling capabilities in combination with a GIS presentation and analysis module were evaluated. The following tools were assessed: PHAST (by DNV), EFFECTS (by TNO), CAMEO (by the US EPA) and HAZMAT Responder (by SAFER Systems). The evaluation results for three sets of criteria were presented: consequence modelling, GIS application and data linking. As to improve the available tools, recommendations were formulated based on the evaluation.

1. Introduction

In EU countries, large quantities of toxic, flammable or explosive chemicals are processed and stored on chemical sites, or are transported along railroads, highways, pipelines and waterways. Possible incidents, involving the release of hazardous chemicals industrial fires may affect large groups of populations, due to toxic exposure, heat radiation, explosions etc. with deleterious effects for their health. Examples like the Bhopal tragedy where the toxic MIC (MethylIsoCyanide) was released, the Mexico city LPG storage explosions, the Toulouse Ammonium Nitrate explosion, the Seveso TCDD (a dioxin) release and recently the Viareggio LPG train explosion illustrate the devastating effects which can cause total social disruption to a region. Depending on the typical phenomena, which may involve fire/heat radiation effects, overpressure effects, and toxic exposure, the affected zone can be hundreds of meters (direct flame contact and heat radiation damage), to a kilometre (broken windows) or even tens of kilometres (intoxication varying from breathing problems to lethal injuries). Furthermore, the type of incident also determines the time depending behaviour. An explosion has an almost instantaneous character (although a flammable cloud may have been

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created during several minutes), a fire may evolve and create a continuously increasing threat on a scale of hours, whereas toxic releases (affected by wind speed / wind direction and topological circumstances) tend to evolve on a scale of minutes.

Recently in the Netherlands, 2 chemical warehouse fires (Moerdijk, January 2011 and Amsterdam, February 2011) show the large regional impact of accidents with chemicals and the importance of forecasting the dispersion of the toxic clouds.

Having learned from the past, the EU Seveso Directive was developed (1982) and later (1996) adapted to cover lessons from recent accidents and the modern needs of safety management. The Seveso II Directive nowadays provides a solid base for safety regulations, involving obligatory safety reporting (including emergency preparation plans), safety inspections, risk communication, and requirements for land-use planning.

Although member states have adopted and implemented differently and in their own rules, related regulations and standards, every country has experienced clear benefits of the EU Directive. The information that became available (amount and type of chemicals, storage locations etc) has been used extensively by emergency response organisations to prepare themselves for potential accidents with chemicals.

With information technology developing rapidly, new possibilities for adequate response to emergency situations have emerged. For an adequate response to chemical incidents and industrial fires, the modelling of the release needs to provide information about potential damage zones. This information can nowadays be projected in a GIS (Geographic Information System) environment, which enables to visualise the public health threat zones, and inform, alarm or evacuate the population under threat. Furthermore, GIS projections can be used to determine access routes for emergency response, evacuation roads, incident attack locations, possible locations for first aid, safe areas, health care centres etc. This is why predictive modelling needs to be able to present results in a GIS environment.

To this end, in the industrial safety and risk management world, consequence modelling tools are commonly used. Although there are many different suppliers of tools, it appears that only a few of them have a large user-base. Furthermore, some well known dispersion models, such as those used in environmental evaluations (e.g. CERC ADMS), do not provide any "release" or "damage" models and were therefore not selected. On the other hand, CFD based programs, which are also commonly used for dispersion calculations, are currently not applicable because of their complexity and required calculation time.

Within the scope of the study, only a limited number of tools could be evaluated. For that reason, a short list has been selected, based on three important criteria:

1. Customer base: it should be well known in the world of "Emergency Response" and have a recognised customer base.
2. Fit for ER use: it should include all required models (not "just" dispersion), give results on time, provide enough accuracy, be able to provide dynamic development etc.
3. Incorporated GIS functionality: it should contain some basic GIS functionality such as presentation of a cloud on top of a topographic map.

Based on these three criteria, this study will evaluate the following GIS-based consequence prediction models:

1. PHAST, developed by DNV
2. CAMEO, developed by the US EPA
3. EFFECTS, developed by TNO
4. HAZMAT Responder, developed by SAFER Systems

This study aims at investigating the requirements and assessing the current possibilities for predictive modelling of chemical releases, including the presentation in a GIS environment.

To this end, we firstly describe the theory and method that provides the backbone of our benchmark (section 2), including the four GIS tools that assessed (Boot and Sterkenburg, 2010). We applied these four tools to a case study, a chlorine release. The chlorine case study and the application of the four GIS tools are presented in section 3. In section 4, we compare the tools on three major categories, including criteria for consequence modelling, criteria for GIS functionality and criteria for data linking. Conclusions and recommendations are presented in section 5, followed by a brief discussion of current research and research needs in the areas (section 6).

2. Methods

To assess GIS mapping tools for emergency response activities, we need to specify:

- □ The information requirements of fire fighters
- □ The available dispersion and GIS modelling tools
- □ Criteria for the assessment of the tools

<u>2.1 Information requirements of fire fighters</u>

The information requirements heavily depend upon the standard operating procedures of fire fighting teams determined to suppress chemical release accident. In the emergency situation involving the release of a hazardous chemical, a number of important phases and actions can be distinguished. In the Netherlands Rotterdam harbour area, where large chemical sites and transportations routes are present, a standard operating procedure can be split up in several stages (NIFV, 2001).

1. Based on the first report, where the type of accident and class of chemical involved is reported, the “Damage Scenario Guidebook” (Schade Scenario Boek) is used to look up the length and width of a typical cloud footprint.
2. Based on the wind-direction and cloud footprint, a safe angle of approach will be defined for emergency response.
3. As soon as detailed information about the chemical is available, the same guidebook and a more accurate estimation of the source rate are used to determine the area to be evacuated.
4. Furthermore, emergency response (ER) guidebooks/procedural cards/chemical handbooks (possibly digitally available) will give information about the advised response for the specific chemical.
5. The contact with the owner of the installation involved (e.g. chemical companies) is also very important, because these people usually have more experience in handling the chemical.
6. Depending on the extent of the accident, upscaling (calling in higher level emergency response specialists and corresponding neighbouring teams) can take place.
7. Only if the actual chemical and release situation have been positively determined and verified, responders will start to use dispersion modelling (e.g. using EFFECTS) to get more accurate estimates of the concentration footprints. Usually, this is already substantially later (½ – 1 hour) than the first actions.

This short description of typical actions illustrate that currently, the actual dispersion modelling is only used during the last phases of a chemical incident. Note that the templates for cloud footprints for special chemicals have been derived using consequence modelling tools (e.g. EFFECTS). The main reason for late employment is the fact that the (dispersion) models require substantially more (detailed) input. Furthermore, the uncertainty in information about the accident (chemical involved, amount of material leaked, occurring meteorological conditions) also tends to make detailed calculations pointless. Nevertheless, current information technology clearly provides new possibilities for:

- Gathering information (chemical information from databases/books, meteorological data)
- Estimating effects (calculating the footprint for a toxic or flammable cloud)
- Presenting results on a map (geographic presentation of position of a cloud, including layers for population, roads/infrastructure and other impact areas).

To be able to deal with these challenging "chemical" emergency response situations, the use of dedicated consequence assessment modelling software in combination with a GIS presenter would be greatly appreciated by the ER teams.

2.2 Available dispersion and GIS modelling tools

We selected four GIS-based consequence prediction tools:

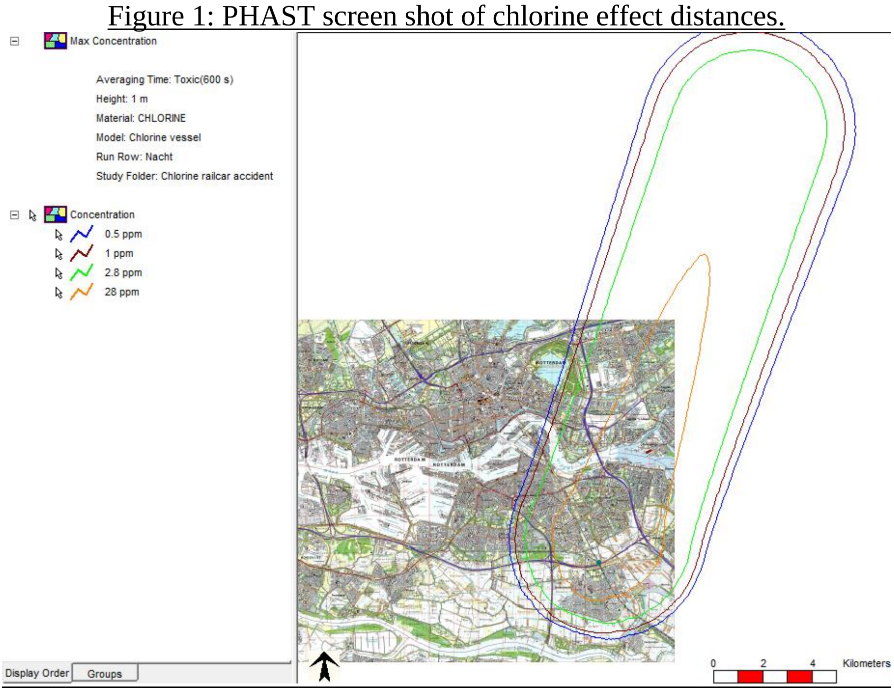
1. PHAST, developed by DNV
2. CAMEO, developed by the US EPA
3. EFFECTS, developed by TNO
4. HAZMAT Responder, developed by SAFER Systems

In the following paragraphs, we provide a short description, including the reasons for selection, of each of these tools.

2.2.1 PHAST (DNV, 2009)

PHAST is one of the most commonly used commercial software tools for consequence modelling. The PHAST software package contains both release and dispersion models and has dedicated damage models for fires and explosions. The dispersion model combines both neutral gas and dense gas dispersion, and is based on a proprietary UDM "Universal Dispersion Model". PHAST is used mainly for assessing consequences of potential hazardous material accident.

Figure 1: PHAST screen shot of chlorine effect distances.



PHAST is delivered with the DIPPR chemical database of 1500 materials, and includes toxic probits, LEL and UEL values, and all temperature dependent physical properties, which are

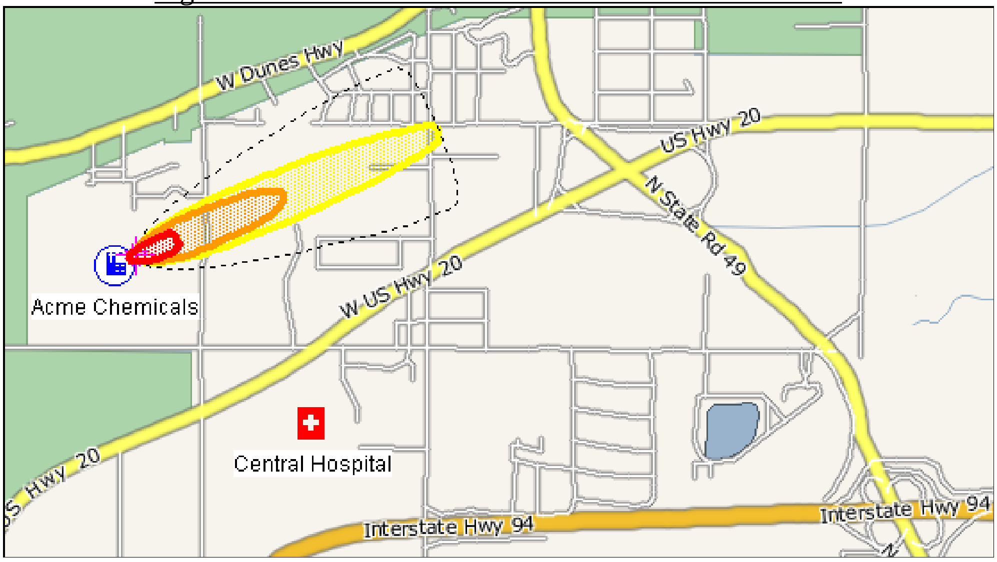
required during calculations. The database includes IDLH thresholds for known chemicals. For the chlorine case, the AEGL-3 is manually entered.
A "map" presentation, illustrating a plume can be exported as an "ESRI Shape file", which enables the possibility to use calculation results in a separate GIS tool. The illustration below shows the 1, 10 and 50% lethality contours for the chlorine railcar accident.
The program also provides the possibility to present "maximum concentration graphs" which can be presented on a map. Another possible visualization is the dynamic concentration mode, where a contour can be shown moving, expanding and shrinking again in time.

2.2.2 CAMEO software suite (EPA, 2009)

The CAMEO software suite is a freeware set of programs distributed by the United States' Environment Protection Agency (US EPA). It is widely used within the US by various environmental agencies for risk evaluation (preparation phase), but also as a tool during emergency response situations. ALOHA is CAMEO's dispersion model which is based on open source dispersion models and includes the DEGADIS dense gas model. CAMEO was selected because of its large user base in the US.
The CAMEO suite consists of four modules: a module that contains the chemical database, a dispersion module, a database application module and a GIS-based integration module. The CAMEO main module integrates the suite into one system. It also contains the CAMEO database application that includes a number of modules (e.g. facilities and contacts) that contain data that can be used and (when applicable) shown on the maps. These database modules clearly distinguish CAMEO from the other tools.

ALOHA, which is the dispersion model, contains models for release and dispersion and has a straightforward simple user interface. The program is clearly based on the US situation, where the location can be picked from a large list of pre-defined American cities. The main result of the ALOHA program consists of (maximum) concentration contours.

Figure 2: ALOHA screen shot of chlorine effect distances.

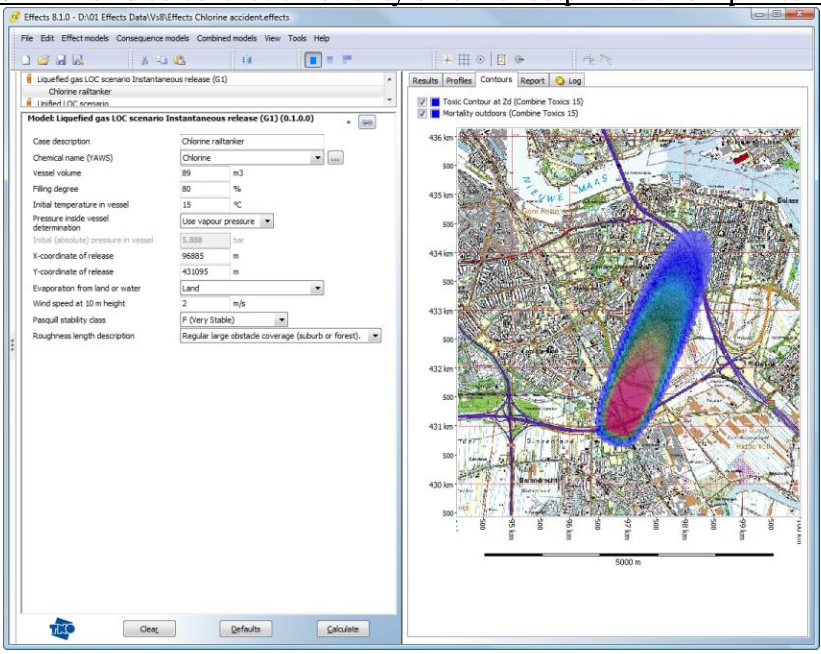


2.2.3 EFFECTS (TNO, 2010)

EFFECTS is a consequence modelling tool developed and distributed by TNO. The program is based on theoretical models described in the "Yellow Book" and "Green Book". These two books are official publications of TNO written after a request of the Dutch Committee for the Prevention of Disasters. It is used for assessing consequences of potential hazardous material accidents and during the suppression of such accidents. TNO EFFECTS is currently used by both the Dutch and Italian regional fire brigades. The typical users in these occasions are officers of dangerous substances of the emergency response teams. For dense gas dispersion, EFFECTS uses the open source SLAB model, from the US Lawrence Livermore National Laboratory. EFFECTS was selected because it is already used by some regional fire brigades and there is feedback information regarding its use.

EFFECTS is TNO's tool for consequence analysis of accidental releases of hazardous materials. The software contains a large number of different calculation models like release models, dispersion models and damage models. The software comes with a complete chemical database (DIPPR database), containing toxicity and flammability values and all thermodynamic properties, as functions of temperature or pressure. An integrated material editor allows the definition of user defined chemicals.
Although all models can be accessed separately, EFFECTS has advanced capabilities to chain models. This enables the possibility to automatically perform all relevant calculations for a given 'loss of containment' scenario (all relevant models, from release through pool formation, evaporation, vapour dispersion and damage will be performed automatically).

Figure 3: EFFECTS screenshot of lethality chlorine footprint with simplified input set.



2.2.4 HAZMAT Responder (Safer systems, 2009)

HAZMAT Responder is an ER dedicated commercial tool distributed by SAFER Systems (previously part of Dupont Safety division). The program is dedicated to ER situations to assess consequences of hazardous material releases and is used by several Civil Defense/Fire fighters organisations (Le Havre Metropolitan Area, Port of Los Angeles, Province of Alberta, Las Vegas Police Dep.) and environmental institutes (Austrian Institute for Meteorology and Geodynamics, Chlorine Institute USA and NASA).
A major difference with other tools is that it incorporates direct feed-back from sensors (concentration samplers and meteorological sensors). These sensors can be mobile (to be placed by ER teams) or fixed in case of an onsite application. This feedback allows an estimation of the source terms (location of release and initial conditions) and therefore a better modelling of the behaviour of the dispersed chemical, the path of the plume and concentration calculations.

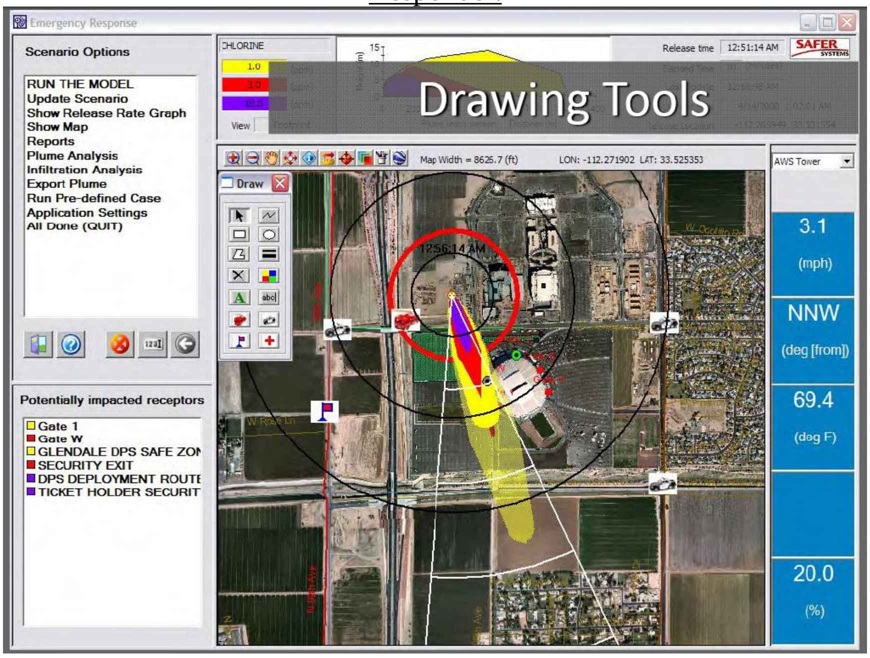
HAZMAT Responder is SAFER Systems’ tool for emergency response. Although it contains all release, dispersion and damage models for fire and explosions that are also available in “TRACE” (the SAFER Systems consequence tool comparable to PHAST and EFFECTS) it

has evolved beyond consequence modelling and includes features that were specifically designed for use during the (emergency) response phase.
First of all, HAZMAT Responder has the capability to include "real time" measurements, both for gas concentrations and meteorological sensors. The meteorological data can come from an internet source ("WeatherBug"), but the tool is also designed to use one or several mobile (or fixed site) meteorological stations.
By using this real time meteorological data the path of the cloud is continuously adapted. Even if nothing more than the release location is known, the system will start plotting a 'corridor' where any material will likely be taken by the wind.

Secondly, HAZMAT Responder already contains important GIS functionalities:

- Chemical sites, installations, storage locations or potential sources of dangerous chemicals can be predefined, including coordinates/chemical/amount, and be used as predefined scenarios.
- Various map layers, such as roads, inhabited areas, hospitals, schools, ER stations are supported. They can be loaded from SHP file and point locations that are under the impact area and are automatically illustrated in the main screen. Selecting such a point reveals information like phone numbers or any information associated with the point.
- Drawing tools can be used to illustrate the current location of ER attack teams, observers' posts, roadblocks, evacuated areas etc.

Figure 4: Screen shot of chlorine effect distance and drawing possibilities in HAZMAT Responder.



2.3 Criteria for the assessment of the tools

The combination of dispersion modelling and GIS mapping requires criteria for consequence assessment, GIS functionality and data linking. The **consequence assessment** criteria focus at the source term of the spill, the properties of released hazardous materials, the affected area and meteorological data. The **GIS functionality** evaluation criteria focus at incorporating geographic details and visualisation of the assessment results on a map. The **data linking** evaluation criteria focus at data connections and input possibilities. A list of the evaluation criteria is presented in appendix 1.

3. Case study

In order to be able to compare the behaviour of the different modelling/GIS tools, a rather serious and complicated accident scenario has been defined. The case study scenario involves a large instantaneous (catastrophic rupture) release of chlorine from a rail tank wagon from a location on a transport route nearby a populated area.

This scenario was chosen because the accurate modelling of the physical phenomena (which involves instantaneous flash, pool formation and evaporation and heavy gas dispersion) is far from trivial. Chlorine is transported as a pressurised liquefied material, and upon release, part of the material will flash immediately, whereas a secondary source of material evaporates gradually. Gravity forces will enhance the dispersion of this heavy aerosol gas mixture. The toxic nature of Chlorine will have serious effects, even at larger distances.

The location where the release takes place is a rail track between Rotterdam and Barendrecht (a small city situated south east of Rotterdam, The Netherlands). The fact that this is the exact location of a "near chemical accident" which happened in September 2009 isn't a coincidence; it is merely an illustration of how much chemical transports may interfere with populated areas. With a south-south-westerly wind, the chlorine vapour will drift towards a nearby business park and some residential areas.

Table 1: Details (input parameters for the models) for the case study

Parameter	Value
Chemical	Chlorine
Type of release	Instantaneous
Total mass released	100 t (89 m^3)
Storage temperature	15 °C
Storage pressure	5.8 bar
Co-ordinates of release	(on rail track in The Netherlands)
Atmospheric stability	Very stable (F)
Ambient temperature	9 °C
Wind speed at 10 m height	2 m/s
Ambient relative humidity	83 %
Wind direction	SSW

One should note that, for safety reasons, systematic chlorine rail transports no longer take place in the Netherlands. To this end, a chlorine production facility was relocated from the Northern part of the country to the Rotterdam harbour. In other EU countries however, chlorine is still transported along railroads. For chlorine, the AEGL-1 (Non-disabling) concentration for 30 minutes is 0.5 ppm (1.5 mg/m3). The AEGL-2 (=disabling) concentration is 2.8 ppm (8.1 mg/m3), and the lethal AEGL-3 threshold concentration is 28 ppm (81 mg/m3).

4. Results

The four models were compared on consequence modelling criteria (table 4.2), GIS criteria (table 4.3) and criteria for data linking (tables 4.4 and 4.5).

Table 2: Dispersion modeling criteria

Dispersion modeling criteria	PHAST	EFFECTS	CAMEO/ ALOHA	HAZMAT Responder
What information does the model produce?				
Max. concentration grids/contours	Yes	No	No	Yes
Max. concentration profiles	No	Yes	No	No
Dose grids/contours	Yes	Yes	No	No
Dose profiles	Yes	Yes	No	No
Concentration contours at time t	Yes[3]	Yes	No	Yes[3]
Concentration profiles (vs. distance and vs. time)	Yes	Yes	Yes[4]	No
Lethality grids/contours	Yes	Yes	No	No
Contours at specific levels of interest: AEGL levels; ERPG levels; LD (01/50/99)	LD	LD	AEGL	ERPG
Confidence limits	No	No	Yes	No
Does the model perform source term estimation?	Yes	Yes	Yes	Yes
total outflow rate	Yes	Yes	Yes	Yes
pool evaporation rate	Yes	Yes	Yes	Yes
liquid fraction	Yes	Yes	Yes	Yes
rainout fraction	Yes	Yes	No	Yes
Does the model combine instantaneous and continuous vapor source	Yes	Yes	No	Yes
Does it have a probit model	Yes	Yes	No	No
Database with chemical substance properties	> 1500 (DIPPR)	> 1500 (DIPPR)	ca. 1000	> 700
physical properties constants + temperature functions	24 + 10	29 + 14	12	14
toxicological properties[5]	ERPG	3	13	ERPG, IDLH
Does it use terrain influence (complex terrain; obstacles; roughness)	No/No/Yes	No/No/Yes	No/No/Yes	Yes/No/Yes
Can this input data be retrieved from the GIS?	No	No	No	Yes/No/Yes[6]
Method used to present "time depending" contours	Dynamic presentation	Contours at Time T	N/A	Real time + Predicted at 5 min interval

From table 2 we conclude that the added value for emergency responders in particularly is offered by the dynamic presentation of the plume development (PHAST and HAZMAT Responder) as well as the terrain influence on the plume dispersion (HAZMAT Responder).

Table 3: Dispersion model test case.

Test case criteria	PHAST	EFFECTS	CAMEO/ ALOHA	HAZMAT Responder
Distances for AEGL3, 30 min, 28 ppm, 81mg /m3	13.3 km	13.3 km	9.3 km	13.9 km
Lethality levels 1% and 50%	3532 m / 2470 m	3541 m / 1925 m	N/A	N/A

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[3] Dynamic presentation
[4] Only versus time, not versus distance
[5] Other toxic properties can be added or can be filled in (ERPG, IDLH, TEEL etc.).
[6] Predefined areas with different roughness lengths can be used

From table 3, we conclude that all models indicate the AEGL distances, where in addition PHAST and EFFECTS present lethality levels.

Table 4: GIS functionality criteria.

GIS functionality criteria	PHAST	EFFECTS	CAMEO/ ALOHA	HAZMAT Responder
Possibilities to export results (grids and contours)	No/Yes	No/Yes	No/No	No/Yes
What are supported file formats (e.g. grid files, shape files, DXF, KML)	SHP only	SHP only	SHP; Text	SHP/KML/direct to Google Earth
Is direct data transfer to GIS tools possible	No	No	No	Yes
What are internal possibility for visualization of GIS sources: Population	SHP only	SHP only	US Maps	Esri Grid + SHP
Industrial sites	SHP only	SHP only	US Maps	SHP import
Transport Routes	SHP only	SHP only	US Maps	SHP layer
Storages	SHP only	SHP only		SHP layer
Facilities for use of background maps	Pixel/DXF/SHP	Pixel/ DXF/SHP	predefined	Pixel/DWG/SHP
Support for population data (in relation to casualty estimation)	No	No	No	No
Support for visualization of locations of hospitals, health centre's etc	No	No	(US only)	Yes: map layer
Support for choice on evacuation routes and ER access routes	No	No	No	Visualization, drawing tools for ER location

From table 4, we conclude that the HAZMAT Responder functionalities provide the most flexibility and usability for the users.

Table 5: Linking Model and GIS with external sources.

Linking of data	PHAST	EFFECTS	CAMEO/ ALOHA	HAZMAT Responder
Information from databases concerning stored chemicals and quantities	No	No	Yes	Yes, as SHP (Predefined scenarios)
Input of meteorological data	User defined	User defined	SAM, via Serial port	Internet/MET sensors/User defined
Input of sensor data: e.g. measured concentrations	No	No	No	Sensors/User defined: ABC

From table 5, we conclude that the plume dispersion prediction based on sensors data is uniqueness offered by HAZMAT Responders.

5. Conclusions and recommendations

All of the evaluated tools provide a certain level of situational awareness with respect to the path of the toxic cloud, the concentrations that will be reached and up to what distance there will be risk for public health.

Having a GIS tool available in combination with well-prepared databases provides good support to determine locations that are 'under threat' and aid in timely warning (and other measures). The presentation of a dispersion cloud, on top of other map layers (population) clearly gives rapid insight into the potential danger of incidents involving hazardous chemicals.
The consequence or dispersion modelling appears to be covered well enough by all evaluated tools. The main differences appear in the field of the GIS functionality. It is obvious that the **HAZMAT Responder** tool has some dedicated ER functionalities that outstands those of **PHAST** and **EFFECTS**. The possibility to directly see the impact areas, to access addresses and phone numbers associated with impact points or shapes on the map, and the possibility to visualise roadblocks, locations of ER teams etc by drawing specific icons on the map clearly increases usability. The **CAMEO** suite is typically designed for the US situation, has a simple user interface, but lacks the possibility to illustrate the time dependent evolution of a dispersion phenomenon.

Since the results in terms of concentration contours of clouds very much depend on the wind-speed and wind-direction, a reliable and simple connection to meteorological data is very important. Currently, only **HAZMAT Responder** offers an automated link to internet based (i.e. Weatherbug) data or dedicated meteorological sensors[7].

In the end, at this moment HAZMAT Responder seems to provide the most advanced features for emergency response purposes to combine predictive hazardous materials dispersion modelling and geographic information presentations.

Based on the evaluation of the tools, and the specific requirements for an ER application it appears that some issues still need further improvement:

Chemical data:
There is no unified method for expressing toxicity of chemicals.

- Non-lethal, long term health effects of chemicals can hardly be quantified.
- For emergency response it is also relevant to be able to predict whether exposed people will still be mobile, and can escape.

Dispersion modelling:

- There is no “unified” or “consensus” model for dispersion.
- Current models don’t take into account that part of the released chemical can be removed from the dispersion source due to photolysis, chemical reactions, gravitational settling or dry deposition.
- In heavy gas situations, the geometries of the surroundings can play an important role. Apart from terrain topology (ditches, river valleys or even mountain slopes) the flow can be obstructed by buildings, equipment etc. State of the art CFD based dispersion models can take geometries into account, but require extensive input and take long calculation times.

Data:

- In reality, the competent authorities have information concerning stored chemicals in databases. Furthermore, this information is included in the emergency plans of the facilities, which are available to Fire Brigade and the First Responders. Although everyone would agree that it is useful to be prepared for potential accidents by collecting data about stored chemicals, amounts and locations, there is no unified method for different countries to gather these datasets.

[7] In the SEVESEO consortium and funded by ESA, similar items have been assessed, however by using satellite functionalities [SEVESEO, 2009].

- Although none of the assessed tools appeared to be able to perform health impact assessment by using calculation results on population data, this is a clear additional possibility of consequence modelling tools in a GIS environment.
- In addition, vulnerability classification of houses to estimate the protective effects of sheltering in-house that clearly depends on the type of housing should be included.
- Further methods to predict the source rate occurring upon a loss of containment need to be developed.
- Finally, decision support on adequate emergency response actions ins needed since depending on the type of chemical and situations, the advice for ER actions may differ (whether to use foam, a water curtain, neutralising agents etc).
- Last but not least currently, none of the software is capable of linking an alarming concentration footprint with the sirens network.

6. Discussion

Aim of this study was the assessment of the strengths and weaknesses of existing approaches of linking (chemical) dispersion models and Geographic Information System tools used in Emergency/Disaster Response situations with chemical incidents. We evaluated four well known, widely used dispersion-GIS tools. Among others, consequence distances were calculated, but the calculations did not take local topography such as height variations and the influence of buildings into account. A very striking result was that 3 out of 4 dispersion models came up with distances to the AEGL3 threshold concentrations that were within 3% of each other (using the same meteorological conditions). Computational fluid dynamics is a promising modelling approach to take care of local topography that might both affect the direction, concentration and speed of the hazardous material dispersion, hence giving more realistic results than in our case study. Still, long computation times and lack of topology data (including local geometries) form a big barrier for applying CFD in emergency response time critical situations.

Currently, TNO, together with the Dutch national weather agency (KNMI) and the Dutch national environmental agency (RIVM) explores the possibilities of applying numerical methods for disaster abatement purposes. Furthermore, this collaboration aims at linking meteorological models that provide time-varying 3D (location and altitude) weather data, with long-range dispersion models, to improve the reliability of concentration predictions in the extended field.

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Appendix 1: Assessment criteria of the GIS mapping tools

<u>*Evaluation criteria of the consequences assessment:*</u>

- *What information does the model produce?*
  - ✓ *Max concentration grids/contours [Yes/No]*
  - ✓ *Max concentration profiles [Yes/No]*
  - ✓ *Dose grids/contours [Yes/No]*
  - ✓ *Dose profiles [Yes/No]*
  - ✓ *Concentration contours [Yes/No]*
  - ✓ *Concentration profiles (vs. distance and vs. time) [Yes/No]*
  - ✓ *Lethality grids/contours [Yes/No]*
  - ✓ *Contours at specific levels of interest [Yes/No]*
  - ✓ *Confidence limits [Yes/No]*
- *Does the model perform source term estimation?[Yes/No]*
- *Which distinguished source rates are presented?*
  - ✓ *total outflow rate [Yes/No]*
  - ✓ *pool evaporation rate [Yes/No]*
  - ✓ *liquid fraction [Yes/No]*
  - ✓ *rainout fraction [Yes/No]*
- *Does the model combine instantaneous and continuous vapour source? [Yes/No]*
- *Does it have a probit model? [Yes/No]*
- *How comprehensive is the database with chemical properties?*
  - ✓ *number of substances*
  - ✓ *number of physical properties*
  - ✓ *which toxicological properties are available [AEGL-1, -2, -3; IDLH; LD01, LD50, Toxic probits]*
- *Does it use terrain influence (complex terrain; obstacles; roughness)?*
- *Can this terrain input data be retrieved from the GIS? [Yes/No]*
- *Which method is used to present "time depending" contours? [Dynamic presentation/Single contours at specified time]*.

Although the study did not provide any quantitative judgement on correctness of results, a number of result values, calculated for the case study, were reported:

- ✓ *Distances for AEGL 3 (lethal) concentration, 30 min exposure,*
- ✓ *Lethal dose distances for 1% and 50% lethality (if available).*

<u>*Evaluation criteria of GIS functionality:*</u>

- *What are the possibilities to export contours in standardised GIS formats (grids and contours)?*
  - ✓ *What are supported file formats (e.g. grid files, shape files, DXF, KML,)?*
  - ✓ *Is direct data transfer to GIS tools possible?*
- *What are internal possibilities for visualisation and import of data from GIS sources, concerning industrial sites / transport routes / storages?*
  - ✓ *Facilities for use of background map*
  - ✓ *Support for population data (in relation to casualty estimation)*
  - ✓ *Support for visualisation of locations of hospitals, health centre's etc.*
  - ✓ *Support for choice on evacuation routes and ER access routes.*

<u>*Evaluation criteria of data linking:*</u>

- *What is the Information from databases concerning stored chemicals and quantities?*
  - ✓ *Support for visualisation of locations of hospitals, health centre's etc.*
  - ✓ *Input of meteorological data (manual/online)*
  - ✓ *Information distribution of population (governmental data sources)*
  - ✓ *Input of sensor data: e.g. measured concentrations.*

INFORISX: INFORMATION WEBSITE ON THE SEISMIC RISK IN ROMANIA

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Keywords

Seismic risk, information system, seismic awareness, seismicity of Romania

Abstract

In a seismically prone country like Romania, where perceptible ground motions occur frequently enough to maintain a permanent awareness of seismic risk in the population, providing correct and systematic information in the field through the most efficient communication channels is a key issue in the mitigation of the potential earthquake effects. According to recent statistics, the Internet ranks third in Romania, with 30%, after television and radio broadcasts, on the list of the media channels used by the public for information. Records of the access to the specialized seismology websites in the country or abroad show that earthquakes and related matters are a constant concern of Romanian Internet users. However, citizens are interested not just by seismic events in themselves, but also by aspects like earthquake prediction, recurrence and mitigation and, in a very large measure, by the earthquake resistance of buildings. The INFORISX website was created in response to these questions and concerns, aiming to provide scientifically rigorous and comprehensive information, contributed by professionals in the field. The favourable feedback received from the users of the INFORISX website, since its launch in 2007, encouraged the authors to plan further developments and updates of its contents.

Introduction

The seismicity of Romania is generated mainly by the Vrancea subcrustal source, but also by a number of other crustal sources that produced together, over time, several destructive seismic events. According to data available from the National Institute for Earth Physics (INFP, 2011), only during the 20th century Romania has experienced 32 earthquakes with a moment magnitude $M_w \geq 6$, originating from the Vrancea source. Perceptible ground motions occur frequently enough to maintain a permanent awareness of seismic risk in the population,

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especially in the regions outside the Carpathian bend, which include the capital city, Bucharest, with a population of about 2 million inhabitants. Consequently, the request of information in the field stays at high levels. The exponential growth of the number of Internet users in Romania in the last decade (35.5% in 2010, from 3.6% in 2000 (Internet World Stats, 2011)) has designated the global network as one of the most efficient channels for seismic information dissemination. However, the information on seismic risk in Romania, that was available on the Internet, did not share the same growing rate. It is significant to mention the situation that occurred after the $M_w = 6$ Vrancea earthquake of October 27, 2004 when, in search of information about the event, Romanian users produced a dramatic increase of web traffic on the site of the European-Mediterranean Seismological Centre, EMSC (CSEM-EMSC, 2006), in the hours and days that followed the event. The situation perpetuated in 2005, when other smaller Vrancea seismic events occurred, such that, according to the same reference, the geographical repartition of Eastern-European end-users showed that 80.4% were from Romania.

It is significant to notice that the interest of the public was focused not only on the seismic event in itself, as probably a small numbers of the above mentioned visitors of the EMSC site were familiarized with seismology-specific terms, but also on aspects as: earthquake resistance of existing building stock in Romania, possibility of predicting Vrancea earthquakes, pre- and post-earthquake measures for seismic protection etc. The information available from other sources, such as television/radio broadcasts or newspapers, was often imprecise, incomplete or sensationalist. Several letters with questions concerning these aspects, asked by citizens, were received at INCERC. Under those circumstances, the necessity of an online project for providing citizens, authorities and scientists with validated information in the required field became evident.

Thesis

Apart from the intrinsic necessity of the development of an online information system concerning seismic risk and mitigation in Romania, some specific features of seismicity and population exposure pleaded additionally in favour of the project.

Due to the fact that, in Romania, strong crustal earthquakes occur at large intervals, at present about 50% of the exposed population did not witness such events and, consequently, does not have an experience of protection and behaviour. Statistical data show that about 35% of the total population of the country, percent which includes over 66% of the urban population, is exposed to Vrancea earthquakes.

By corroborating data in the seismic macrozonation standard of Romania (ASRO, 1993) and census data on the spatial distribution of the population, it can be concluded that, from the point of view of seismic risk exposure (and by considering only the risk due to the Vrancea earthquakes) the following distribution exists:

- In the zone of seismic intensity 7_1 – 14.77% of the population (27.5% of the urban population)
- In the zone of seismic intensity 8_1 – 19.07% of the population (34.73% of the urban population)
- In the zone of seismic intensity 8_2 – 1.37% of the population (2.5% of the urban population)
- In the zone of seismic intensity 9_2 - 0.0096% of the population (1.75% of the urban population).

The above figures show the significant exposure of the population of Romania to the effects of strong earthquakes, as well as the massive proportion of the population which does not have the experience of living through an earthquake. Consequently, this points out the urgency of developing efficient means for informing and educating the citizens about seismic risk, given the key role of preparedness and prevention in the mitigation of earthquake effects.

Given the dynamics of the number of Internet users in Romania, the use of the global network as dissemination channel was deemed as the most adequate for the scopes of the project. Among the advantages of this solution, as compared, for instance, to television and radio programs, can be mentioned the persistence of the information in written form, as well as its easy retrieval when needed.

The INFORISX website (INFORISX, 2007), was created in the framework of a project financed by the Romanian Ministry of Transports, Constructions and Tourism (MTCT, 2006), currently the Ministry of Regional Development and Tourism, MDRT. The project team included members from the Earthquake Engineering Division of INCERC, the National Institute for Building Research (currently INCERC Bucharest Branch of the National Research and Development Institute in Construction, Urban Planning and Sustainable Spatial Development URBAN-INCERC) and from the Technical University of Civil Engineering Bucharest. The project was launched in 2006 and completed in 2007, when the INFORISX website was published online.

Application

The materials used for the INFORISX website are compiled and provided by the project team members. When necessary, documents include the appropriate references. Given the profile of the target users of the website, presently only Romanian language is used.

The website is organized in three main sections: “About Earthquakes”, “Seismic Data” and “Seismic Protection”.

Fig. 1. INFORISX: A page in the section “About Earthquakes”

The first section, “About Earthquakes” (Fig. 1), presents, in four subsections, basic aspects on seismic hazard, the seismicity of Romania, seismic design codes and seismic microzonation.

This section aims to clarify some key aspects about earthquakes, with a particular focus on those issues that were observed as being presented imprecisely or erroneously in the mass media. The section is contributed by the faculty members of the project team.

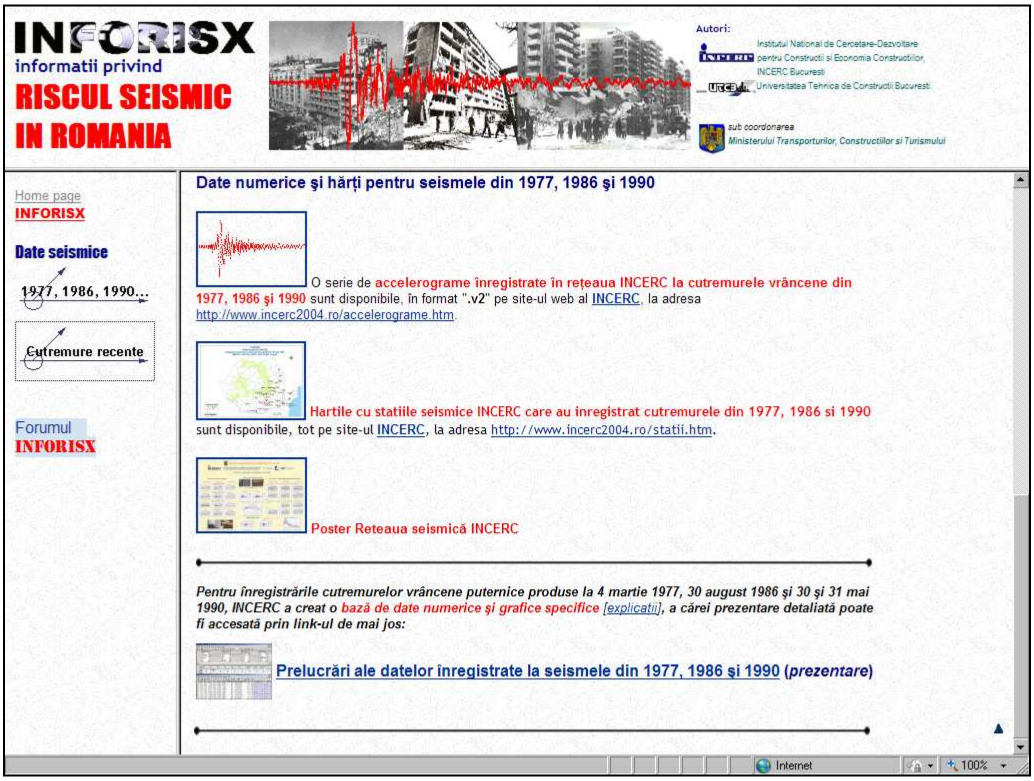
The “Seismic Hazard” subsection makes a brief presentation of the seismic phenomenon and of its causes and explains, at the same time, some notions which are frequently used for describing earthquakes, as focus, focal depth, epicentral distance etc. The classification of earthquakes according to their focal depths is given, as well as some basic notions concerning seismic hazard and seismic risk, factors which influence ground motion characteristics etc. The MSK-64 seismic intensity scale is provided for reference.

The subsection “Seismicity of Romania” presents the main seismic sources that affect the country, with particular attention to the Vrancea subcrustal source. Brief information on the destructive Vrancea earthquakes of 1977 and 1940 is provided. Additionally, two earthquake catalogues are included, one with the strong seismic events of the 20th century (with $M_{G\text{-}R} \geq 6.0$ or $M_s \geq 6.0$) and the other with historical earthquakes with intensity greater than 9 on the MSK-64 scale (the Radu catalogue).

The subsection “Seismic Design Codes” provides information on the evolution of seismic design codes in Romania, from the provisional instructions issued in 1941 to the present codes.

The subsection “Seismic Macrozonation” contains the list of successive standards concerning the macrozonation of Romania. The evolution of macrozonation is traced back to 1952, the year of the enforcement of the first regulation in the field. For each standard, microzonation maps are available.

Fig. 2. INFORISX: A page in the section “Seismic Data”



The second section, “Seismic Data” (Fig. 2), contributed by the INCERC Bucharest members of the project team, contains scientific information and data on the strongest earthquakes that occurred in Romania starting from 1977, i.e. on the earthquakes of March 4, 1977 (M_w=7.4), August 30, 1986 (M_w=7.1), May 30, 1990 (M_w=6.9) and May 31, 1990 (M_w=6.4). The section provides several links to the INCERC website, where seismic data, maps and information on seismic networks in Romania are available. A presentation of the strong ground motion database of INCERC, including processed data, as well as response spectra, is also given in this section. The subsection also provides numerical data, information and maps for a number of more recent seismic records from significant earthquakes with $M_w \geq 5$, including the earthquake of October 27, 2004 ($M_w = 6$).

Fig. 3. INFORISX: A page in the section "Seismic Protection"

The third subsection, "Seismic Protection" (Fig. 3), contains an important amount of information dedicated to citizens, authorities and media. Different aspects of seismic protection are discussed, including responses to frequently asked questions. The subsection, contributed by Dr. Emil Sever Georgescu, is divided into five chapters, according to the target audiences.

The first chapter, consisting in several web pages, is dedicated to the seismic protection of dwellings and provides information of general audience. The chapter contains answers to questions that are frequently asked by citizens. These include tips for seismic preparedness, advice concerning the behaviour during and after the earthquake, information on earthquake-caused post-traumatic syndromes, information on the seismic vulnerability of buildings in Romania, types of earthquake effects and destructions, Romanian legislation on seismic assessment and rehabilitation of buildings etc.

The second chapter addresses seismic protection in large indoor spaces (auditoriums, theatres, exhibitions, stadiums, restaurants etc.). The chapter references the Romanian legislation in the field and provides recommendations for seismic preparedness measures to be taken by the owners, managers and administrative personnel of the concerned spaces. Recommendations are formulated according to the categories of buildings/structures, with focus on the categories that are most frequently used in Romania. Also, recommended egress measures are listed. The final part of the chapter provides basic notions on the psychology and sociology of masses, applicable to the reaction of large groups of persons in case of earthquake. Some examples are given, concerning the behaviour, during the earthquake of March 4, 1977, of a number of significant buildings with large indoor spaces (in Bucharest: Romanian Athenaeum, Romanian Opera, National Theatre; in Iassy: the Philharmonic Hall, other important buildings in various cities in Romania).

The third, fourth and fifth chapters of the subsection address the seismic protection of:

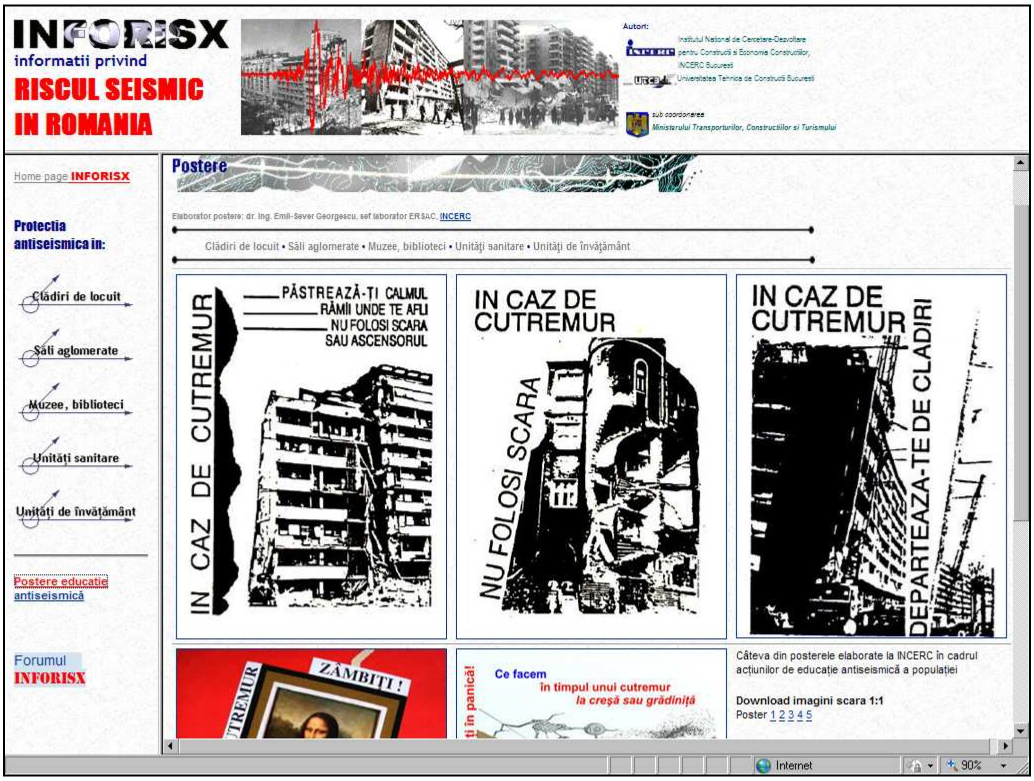
- Museums, libraries and other buildings that store heritage artefacts
- Medical facilities
- Educational facilities (kindergartens, schools, colleges, universities etc.).

The content of these chapters references specific Romanian regulations in the field (some of those were developed by the author of the section, Dr. Georgescu) and also provides guidance for managers and administrative personnel, concerning the appropriate preparedness measures, the behaviour during and after the earthquake, as well as some examples from past experience with similar buildings.

Four brochures, developed by Dr. Georgescu in collaboration with specialists from the Romanian Ministry of Education and aimed for instructional use in primary, middle and high schools, are available as free downloadable resources in this section.

Additionally, a collection of printable posters (Fig. 4) on seismic education, contributed by the author of the section, is available for download from the INFORISX website.

Fig. 4. INFORISX: Downloadable posters in the section "Seismic Protection"



In order to facilitate user feedback, the INFORISX website also provides a discussion forum, moderated by the members of the project team.

Findings and Discussion

The INFORISX project makes available online an important amount of information, issued from authoritative sources and structured systematically, in order that it addresses the needs of the different categories of users: citizens, mass-media, professionals, authorities etc. The content includes basic information, educational resources and scientific data. The website integrates also a discussion forum, moderated by members of the project team.

Since the launching of the INFORISX website, two seismic events with magnitude greater than 5 generated media debates over the seismic risk and seismic safety of the building stock in Romania. One event occurred in Vrancea on April 25, 2009 and the other, on August 5, 2009, had the epicentre located in the Black Sea, near cape Shabla, Bulgaria. Both earthquakes were felt in Bucharest and alarmed the population, even if they did not cause any destruction. Following the events, catastrophic and confusing information was spread by mass media, especially by some large audience television channels. These channels announced much greater magnitude values, pretended having news about serious damage caused by earthquake and even showed pictures of collapsed buildings from the 1977 earthquake, without tagging them visibly as archive pictures.

Another subject that constantly re-appears in the Romanian mass-media concerns the catastrophic earthquake predictions of a bunch of so-called clairvoyants. Even if all their predictions have failed, any statement made by these persons is largely broadcast, presumably in the hope of obtaining higher audience ratings.

It must be noticed that the public has gradually learned to ignore such type of information, after repeated situations in which it proved untrue. However, as the pressure of the events tends to diminish the time or the ability to discern, the penetration of sensationalist news still remains at high figures, especially after the occurrence of perceptible earthquakes.

During the last few years, a number of private or individual initiatives have lead to the creation of various sites discussing, among others, aspects of seismic risk in Romania. These sites, most of them structured either as forums or as blogs, are developed by enthusiasts, non-specialists, as a reaction to the confusing way the mass media is dealing with seismic issues. The fact that they are citing the INFORISX website as a reliable resource of information in the field is a subject of satisfaction for the authors.

The information in the site is easy to find, as INFORISX is indexed by the major search engines; for instance, a Google search with the words “riscul seismic” (“seismic risk”), performed in March 2011, has ranked the site the second in the list of results.

The number of visitors of the INFORISX website increases significantly after each important seismic event in Romania or abroad; the recent catastrophic earthquakes of Haiti, Chile, New Zealand and Japan, largely commented in mass media, have also contributed in maintaining the traffic on the site.

The feedback received by the authors since INFORISX was first published online, as well as the evolutions that occurred both in the knowledge in the field and in the information presentation techniques, suggested various possible developments and improvements of the website. Consequently, future work is planned, including a bilingual version (Romanian/English), which would ensure a larger audience for the included resources.

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NATIONAL CENTRE FOR SEISMIC RISK REDUCTION AND JAPAN INTERNATIONAL COOPERATION AGENCY TECHNICAL COOPERATION PROJECT IN ROMANIA

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Abstract

Seismic risk reduction can be achieved through several types of actions from which the major ones are (i) seismic vulnerability assessment, (ii) seismic rehabilitation of existing buildings and modern earthquake-resistant design for new buildings, (iii) increased number of recorded strong ground motions in conjunction with accurate soil characterization, and (iv) education and information of citizens. In this respect, a great support for Romanian efforts for seismic risk reduction came through a Japan International Cooperation Agency (JICA) project in Romania, implemented by the National Centre for Seismic Risk Reduction (NCSRR) in the period of 2002-2008. The Project and NCSRR's activities are described in the present paper.

Keywords: Romania, NCSRR, JICA, project, seismic risk reduction

Introduction

The Ministry of Regional Development and Tourism in Romania (MDRT) is currently developing 3 main programs for seismic risk reduction in Romania:

- Program for the retrofitting of multi-storey residential buildings – Romanian Government is currently supporting from public funds the retrofitting of multi-storey seismic vulnerable residential buildings, irrespective of the ownership type;
- High emergency retrofitting program for public interest buildings – this program addresses to the high importance buildings, historical monuments, etc. The retrofitting of these structures is supported by MDRT;
- Program for risk mitigation and preparedness for natural disaster co-financed by Word Bank and International Bank for Reconstruction and Development.

As a result of the seismic evaluation in Bucharest (as for 2010), 392 residential buildings were ranked as seismic risk class I (on a scale from I to IV), and MDRT decided to retrofit them with high priority.

Based on the first program 15 buildings have been retrofitted, 6 are under retrofitting work and for 19 buildings the retrofitting work is being prepared to start the works. Moreover, design for seismic retrofitting is ready to start or undergoing for 23 buildings.

The World Bank program for seismic risk reduction worth of 73.7 mil USD (from which 56.9 mil USD are to be paid by International Bank for Reconstruction and Development and 16.8 by Romanian Government and co-financed by the owners with 108 mil USD) will lead to the retrofitting of 8 public buildings of high importance. 17 buildings are under retrofitting and 18 buildings will follow.

Moreover, MDRT is paying efforts towards the revision of seismic design, evaluation and retrofitting codes and of guidelines for quick inspection of damaged buildings after the

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earthquake. At central governmental level a comprehensive risk management program is under development. This comprises all kind of hazards: natural hazards, industrial hazards, pollution etc. MDRT is coordinating the cell of the Commission for Emergency Management handling the earthquake related hazards. MDRT is constantly supporting the management and development of the engineering seismic networks within it's specialized subordinated institutions.

While the public authorities are responsible for issuing modern regulations, implementing the effective construction quality control system and easy access of owners to the technical and legal tools, the research institutes and universities are called to play the major role in seismic risk mitigation by extensive research and education of practitioners and general public.

In this respect, a great support for Romanian efforts for seismic risk reduction came through a Japan International Cooperation Agency (JICA) project in Romania, implemented by the National Centre for Seismic Risk Reduction (NCSRR) in the period of 2002-2008. The Project and NCSRR's activities are described in the present paper.

National Center for Seismic Risk Reduction

Since modern or/and cost time-effective retrofitting strategies and techniques were not fully available to Romanian structural engineers, at the initiative of Technical University of Civil Engineering Bucharest (UTCB), the Romanian Government requested in 1998 to the Japanese Government (Japan International Cooperation Agency, JICA) to begin a technical cooperation on the seismic risk reduction focused on the improvement of retrofitting techniques. Extensive negotiations started and several Japanese investigation teams visited Romania. Also, from 2000 a long-term Japanese expert was dispatched at UTCB for supporting the construction of the cooperation Project.

After four years of intensive efforts the Project Design Matrix (PDM) was defined and agreed, and on August 1, 2002, the Record of Discussions (RD) was signed between MDRT of Romania and JICA. The JICA Project started on October 1st, 2002 with NCSRR as the implementing agency. The initial planned duration of the Project was five years, but after Romanian side request, an extra half-year was accepted, and the Project ended on 31 March 2008.

According to the RD of the JICA Project the purpose was "Improving and dissemination of the technologies for reducing building collapse in case of devastating earthquakes are achieved". The target of the Project were the Romanian citizens, in particular those in Bucharest. All along the project was carried out a sustained activity of dissemination to the Romanian civil engineers of modern techniques and methodologies, and seminars for disaster prevention education were held for citizens.

The implementing agency of the JICA Technical Cooperation Project on the Reduction of Seismic Risk for Buildings and Structures was the National Centre for Seismic Risk Reduction (NCSRR) as a public institution of national interest, a specialized legal entity created in 2002, subordinated to the MDRT of Romania. The main activities of the NCSRR are as follows:

- Studying, evaluating, applying and disseminating new technologies for retrofitting the earthquake vulnerable buildings and structures;
- Supporting the revision of codes and regulations for earthquake resistant design, seismic evaluation and retrofitting;
- Seismic instrumentation (with focus on Bucharest) and soil testing;
- Transfer of state-of-the-art knowledge in the domain of earthquake engineering to specialists through the organization of seminars, symposiums and conferences;
- Issuing documentation regarding education of the population for preventing the seismic consequences;
- Improvement of technical knowledge by training, studies and documentation, seminars, courses and lectures in Romania and abroad;
- Promotion of the international cooperation in the domain of seismic risk management;
- Publishing papers, studies and publications in the field of earthquake engineering;

- Other activities related to national and international projects.

The activities of NCSRR were carried out in partnership with Technical University of Civil Engineering Bucharest (UTCB) and National Institute for Research and Development in Construction and Construction Economics (INCERC) Bucharest. The main Japanese research institutions that supported JICA were the Building Research Institute (BRI) and the National Institute for Land and Infrastructure Management (NILIM).

During the JICA Project period, twenty nine (29) Romanian researchers/engineers were trained in Japan, seven (7) Japanese long-term experts and thirty seven (37) Japanese short-term experts were dispatched to Romania. Within the Project, equipments for seismic instrumentation, for soil investigation and soil testing, and for seismic testing of structural elements rising up approximately 2.2 million USD were donated by JICA to Romania, through NCSRR. The total JICA financed Project cost was 7 million USD.

The activities of the NCSRR were carried out in four divisions, namely:
- Division 1 - Building Retrofitting and Design Codes
- Division 2 - Seismic Observation Network
- Division 3 – Technical Experimentation for Soil and Structures
- Division 4 – Dissemination of Knowledge and Training of Engineers.

NCSRR experimental research on structural elements

The main purpose of the structural testing conducted at NCSRR was to try to identify the behavior of structural members designed according to the Romanian state of practice at different periods of time. This objective implies the identification of the failure pattern and the evaluation of the parameters that can describe in a favorable manner the member's behavior (e.g. for reinforced concrete members: yielding force and displacement, displacement ductility, ultimate bending force, ultimate shear capacity, etc.). While some of these parameters can be reliably evaluated by analytical means, other can only be identified by experimental research. For example, the analytical procedures available for the evaluation of the shear capacity of reinforced concrete elements are calibrated to be used in the design of new structural system, therefore these procedures offer conservative values of the capacity. These values cannot be used to reliably identify the capacity of the structural system although they are perfectly suited for the checking of the performance objectives criteria. Moreover, worldwide-developed capacity assessment or design equations can be used only after a reliable confirmation by structural testing in a particular country. The suitability of each relation strongly depends on the state of practice in each country given not only the traditional construction materials and techniques but also quality of workmanship.

Therefore, structural testing is an essential tool in the process of issuing or revising design, evaluation and retrofitting codes. The experimental testing was developed as key component of the seismic risk reduction in Romania within the JICA technical cooperation project.

The structural testing facility consists of a steel reaction frame, loading control device, data acquisition and processing systems. The reaction frame is similar to the one existing at Building Research Institute, Tsukuba, Japan. The maximum weight of tested specimens is 70kN and the maximum dimensions of the specimens are 2.5m by 3.0 m.

The following load combinations are possible with this provided equipment: bending with shear force for beam testing; bending with shear and axial force for column, shear wall and portal frame; bending and shear tests for frame joints; shear test for slabs.

This structural testing facility, worthy of approximately 1 million US$, was donated by JICA to the NCSRR and installed in March/April 2004 at the NCSRR UTCB site, Bucharest Figure 1.

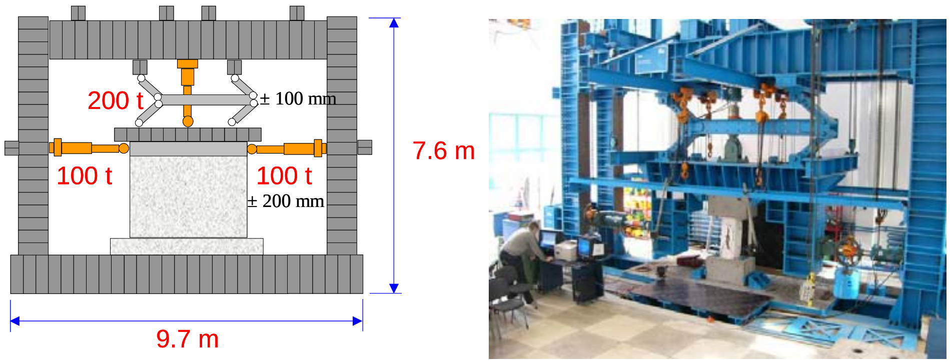

Figure 1. Overall dimensions, force and stroke capacities of reaction frame loading system

The number of tested specimens since 2004 is presented in Table 1. At the beginning, the testing effort concentrated on vulnerable concrete elements designed and detailed according to the state of practice in Romania at the middle of the 20th century. Subsequently, masonry walls, RC slabs, and steel braces were tested.

Table 1. Current status of structural tests

Structural element	Number of tested specimens since 2004
RC columns	22
RC walls	5
Masonry walls	45
Steel braces	3
Energy dissipation device	1
RC slabs	14

Strong ground motion observation and soil investigation

The main objectives of NCSRR activities for seismic strong motion observation and soil testing are:

- Seismic strong ground motion data collection (in free field and boreholes);
- Seismic strong motion data collection in buildings to study buildings behavior;
- Revision of strong ground motion design parameters and developing new models for strong ground motion studies;
- Ground condition characterization (especially at seismic station sites) through site investigation and laboratory soil testing.

The equipment for strong ground motion observation, NCSRR staff installed soil testing and investigation donated from JICA in 2003 with technical support from Japanese experts and technicians from OYO Seismic Instrumentation Corp. dispatched in Romania especially for this purpose. Starting from 2005 NCSRR network was enlarged with Romanian investment (within the budget ensured by MDRT), other sites and buildings being instrumented with Geosig equipments and technical support. Nowadays NCSRR digital network consists of 40 accelerometers (6 ETNA, 11 K2, 10 IA-1, 3 GSR), 34 under exploitation and 6 under installation.

<u>Free-field seismic stations for ground motion attenuation analysis</u>

Six Kinemetrics ETNA stations were installed in 2003 on the SW direction starting from Vrancea epicentral area toward Bucharest, for ground motion attenuation analysis. All of them are in buildings with 1 or 2 storeys, which can be considered as a free field condition. Ground conditions are under investigation. One Geosig IA-1 accelerometer was installed in 2007, on a perpendicular axis to the SW, direction that will be further instrumented.

Seismic stations for site effects assessment in Bucharest

NCSRR installed in 2003 in Bucharest seven (7) Kinemetrics K2 stations with sensors at ground surface (close to free-field conditions) and in boreholes at two levels of depth: the first level at about 30m depth and the second level between 52m and 153m depth. In 2005 another site in Bucharest was instrumented with Geosig equipments (free-field and a 30m depth borehole). At all the stations the soil profile of the boreholes is known, and NCSRR and Tokyo Soil Corp. (Japan) performed down-hole tests. A brief description of the borehole instrumentation is given in Table 2.

Table 2. NCSRR Seismic Network – free field and borehole instrumentation in Bucharest

No.	Site	Surface sensors location	Shallow borehole depth	Deep borehole depth	Type of instruments
1	UTCB Tei/NCSRR	free field	-28	-78	*K2/FBA-23DH*
2	UTCB Pache	1 storey building	-28	-66	*K2/FBA-23DH*
3	INCERC/NCSRR	1 storey building	-24	-153	*K2/FBA-23DH*
4	Civil Protection Hdq.	1 storey building	-28	-68	*K2/FBA-23DH*
5	Filantropia Hospital	free field	-28	-151	*K2/FBA-23DH*
6	City Hall	free field	-28	-52	*K2/FBA-23DH*
7	Municipal Hospital	free field	-30	-70	*K2/FBA-23DH*
8	UTCB Plevnei	free field	-30	-	*GSR24/ AC23-DH*

Seismic stations for structural monitoring

Two residential buildings and two public buildings were instrumented in 2003 with Kinemetrics instruments. In 2006 the Technical University of Civil Engineering Bucharest UTCB main building and in 2008-2009 the Faculty of Civil Engineering Brasov were instrumented with Geosig instruments. All sensors are tri-axial acceleration sensors, their orientation follows the transversal and longitudinal directions of the buildings. In the case of Kinemetrics instrumentation, all sensors are connected to one K2 acquisitions station that also has an internal sensor. In case of Geosig instrumentation are used two acquisition stations with internal sensors. The building instrumentation is described in Table 3.

Table 3. NCSRR Seismic Network – Building instrumentation

No.	Site	Station(s) location	Sensor 1	Sensor 2	Sensor 3	Type of instruments
1	Stefan cel Mare 1	10th floor (base)	10th floor (top)	4th floor	basement	*K2/Episensor ES-T*
2	Stefan cel Mare 2	basement	7th floor (top)	Free field	-	*K2/Episensor ES-T*
3	*TVR* Tower	13th floor (base)	13th floor (top)	basement	-	*K2/Episensor ES-T*
4	*BRD-GSG* Tower	19th floor	3rd basement	-	-	*K2/Episensor ES-T*
5	Faculty of Civil Engineering, Bucharest	3rd floor (top) & basement	-	-	-	*IA-1*
6	Faculty of Civil Engineering, Brasov	8th floor top & basement	-	-	-	*IA-1*

Since its installation in 2003, the NCSRR network recorded almost 200 seismic motions from over 30 earthquakes (from Vrancea subcrustal and crustal seismic sources, and also from Bulgaria and North Dobrogea shallow sources) with moment magnitudes ranging from Mw=3.2 to 6.0. The October 27, 2004 Vrancea earthquake (Mw=6.0, focal depth 98.6km) is the strongest recorded until now by the NCSRR seismic network and is the strongest event since 1990. The earthquake was felt on large areas but produced almost no damage (as reported by news agencies). In Figure 2 are presented examples of ground motions recorded during the October 27, 2004 earthquake.

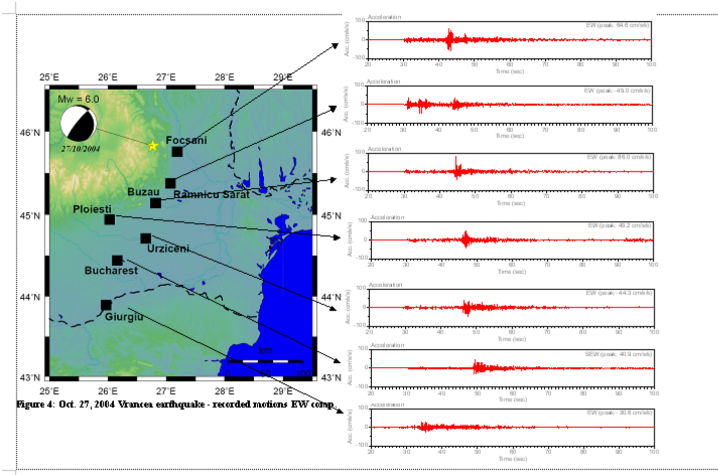

Figure 2. Seismic records obtained in NCSRR network during Vrancea earthquake of October 27, 2004

Microtremor observation is another activity developed within the Project by Division 2. Portable acquisition stations and sensors were also donated by JICA. Microtremors were measured on buildings and on ground (single-station of array measurements) for the identification of building dynamic characteristics, for the evaluation of site response characteristics and for identification of seismic velocity profiles.

Until today the following measurements were performed:
- Single station measurements of ground ambient vibrations – 19 locations
- Array measurements of ground ambient vibrations – 5 locations
- Measurements of building ambient vibrations – 7 buildings.

A joint activity of Divisions 2 and 3 is the borehole geophysical investigation (PS-logging tests) for identification of seismic velocities at different sites. The equipments were also donated by JICA. Until today, more than 30 PS logging tests were performed.

Soil investigation

In 2003, NCSRR received, as a donation from JICA, the drilling equipment FRASTE Type Multidrill XL, Figure 3, which has as attachments an automatic device used for Standard Penetration Test. In July 2004, NCSRR received as donation from JICA a CPT equipment from Geomil, Holland. In July 2003 the triaxial equipment manufactured, Figure 4, by Seiken Inc. Japan and donated by JICA was installed at NCSRR. The equipment fulfils all the requirements of the Japanese Geotechnical Society, 2000.

Researches of the dynamic characteristics of soil have been carried out using laboratory soil testing and in situ tests, including geophysical methods. Using the equipments donated within the Project, Division 3 performed the following activities:
- Drilling boreholes – 17
- CPT tests – 5
- SPT tests – 35
- Surface wave tests – 6
- Dynamic triaxial tests – 43
- Static triaxial tests – 45
- Bender element tests – 15.

Figure 3. Drilling equipment on truck

Figure 4. Dynamic triaxial equipment

NCSRR activities for dissemination and education of citizens and engineers

Seminars for engineers, inhabitants of vulnerable residential buildings and students were organized by NCSRR in cooperation with MDRT and Bucharest City Hall Office. The total number of seminars amounted at 32, out of which 4 were for citizens, 7 for students and 21 for engineers. The importance of preparedness for the next big earthquakes such as adequate behavior in the earthquake and seismic evaluation and retrofitting of the vulnerable buildings were emphasized in these seminars.

Seminars for engineers are organized by NCSRR in cooperation with UTCB and INCERC. Lecturers in these seminars are Japanese experts and the staff of NCSRR. The Project contributed in the preparation of a series of educational leaflets to instruct disaster preparedness for school children as shown in Figure 5.

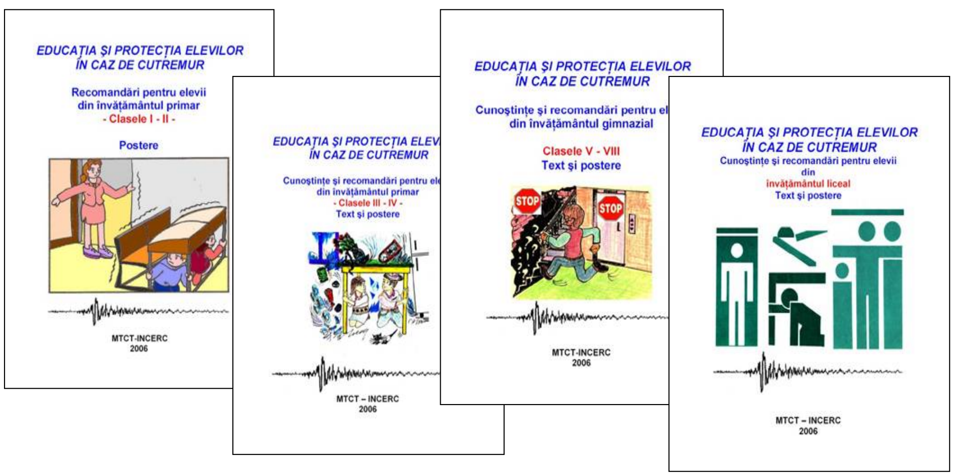

Figure 5. Manuals on disaster preparedness for school children

For efficient information of the students and engineers regarding the implementation of retrofitting works, a full-scale model of one story frame was constructed at UTCB. Using this frame, Figure 6, various retrofitting techniques were applied: concrete infill wall, steel brace, steel jacketing, fiber carbon jacketing for columns and beams.

<u>Earthquake engineering international conferences in Romania with JICA support</u>

The International JICA Seminar "Earthquake hazard and Countermeasures for Existing Fragile Buildings" was organized at UTCB in 2000. The event was entirely supported by JICA. The International Conference ELERR "Earthquake Loss Estimation and Risk Reduction" was organized at the Romanian Academy in 2002. The event was jointly supported by JICA and by two other international research projects (SFB 461 and RISK-UE).

Figure 6. Model frame with retrofitting solutions

The ISSRR2007 "International Symposium on Seismic Risk Reduction, The JICA Technical Cooperation Project in Romania" was organized at the Romanian Academy in 2007. The event was entirely supported by JICA and sponsors, and was attended by 188 peoples from 13 countries.

On the occasion of these events, the following publications were issued:
- Earthquake hazard and Countermeasures for Existing Fragile Buildings, 2001. Contributions from JICA International Seminar, Bucharest, Romania, November 23-24, 2000, Lungu, D., Saito, T. (Ed.), Independent Film, Bucharest, 315 p;
- Proceedings of the International Conference "Earthquake Loss Estimation and Risk Reduction", Lungu, D., Wenzel, F., Mouroux, P., Tojo, I., (Ed.), 366p + 421p;
- Proceedings of the International Symposium on Seismic Risk Reduction. The JICA Technical Cooperation Project in Romania, Ed. Orizonturi Universitare, Timisoara, 753p.

Within the JICA Technical Cooperation Project for Seismic Risk Reduction, NCSRR and JICA organized in the period July 25 – July 27, 2007 a Training Program on Seismic Risk Reduction. Ten engineers from universities and design offices participated in the program. The topics of the lectures covered the fields of seismic evaluation and retrofitting and geotechnical earthquake engineering.

Conclusions of the final evaluation for the project

According to the evaluation report prepared by the Joint Evaluation Team, the Project has been implemented timely and properly according to the Record of Discussions towards the achievement of the Project Purpose. The Project Purpose and Overall Goal are valid and in line with the policy of MDRT as well as with the principle of Japanese cooperation to Romania.

In the Project, the followings are the most highly rated achievements:
- the first retrofitting design using modern techniques was completed for a soft-story building in Bucharest;
- seminars and meetings with the residents in vulnerable buildings, students and engineers were held frequently, which improved their understanding on the earthquake effects and countermeasures;
- as a result of the cooperation between JICA experts at NCSRR and INCERC, manuals of earthquake education for school students were issued;
- state of the art equipments were provided and are operated properly by Romanian counterparts.

In July 2010 MDRT decided to dismantle the NCSRR as an independent public institution.

About 90% of the NCSRR researchers involved in the JICA Project are presently at UTCB.

Acknowledgment

The people involved in JICA project and NCSRR deeply acknowledge the generous, continuous and long-lasting financial support of JICA during the implementation of the Project. The financial support of MDRT to NCSRR and the technical support of Building Research Institute (BRI), Tsukuba and National Institute for Land and Infrastructure Management (NILIM), Tsukuba, Japan provided to NCSRR staff is gratefully acknowledged. The partnership between NCSRR, UTCB and INCERC for the implementation of the JICA Project is valuated.

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Biography

Dr. Radu Vacareanu is professor of structural reliability and risk analysis at Technical University of Civil Engineering in Bucharest. He got a Ph.D. in Civil Engineering in 1999 from the same University. Dr. Radu Vacareanu served as the Director of the National Center for Seismic Risk Reduction from 2002 to 2008.

CITIZENS EARTHQUAKE PREPAREDNESS IN ROMANIA: TOWARDS A NEW CONCEPTUAL APPROACH FOR A TRAINING PLATFORM AND FACILITY IN URBAN-INCERC

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Key words

Earthquake preparedness, training platform, seismic simulators, Vrancea, Romania

Abstract

The paper presents the new research project of URBAN-INCERC, financed by MDRT-Ministry of Regional Development and Tourism, Bucharest, Romania, aiming to evaluate the feasibility and then to create and operate a center for education, training and public communication concerning safer earthquake behaviour, associated with a special facility – a demonstrative platform. The center will develop and use specific hardware and software, didactic equipment, earthquake simulators and mass-media tools for knowledge transfer. The new approaches take into account the need to use reliable earthquake engineering researchers of URBAN-INCERC, INCERC Bucharest Branch, for training, to identify the gaps in present public information and to cover all age and professional categories of population and public servants, to teach them practical approaches to protect and cope with disasters impact. Some partner laboratories for training are taken into consideration in URBAN-INCERC Branches of Iasi and Timisoara.

Introduction

According to the earthquake zoning maps (Code P100-1/2006), almost the entire territory of Romania is earthquake-prone, and the significant seismic zones include more than 60% of the population. The seismic zones exposed to Vrancea earthquakes, a deep source at the Curvature of Carpathian Mountains, account for more than 50 % and the zones exposed to shallow earthquakes in West (Banat) and North are at risk too. The statistical data on urban population distribution in the seismic zones of the country indicate that about 35% of the population, i.e. more than 66% of the urban population, is exposed to Vrancea earthquakes in urban settlements. Vrancea earthquakes of November 10, 1940 (M_w 7.6-7.7) and March 4, 1977 (M_w 7.5), caused a large number of casualties. Due to the fact that in Romania intermediate depth strong earthquakes hit at long time intervals, more than 50% of the exposed population did not live in the period of occurrence of such events and, consequently,

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has no recent experience in seismic protection and behaviour. In the shallow earthquakes zones, the longer intervals of recurrence indicate that almost 100% of the population has no individual earthquake experience (Georgescu et al, 2004, 2006, 2008).

Thesis

The hazard exposure of Romania and the lack of coping experience of recent generations justifies a new approach to the earthquake education, preparedness, protection of the population and communication in case of earthquake disasters.

The education, training and information on earthquake disaster potential are important factors to mitigate the earthquake effects. Such activities, however, need time to be developed and may take different forms of presentation in order to capture the attention, to increase interest, to develop skills and attitudes in order to induce a proper behaviour towards safety preparedness. Earthquake awareness must be based on motivation, meaning the understanding of cause-effect relationships, associated to the will and means to prevent death, injury and damages. It shall also be based on the accumulation of concerns and knowledge, which are, in principle, a consequence of the motivation, but which depend on the methods applied and actions taken for efficient earthquake preparedness, assessed and updated following actual earthquakes (Midorikawa, Miki and Ohmachi, 1988).

As historical evolution, earthquake vulnerability is in fact constructed in the course of the development of the social and built environment, but public and individual perceptions on seismic risk depend of many factors (Solberg et al, 2010). These authors agreed and cited a study of Paton et al., 2010, stating that „when communal knowledge and resources concerning earthquake preparedness are seen as insufficient, people seek help from powerful and expert sources such as scientists and emergency management organisations", and hence, „collective efficacy in itself has a positive effect on empowerment and empowerment has a positive influence on adjustment intentions, if the experts are trusted". The Romanian authors of the present paper agree this idea, as much as the National Program of Earthquake Education was built independently but on similar premises (Vataman and Georgescu, 1992).

Since 1990, MDRT and URBAN-INCERC (INCERC Bucharest Branch) developed this Program using posters and illustrated folders, booklets for different categories of professions and population at risk (e.g.: citizens in residential buildings), earthquake preparedness manuals (practical guides) for children and school staff, staff of kindergartens and nursery, as well as short documentary films. The dissemination of these materials was for poster in some 40,000 copies, for booklets in 5,000 copies etc. (Georgescu et al, 2004, 2006, 2008). Romanian materials on earthquake education of the population or these of Civil Protection, are a part of the National System for Emergency Situations Management, and MDRT is the main institution in charge for earthquake issues.

A new and important knowledge dissemination programme in schools, with four types of booklets on earthquake education, started in 2007 in partnership with the Ministry of Regional Development and Tourism-URBAN-INCERC, with the Ministry of Education and Research, the Ministry of Administration and Internal Affairs, and some contribution of JICA Experts. All booklets are avilable on INTERNET (Georgescu et al, 2004, 2006, 2008; Stamatiade et al 2005; Georgescu, 2007).

At 20 years from the first release in the National Program, in this process of direct action or empowerment in earthquake information-education, some gaps are easily identifiable:

- although MDRT have financed and developed many earthquake educational materials for the population, the implementation of these materials is a difficult process, and mass-media plays in many cases a negative role, vehiculating mostly catastrophic views;

- the legal basis for recommending information sources for earthquake education of the population, is a duty only for some public institutions, while media convey a lot of alarming yet false information;
- there are no legal provisions on procedures or other ways to inform the public about emergency situations, these only stipulate what institutions are responsible for public information. Reactions of the authorities and professionals are usually only a response to critical events or mass-media warnings;
- there are no specific institutional structures to provide earthquake education as a long term, diversified activity, with financial, material and human resources;
- available resources are not sufficient to disseminate the required amount of educational materials /documentation;
- a relatively low participation of teachers and permanent staff in schools in this process, to explain the scientific and technical issues; a limited knowledge of school students about basic data and some details of the hazards to which they may be exposed;
- some owners that are living in weak and vulnerable buildings are passive in reducing seismic risk; the issue of convincing more owners of Bucharest apartments at risk to sign a contract for strengthening is rather difficult and some Romanian institutions are not fully prepared for the social communication of that kind; some lawyers and court judges are confused in their decisions concerning the balance between private property apartments inviolability and risk reduction needs in condominiums;
- there is missing a specific task for public institutions, to protect their assets and staff, as well as to have a role in communication with citizens.

In order to compensate these gaps, the new concept of our research project (Contract MDRT – INCERC no. 402/2009) is that public policies should generate results at the level of :

- citizens: knowledge and skills for a preventive behaviour, active participation in the prevention and management of the emergency situations at home and within the local communities;
- ministries and central bodies, local and county councils, and city councils, mayors: in the legal framework for emergency management, as empowerment;
- institutions and business operators: prevention and management of emergency situations in their businesses and for their staff;
- National Committee for Emergencies: through inter-sectorial or interdisciplinary actions.

The availability of reliable publications on earthquake protection of the population in the public institutions shall be a part of the communication with the citizens and the mass-media. Every citizen must show that he/she, as an employee or client of a public institution, is aware of the risk he/she is exposed to in case of a major earthquake, being able to answer to a number of questions related to the environment he/she might be at a particular time/ job place (thematic questionnaires). Also for the earthquake protection of the institution, a number of aspects related to the disaster prevention measures, the earthquake response/reaction and recovery measures shall be conceived and solved. There is a need of new brochures, posters, video cassettes and spots including recommendations for earthquake preparedness and behaviour in case of tremor.

There is also a need of a specific facility, a long-run specialized center, endowed with earthquake simulation equipments for quasi-real shaking, experts, dissemination and communication materials, a specific website, booklets and e-questionnaires.

Sources of information

In order to devise a Center for earthquake information, education and training of the citizens, a number of illustrative examples was evaluated (see reference list):

- Advanced earthquake training and information centers, provided with specifically built and equipped rooms, and using automated devices, educational tools, virtual systems and earthquake shaking tables: The "Seismopolis" Center for improvement of behaviour in case of an earthquake (Greece); Center with shaking table (Ankara, Turkey); Civil Earthquake Training Center, Shizuoka Prefecture (Japan); Earthquake Disaster Education, Training and Communication Center, Shinshiro/ Aichi Prefecture (Japan); Training/ Education Center for a Safer Life – Honjo (Tokyo, Japan); Southern California Earthquake Center (USA), etc.

- National programmes and projects for earthquake education and preparedness for disasters: EDURISK Project – EDUcational Itineraries for RISK reduction (Italy); Websismo (Spain); "CD-Rom Nee-Naw and friends: Tinoni & Co" (Portugal); 'Be safe net'/EUR-OPA Major Hazards; EduSeis- European Educational Seismological Project; "What's the Plan, Stan?" (New Zeeland); National Center for Research on Earthquake Engineering (Taiwan), etc.
- Projects including earthquake simulation, independent of the existence of a suitable center: "Earthquake Simulator" (Civil Protection, Italy); Earthquake Awareness Days (Turkey); University Consortium of Instructional Shake Tables (USA); Development of instructional material for structural and soil dynamics experiments, University of Nagoya (Japan);
- The access of school children / students to earthquake engineering laboratories for educational purposes: Multi-disciplinary Earthquake Engineering Research Center, USA, MCEER, Buffalo; Disaster Prevention and Mitigation Research Center – Harbin Institute of Technology – Laboratory of Structures and Earthquake Effects Prevention and Mitigation, People's Republic of China; Faculty of Engineering, New Zeeland.
- Earthquake education exhibitions in museums or at seminars: Human Renovation Museum, Kobe; ShakeZone (California, Kid Zone); Natural History Museum of London; "All Fall Down"- Tutti giù per Terra (Italy) etc.

Each of the presented solutions and documentation centers can be a pattern likely to be adopted. From a financial point of view, the establishment of such a center needs about EUR 1 million (Greece and Turkey) and about EUR 100,000 / year for activity financing (Aytun, 2004; Dandoulaki, 2009; Seismopolis, 2006-2009).

Findings

As basic principles, one takes into account that knowledge can be disseminated through public information, training and education (Erdik, 1992):

- public information - assures the basic awareness for earthquake disaster impact and mitigation, using public communication media, thus acting as an informal vector of education;
- training - presumes a concentrated set of learning activities and objectives, to teach individuals to fulfill specific tasks, using an accepted methodology and available techniques;
- education - represents the most formal and larger approach to learning disaster mitigation, aiming to guide a person towards understanding of the subject up to forming independent opinions, becoming able for setting priorities and knowing relevant methodology.

The new conceptual approach for a public center with demonstrative / training platform as a specialized facility in URBAN-INCERC, INCERC Bucharest Branch, is conceived as a local organizational structure, with suitable spaces and technical equipment and specific operational status in order to fulfil its tasks, a part of the prestigious national research institute, capable to provide reliable knowledge on the seismic risk mitigation measures with its own researchers. The equipment and didactic devices donated by JICA for NCSRR (Georgescu et al, 2002, 2004, 2006) will be used in this framework. The knowledge from Japan will be also useful (Ichimura et al, 2007; Fukuwa et al, 2008). The URBAN-INCERC Branches of Iasi and Timisoara, with their existing laboratories, will be partners. The

INCERC website INFORISX may be extended and associated to this approach (Craifaleanu et al, 2011).

The topical themes shall be based on earthquake education materials, training and education sessions in order to provide:

- A clear understanding of the basic concepts: magnitude, intensity, seismic hazard, vulnerability, risk exposed elements, seismic risk;
- What is reality and what is fiction in earthquake forecasting;
- Importance and ways to mitigate the seismic risk of buildings; Categories of earthquake-endangered buildings – according to available statistical data;
- Visualization and understanding of seismic response and damage of the buildings, with or without strengthening, using data and images of the 1940 and 1977 earthquakes;
- Recommendations for individual and group seismic protection;
- People to be trained to understand the ISDR principle according to which in case of a major seismic event “the citizen is the first rescuer”;
- Enforcement of the legal provisions, liabilities and opportunities resulting from the Ordinance of the Government 20/1994 on the mitigation of the seismic risk of the existing buildings;
- Legal assignments related to the necessity to communicate with the citizens, the deontological principles and the freedom of expression.

The content of the information materials and/or e-learning questionnaires shall comply with that of the materials already approved by the Ministry of Regional Development and Tourism, and with that of the EU requirements (European Parliament Resolution, 2007). It shall be updated in order to cover the experience gained from the recent seismic disasters in Chile, China, New Zeeland and Japan. The Center will combine the training in seminar rooms with e-learning and specialized web sites for children, students, office staff and population.

The partnership between the Ministry of Regional Development and Tourism, with its National Research and Development Institute INCD URBAN-INCERC and the mass-media on mitigation of the seismic risk, may result in a Practical Guide to the earthquake education and training of the citizens by the mass-media, called “S” Files (Earthquake knowledge for the mass-media).

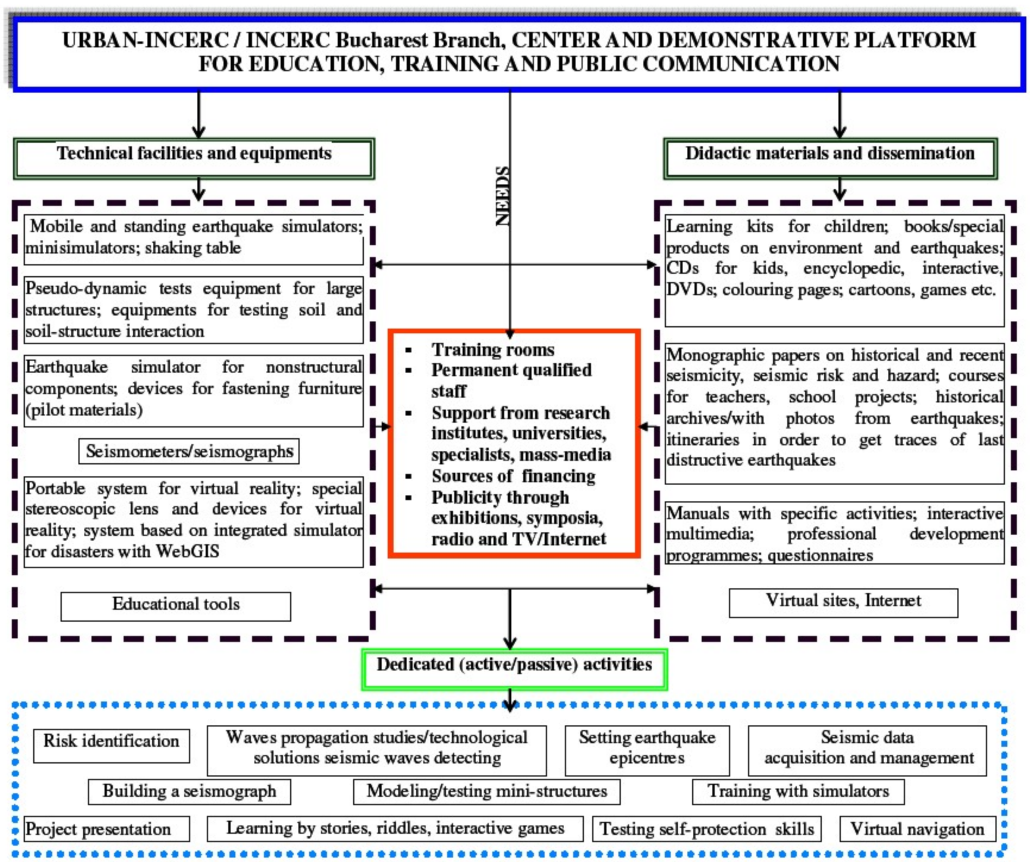
The Center will develop and use specific tools and advanced technology for knowledge transfer:

- presentations and/or on-line training courses or e-learning, with a virtual dialogue, in correlation with the educational level and the psychological profile of various social and professional categories of population – by age, attributions and previous experience;
- e-learning methods – computer technologies including particularly digital technologies, learning techniques where the student uses the computer, and the Internet for a proper development of distance education;
- earthquake simulating software and protective measures against earthquakes - flowcharts and preparing data for the actual development of the software, based on examples from Italy, Greece, Turkey, Portugal, Japan, USA, New Zealand etc. ;
- “earthquake preparedness certificates” for people who, after training courses and e-learning courses, pass the simulation tests, and people developing other activities within the proposed Center;
- the organization of mid-level courses for individuals and/or technical staff – good practice rules concerning self-financed buildings, as well as new construction techniques will be considered as alternatives;
- where appropriate, trainers will be trained to teach volunteers in schools how to explain the protective measures to students; or volunteers, e.g. students, to transfer knowledge to communities;

- communication sessions for public institutions, citizens and the media, will include recommendations and anti-seismic protective measures for public institutions and their staff.

Figure 1 shows the main equipment, information logistics (hardware and software) and possible educational materials, as well as the activities of a center for public information, education and training.

Fig. 1- The public earthquake education, training and information center of URBAN-INCERC, INCERC Bucharest Branch (Contract MDRT – INCERC no. 402/2009)



The demonstration platform for education, training and public communication on public reaction to earthquake includes logistics and adequate spaces for performing tests, demonstrations and simulations. The dynamic simulators must take into account the specificity of local earthquakes, and shall use furnished precincts to allow a visual contact with shaking items. In order to ensure better understanding, model buildings with different scales will be analyzed in terms of structural design methods and seismic response. The space will be organized in such way as to enable people to attend the tests performed on existing structural models. Several existing laboratories could cooperate within the platform.

Discussion

A reasonable public response to strong earthquakes is a must in Romania and the suggested Center may provide a proper preparedness. Seismic simulators and other IT devices will provide attraction. The proposed Center will enhance the responsibility of public authorities, research institutes and professionals in relevant fields of activity, because:

- release of catastrophic data causes serious social anxiety disorder; rumors and false predictions are constantly harming the mind of people;
- professionals acting in the field of earth sciences should cooperate with those involved in earthquake engineering and disaster management to correctly and clearly present the various scenarios to the population;
- for earthquake drills and protective measures, the authorities should only use information consensually validated by professionals acting in the relevant field / interrelated fields.

Correct, continuous and timely information of the population about the situation in affected areas and the interventions, rescue and recovery is a major responsibility of both public institutions and the media. This is in the agreement with the EU Directives on Civil protection and EU Parliament Resolutions about the right to information, education and protection of the population. The press, radio and television should involve, on a long term basis and using specific means, in supplying information about the progress of earthquakes protective systems, education and training of the population to react in a rational way when an earthquake occurs. The knowledge related to earthquake preparedness, individual and group earthquake safety measures may contribute to continuous, clear and accurate information of the population in the aftermath of major seismic events. Apart from the mitigation or prevention of deaths and injuries of the personnel, journalists must be trained to convey information from reliable sources in order to avoid propagation of panic, rumours and disorganization.

Given the area exposed to strong earthquakes in Romania, we believe that the programs and new ways of earthquake awareness and education of people should be a national priority and needs to be supported by a coherent and comprehensive legal framework strongly correlated with, but different from existing laws on civil protection. During the last 15 years, MDRT initiated and supported many specific activities of earthquake education and preparedness, drafting materials for citizens, students, professors etc. and this is a long-term committment, mainly achieved by INCERC and since 2002 with valuable assistance of JICA Experts of NCSRR. However, since generations are changing, there is need of a further and more efficient knowledge transfer about risk mitigation from specialists and authorities to the citizens, public sevants and school students, as well as from EU and countries like Japan, USA, New Zealand to Romania.

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DAMAGE ASSESSMENT OF AFFECTED AREAS USING SATELLITE IMAGERY DURING THE FLOODS IN ROMANIA, JUNE-JULY 2010

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Keywords

Flood, map, satellite imagery, emergency service

Abstract

In June-July 2010, heavy rainfalls flooded large areas in East and North-East Romania. For intervention and monitoring purposes, the Romanian Space Agency activated GMES Emergency Response Service (ERS). Satellite data derived information products were delivered by ZKI DLR (Center for Satellite Based Crisis Information of the German Aerospace Center) in the framework of the GMES Emergency Response project Safer funded by the European Community's Seventh Framework Programme. Using the Flood Masks provided by ZKI-DLR, ROSA together with its partners produced several maps for the affected areas.

This paper presents the methods and the products conceived for damage assessment. Thus, overview maps for large regions, detailed maps for specific affected localities and flood evolution maps were produced. All these products contain quantitative estimators for the affected areas as a function of the land cover categories. The damaged ways of communication were evaluated using high resolution satellite imagery. Furthermore, ROSA used SPOT images, IACS/LPIS data base and Corine Land Cover data base, in order to map and evaluate the damaged areas. All maps were published and made available to the users on ROSA website http://www.rosa.ro.

Introduction

For Europe, floods events are the most frequent natural disasters affecting a large number of people. In 2010, more than 13 countries from all regions of Europe were flooded: France, Poland, Croatia, Bulgaria, Albania, Germany, Romania, Republic of Moldova, Italy and others. Some of these countries were affected by floods twice in the last year (EMERGENCYRESPONSE, 2011). In late June, heavy rainfalls increased the level of some major rivers from North East Romania and caused flooding along their riverbeds. More than 10 persons were reported dead and hundreds had to be evacuated from their houses at that time.

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Due to high impact in terms of both material and human lives loss, the European Community is concerned with the management of floods and other types of natural disasters, as part of civil protection. For more than ten years, the civil protection has been an important issue intensely disputed at European level. It is necessary to involve many types of services and programmes from different domains in order to achieve it. As mentioned above, one of these domains is the management of natural disasters, humanitarian crises and man-made emergency situations.

In (EC, 2007), floods are defined as *natural phenomena which cannot be prevented and which have the potential to cause fatalities, displacement of people and damage to the environment, to severely compromise economic development and to undermine the economic activities of the Community*. The need to achieve a quality management of floods is described in the same directive.

When disaster strikes, rapid access to data for the affected area is very important and it can save lives. Taking into consideration this need, more than 10 years ago, the international community developed an Information Service for Emergency Situations based on Earth Observation and in-situ data, and named International Charter "Space and Major Disasters". This is an agreement signed initially in 1999 by CNES- French Spatial Agency and ESA- European Space Agency and afterwards, by several international institutions and organisations (DisastersCharter, 2011).

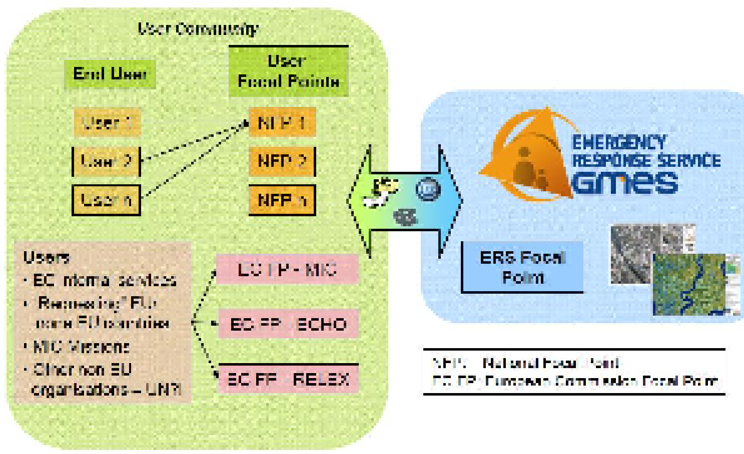
GMES (Global Monitoring for Environment and Security) is a European Space programme led by the European Union and implemented by the European Commission, European Space Agency and the European Environment Agency. Earth observation-based services already existed in Europe before the GMES, but they were dispersed at national or regional level and could not provide a sustainable observation capacity. This was a good reason for Europe to develop a sustained and reliable Earth observation system of its own (GMES, 2011).

The GMES program is governed by a regulation enforced on the 9th of November 2010 and it aims at monitoring and forecasting the state of the environment on land, sea and in the atmosphere, at supporting the security of the citizens and the emergency services. This program has three main components: services component, in-situ component and space component. Services are developed under the coordination of the European Commission and include information services in response to European policy priorities. The in-situ component is coordinated by the European Environment Agency and it integrates national level data, supervised on European level. The space component is coordinated by ESA and includes the sentinel satellites - Earth Observation missions developed especially for the GMES and the other Earth observation contributing missions (ESA, 2011).

In support of citizens' security and emergency services, the GMES initiated a pre-operational service named GMES ERS - Emergency Response Service, a service that can be used in all phases of the emergency situations, with initial focus on rapid assessment of reference information (EMERGENCYRESPONSE, 2011). All the actors involved in the management of natural disasters and emergency situations are gathered in the same place, providing high resolution satellite products in due time (as show in Figure 1). Using Earth Observation information, risks can be analysed faster than using any other method and can meet the need of transparency of transparency which can help engage all interested actors in society expressed in (EC, 2007).

This service is open for many types of disasters, including natural disasters (floods, fires, landslides, storms, earthquakes and volcanic eruptions), technological disasters (oil spills, technical accidents) and humanitarian crises. This is a permanent service available 24/7. This service currently is available in its pre-operational phase through two European projects: SAFER (Services and Applications For Emergency Response) and LinkER (Supporting the implementation of Operational GMES services in Emergency Response). The connection between the users and ERS Focal Point is made by a National Focal Point. The Romanian Space Agency is the National Focal Point for Romania and at the same time it is one of the SAFER partners, a project focused on developing user-friendly space-based geo-information products in order to strengthen European information capacities in response to emergency situations (EMERGENCYRESPONSE, 2011).

Fig 1. Actors involved in disaster management (EMERGENCYRESPONSE, 2011)



After a fruitful collaboration with the International Charter "Space and Major Disasters" in 2005, 2006 and 2008, in 2010, together with the General Inspectorate for Emergency Situations (IGSU), ROSA decided to trigger for the first time the GMES ERS.

Approach

The request for activation was sent the 28th of June 2010 for three initial areas: Botosani, Covasna and Galati. Until the end of the service activation, ROSA's National Focal Point from has been in permanent connection with the ERS contact point, updating the list with the new areas affected by floods. On the 20th of July 2010, ROSA requested the activation of the ERS for the Republic of Moldova because of the Prut River floods that affected both Romania and the Republic of Moldova. The service was active until the 27th of July.

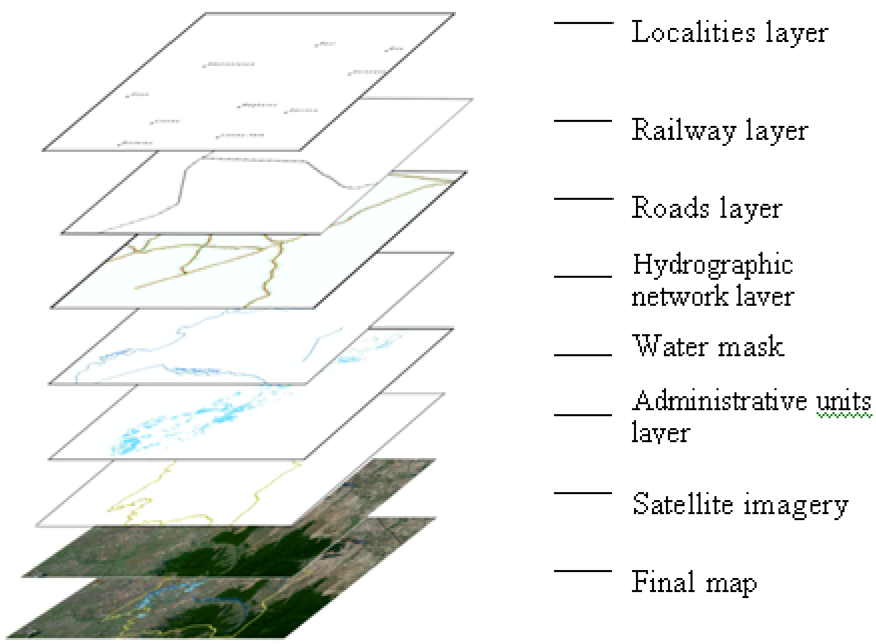
While the floods from 2005 and 2006 were the worst flood events from the last 40 years, the floods in 2010 produced lower material damages but were considered the most extensive floods (Irimescu and all, 2010), affecting 37 counties and 481 localities. The Siret and Prut Rivers produced the largest damages.

In order to monitor the flood, a team of researchers from ROSA, the National Meteorological Administration and the Centre for the Use of Remote Sensing in Agriculture produced different cartographic products including maps at different scales and resolutions, with different purposes. At a national level, these results were included in the SIGUR project (Satellite based Information Service for Emergency Situation Management). This is a project oriented on achieving a national service able to offer products obtained from processed satellite imagery, useful for management of emergency situations. This service was designed to ensure compatibility with the GMES Emergency Response Core Service and delivers basic geoinformation products and emergency products. (ROSA, 2011).

Before providing valuable information, satellite images must pass through several phases: acquisition and reception, processing, analysis and interpretation of final products. Products with hydrological characteristics specific to each phase of the emergency situations management can be obtained by correlation with in-situ data (Vlad and all, 2009). Therefore, for a potential flood area it is necessary to produce an overview map in order to analyze the situation on the ground (dams, railways, roads and other infrastructure elements that can be affected by floods). For this kind of maps pre-event satellite images may be used. If the areas are already affected by floods, pre and post-event data is mandatory for a good analysis.

Figure 2 shows all the layers used for achieving flood maps in June-July in Romania.

Fig 2. Technological process to achieve flood maps



The flood maps production workflow implies the following:

- Satellite images acquisition, download and distribution to the crisis management centres;
- Processing – radiometric and geometric enhancement and geocoding - of satellite imagery
- Integration in existing geospatial information systems and extraction of flooded area as a water mask;

- Intersection of the flooded area with reference data for land cover, data about infrastructure elements (roads, bridges, railways, dams), river layers, localities layers and other data as administrative units (country borders, district borders, commune borders) over a satellite image that can highlight the normal state of the land cover.
- Evaluation and interpretation of results (surfaces of affected areas, infrastructure elements affected)

The water masks made available to the Romanian team in the frame of Safer GMES ERS service were produced by ZKI DLR- Centre for satellite Based Crisis Information, a service of German Remote Sensing Centre (DFD) of DLR. It provides a 24/7 service for the rapid acquisition, processing and analysis of satellite imagery during environmental disasters, for humanitarian crises and civil security issues worldwide. ZKI center produced not only water masks, but also overview maps for the affected areas. These maps can be found on ZKI DLR website (ZKI, 2011). Multiple satellites, such as RADARSAT-2, TerraSAR-X and SPOT-5 were tasked for acquisition.

During the operations in 2010, the damage assessment was made using IACS/LPIS data and Corine Land Cover 2006. Land Parcels Identification System - LPIS is a 1-meter resolution database, permanently updated, used in the frame of Agency for Payments and Intervention for Agriculture (APIA, 2011). Corine Land Cover is the European reference data set for land cover developed and maintained by the European Union in partnership with multiple national and European institutions. Corine Land Cover (CLC) classification system includes 44 distinct classes grouped on 3 hierarchical levels. The first hierarchical level was used for estimating the damages produced by the floods. The minimum mapping unit of CLC is 25 Ha (EEA, 2011).

In flood management, identification, delineation and mapping of affected areas are important activities, Earth observation by remote sensing being an instrument which can reduce the costs of these activities and improve the quality of the management process.

Results

In flood risk management, different types of maps for different phases of the process must be produced. A first type of maps is produced using older (archive) satellite imagery, in order to prevent floods. For the floods in June-July in Romania, this type of maps was requested for some areas which could be affected by floods by the public authorities. These maps are produced in order to further allow the integration of the affected area in the region and detailed maps for localities or other settlements or strategic objectives as dams, roads or bridges. Another type of maps is produced for showing flood evolution.

Such map examples are given in the figures below. Siret River recorded one of the highest water flow levels in history and flooded localities and regions in its neighbourhood. Figure 3 represents an overview map for Siretu-Galbeni sector from Bacau County.

The flood extent data can further be used during the prevention phase for identifying and evaluating the flood risk as calibration data for the simulation models.

A third type of maps that can be produced is showing the affected types of land and infrastructure. During the floods in 2010, affected areas were evaluated using CLC 2006.

Fig 3. Overview map, Siretu-Galbeni, Bacău County

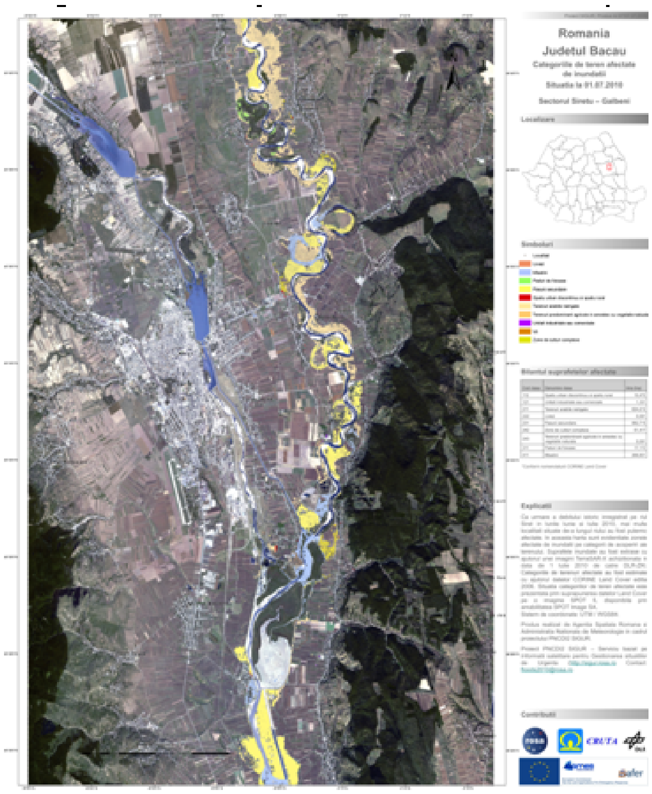
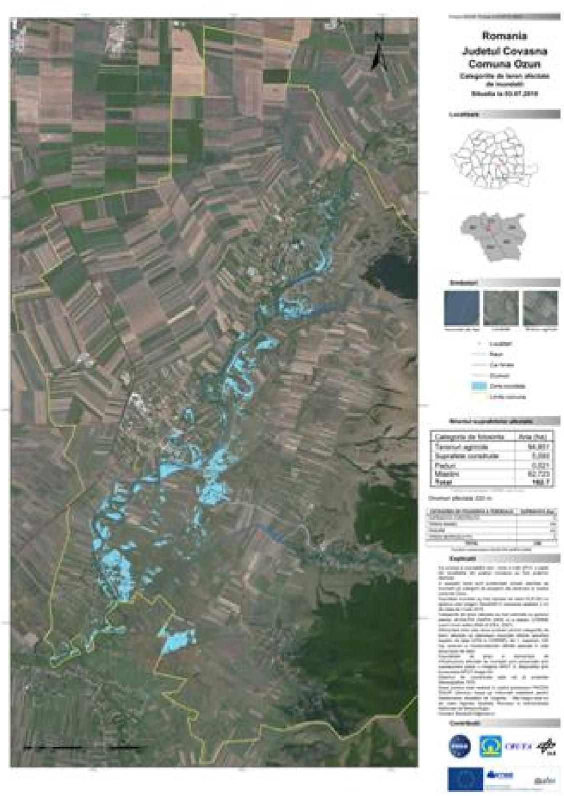
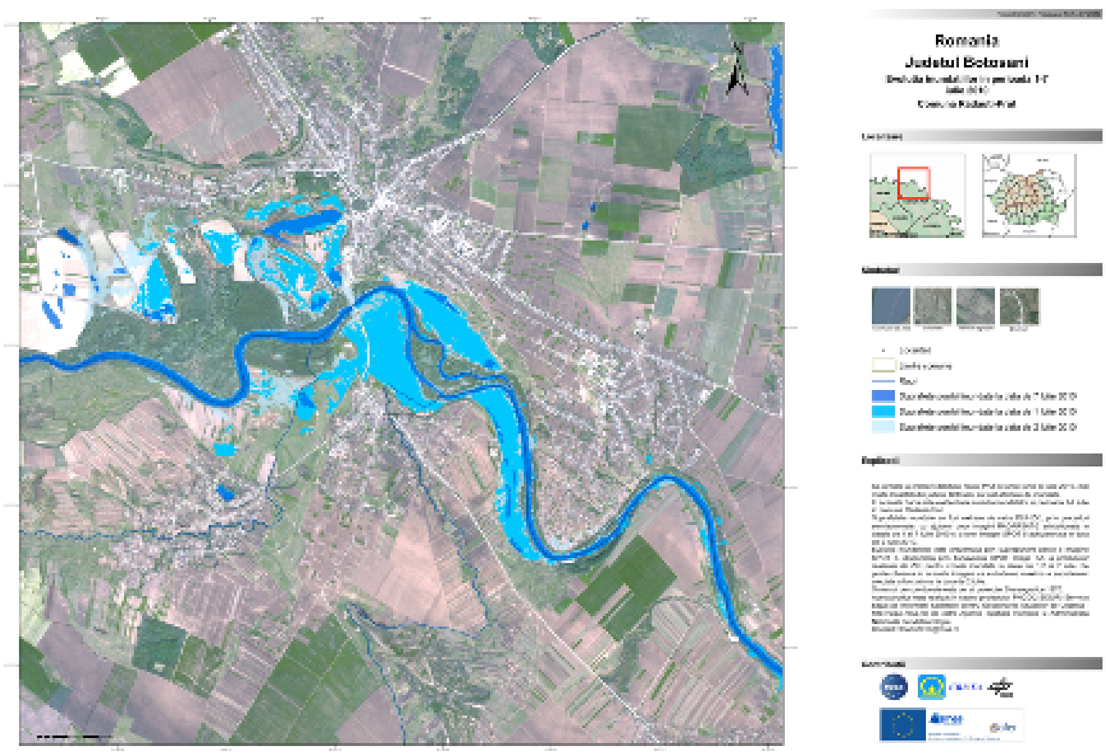


Fig 4. Detailed map, Ozun Commune, Covasna



Furthermore, detailed maps were produced for different communes and localities neighbouring the river. In this case, the results can be easily converted in monetary units (e.g. Euro) per square meter or kilometre.
Not only the Siret River had a high flow level, but also Prut, Jijia, Raul Negru, Danube and others. Figure 4 shows a detailed map produced for Ozun Commune from Covasna County. The map shows the evaluation of the affected areas using CLC and LPIS and the analysis of infrastructure elements in both tabular (figures) and graphical (location) form.
Figure 5 presents the flood evolution for Radauti- Prut, Botosani County from 1st to 7th of July 2010. In the overlap view, it can be seen that maximum flood extension was recorded on the 2nd of July, on the 7th of July the Prut River water flow level being almost normal.

Fig 5. Flood evolution map, Radauti-Prut Commune, Botosani County



The Siret and the Prut Rivers registered high water flow levels for the longest period, the former from the 21st of June to the 11th of July and the latter from the 1st to the 20th of July. This map is depicted in Figure 6.
Floods from last summer affected 37 counties and 481 localities. Material damages were estimated to 876 million Euros (SGG, 2011). Figure 6 shows a resume of the most important floods and their location on the rivers, while figure 7 presents the map with the flood affected localities and counties.

Fig 6. Floods map in Romania, 2010

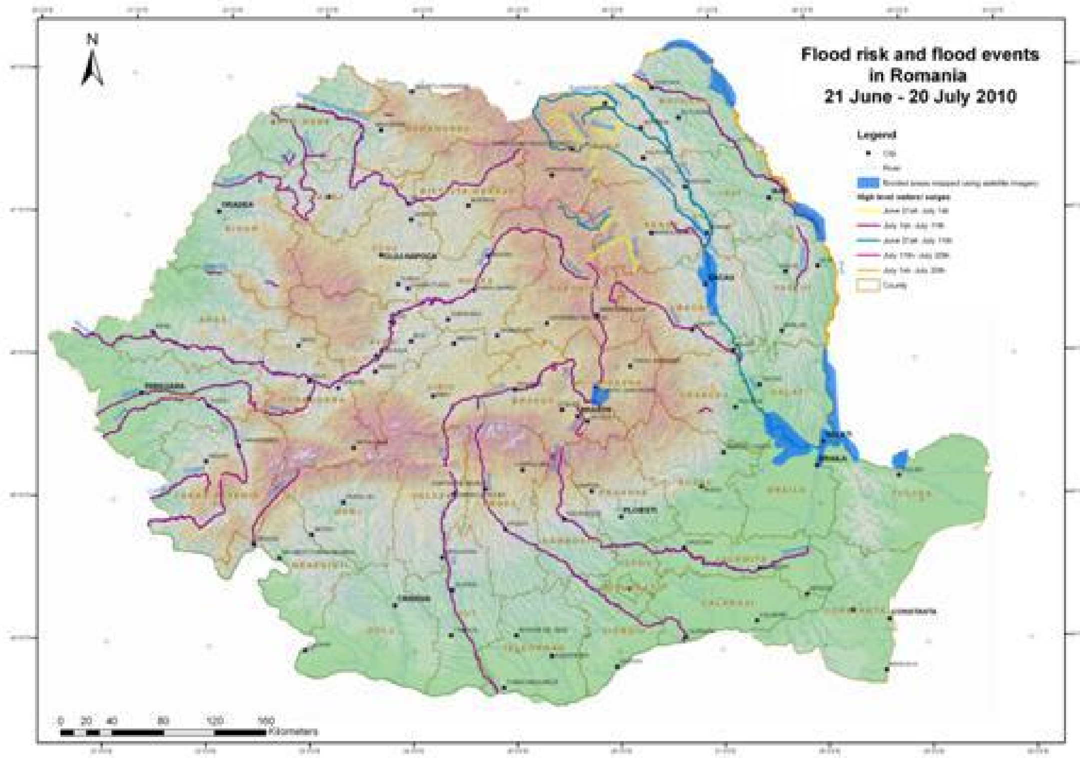
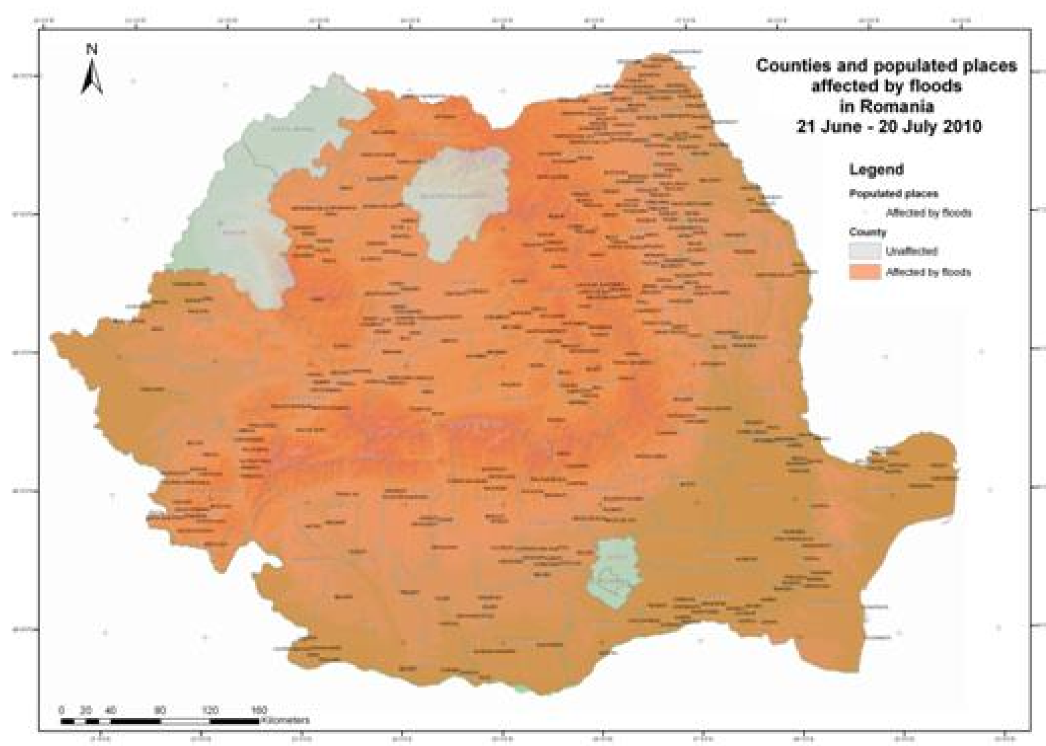


Fig 7. Map of counties and localities affected by floods



Discussions

Risk management in general and more visibly Emergency Response can be considerably improved when satellite data is used can improve considerably. The management of crisis situations either produced by natural or man-made disasters, from prevention to rapid access and evaluation can be more effective if existing geo-spatial data is combined with real-time Earth observation.

Some of the main advantages of using satellite data and emergency services are the following:

- possibility of quasi-real time monitoring using new and archive data allowing fast change detection of different types of phenomena – flood, fire, earthquakes;
- rapid mapping method compared with other methods (such as collecting in-situ data)
- possibility to apply many automatic or semi-automatic methods and thus ensure objectivity of the information produced;
- the information derived from satellite date can be used during all the risk management phases;
- for floods, remote sensing data can be used for identification and mapping of the hydrological risks on basin level and surrounding areas (Vlad and all, 2009).

More than that, the context created by the development of GMES is creating better conditions for accessing Earth observation data and service in support of risk management and emergency response.

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The Corellation of the Place Attachment Levels of Disaster Victims in New and Old Settlement

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Abstract

This study clearly evaluates the post disaster reconstruction in physical phases and explores how the space formed from a psycho-social perspective. So the new formation of space during the community reconstruction is explored by measuring the user expectations and defining the psycho-social background of the victims. Furthermore, the socio-spatial dynamics of the post disaster reconstruction are evaluated in Turkey- Düzce case study. The qualitative method of semantic differentiatiom method used to measure the victims' perception of the old and new neighborhoods by means of 3D models.

The analysis of the perception of the new environment by the victims shows the lack of use of the old environment data in the new environment design process. This situation creates adaptation problems to the new environment so that the tendency to relocate from the new permanent housing sites was determined very high.

Key Words: *:* Place attachment, Semantic diferentiation, Settlement

1. Introduction

Disasters destroy assets, undermine the flows of goods and services and disrupt people's sense of security, thereby forcing relocation of household (Handmer, J. and Hillman, M. 2004). All appropriate actions after the disaster are taken to enable individuals and their communities to return to their normal life as soon as possible both physically, socially and psychologically (EMA, 1996). Disasters occur at the interface of society, technology and environment and are fundamentally the outcomes of the intersection of these features. To adequately analyze disasters the barrier between human activity and eco-system activity must be collapsed, transforming a relationship of difference into a relationship of mutuality (Oliver-Smith, A. 2002).

Place researchs begin with an understanding of what place means. Relph (1976) suggests that places are given meaning through the range of experiences that allow us to know a place and without meaning, places exist merely as spaces. Place is not only a physical concept but also had a psychological background and corresponds to an interactive comprehension. Because the environment consists of a combination of social and physical attributes. Place attachment is the accumulation of experiences in the physical and social millieu of people. In other words, we build our specific place in some degree that these places can not exist independent from us (Steele, F. 1981). In short, the role of the place is very deep in our life because of the presence of complex mental and emotional ties.

There are several approaches to the study of place connections and a variety of phrases are used to identify them. This phrases are; place attachment, sense of place, sense of community, rootedness, place belonging, urban identity, place identity and place dependency. For the purpose of this study, the term of place attachment was used because it represents the most concise description of place connection. On the other hand the concept of place disruption may be used contrary to the term of place attachment. Disruption is defined as "any severe loss may represent a disruption in one's relationship to the past, to the present, and to the future. Losses generally bring about destruction of routines, of relationships, and of expectations, and frequently imply an alteration in the world of physically avaliable objects and spatially oriented action. It is a disruption in the sense of contunuity which is ordinarily a taken-for-granted framework for functioning in a universe which has temporal, social, and spatial dimensions... The loss of an important place represents a loss or a change in a potentially significant component of the experience of continuity"(Fried, 1963).

Place attachment may disrupt in sudden cases such as disaster whether by voluntary or involuntary relocation. Relocation is defined as; the movement of a settlement (or portion of a settlement from an unsafe location to a safe location to re-establish a community, or it can be defined as; removal to an other location with provision of land and housing. It can be voluntary or involuntary. The relocated people affected by disasters are called as: “victims of disaster” (Tercan B., 2001).

The study aims to understand how the place attachment emerged in two newly established environments following the disaster, , which one of it designed and constructed for relocated people and the other for non-relocated victims after the traumatic events disrupted the sense of place connections.

The Impact of Post Disaster Relocation on Person-Place Relationship

The relocation of any community exposes serious problems, due to the attachment of communities to their settlement location on account of ethnic traditions, kinship ties, livelihood security and cultural/ historical associations. However, there are situations where relocation is unavoidable, and thus it needs to be managed with skill and sensitivity. Relocation of settlements can be a temporary or permanent option and relocation is a temporary life style with the settlement that it is inundated and therefore they need to be relocated, with possible external assistance, until flood waters recede. However, when flood waters erode land, or landslides destroy settlements, then relocation has to become a permanent reality. Relocation after conflict can be both temporary and permanent, depending on the extent and continuation of hostilities. In some areas where there are high levels of vulnerability to natural hazards, authorities attempt permanent relocation but this is very rarely a feasible option, since it is normally opposed by residents, who resent such imposed actions and fear the economic consequences. Another objection is that the vacated unsafe land resulting from relocations is normally rapidly re-occupied by incoming families, thus re-establishing the vulnerable status-quo (Ian D., 1978). Involuntary relocations on the other hand often follow natural forces, such as earthquakes, hurricanes drought or flood, or human actions, such as toxic contaminations, or economic development initiatives such as dam or highway building or urban renewal projects. These relocations are often sudden, with change threatening to overwhelm stability. They can involve injury or loss of life and possessions, losses are integral to self-definitions. In fact, the following discussions of two particular disasters will illustrate how places sustain multiple sources of identity, including kin, friends, and neighbors; institutions and cultural structures; and meaningful behaviour settings tied to work, leisure, and celebration (Fried, 1963).

When one is forcibly moved from one place to another because of a natural disaster, refugees have to face many problems in adjusting to their new surroundings. From relocation to restoration, the housing is conceptualized in understanding environment-behavior transactions (Kobayashi, M. and Miura K., 2000). Post-disaster behavior in securing shelter and housing is "influenced and constrained by social, cultural, ecological, historical and political-economic conditions". Finally, the issue of relocation is directly tied to pre-event social location. Most of research indicates that victims resist any type of relocation, even to temporary shelters, and they insist to stay as close to their homes as possible (Oliver-Smith A., 1991).

2. Duzce as Case Study

On 17 August 1999 at 03:02, an earthquake measuring 7.4 on the Richter scale struck the northwestern part of Turkey. Officially it is called the ‘Kocaeli Earthquake’, it was situated on the North Anatolian Fault Zone and the epicentre of the main shock (40, 70^0 N29, 91 ^{0} E, with a focal depth of 15,9 km.) was about three kilometres away from the centre of the town Gölcük. The earthquake ruptured 120 km of the North Anatolian Fault Zone, affecting a large area (approximately 41.000 m^2) between Bolu and Istanbul, in the economic and industrial heartland of Turkey (34.7% of the GNP) (Özerdem, A. 1999). The major areas affected from this disaster include the provinces of Kocaeli, Sakarya, Yalova, Bursa, Eskişehir and Bolu (Figure 1). This earthquake resulted with the recorded death of 17,480 people and 43,953 injured people. More than 75,000 buildings within the region were demolished completely (Özmen, 2000).

Not even three months after, on 12 November 1999 at 18:57, another big earthquake with a magnitude of 7.2 on Richter scale occurred in Düzce, affecting mainly Bolu, Düzce, Kaynaşlı, Gölyaka, Çilimli, Cumayeri and Gümüşova cities. The epicentre (40,76^0 N31,14^0 E, with focal depth of 14 km) of the earthquake was located in Düzce and it ruptured an additional 43 km of the North Anatolian Fault to the east of Gölyaka. Although smaller in extent, this second earthquake also caused death and destruction; 763 people were recorded dead and 4948 people were injured (T.C. Başbakanlık Kriz Yönetim Merkezi, 2000).

Figure 1 Areas affected by the Marmara and Düzce earthquakes in 1999 (Jhonson C., 2009)

Düzce province is located on the North Anatolian fault line in Düzce plain (Figure 1). As a result of the rapid industrialization between 1980–1998, the migration to the city from the rural areas increased and the housing demand rapidly increased as well. This rapid migration prompted unplanned construction, and builders added more floors to old buildings, reaching beyond the limits of the municipal codes and regulations. As there were no reliable construction control system for the building construction process in Turkey at the time, new buildings were constructed rapidly with improper techniques and materials and no supervision from the authorities. This created an extremely vulnerable built environment, and such, when the earthquakes struck and it caused great amount of damage to the housing stock and other buildings.

In Duzce, there were 16,666 dwellings or houses totally destroyed, 10,968 semi-damaged and 13,070 slightly damaged – according to the categories used in official records (T.C. Sayıstay Başkanlıgı, 2002). In total, 84% of the houses and were damaged to some degree. There were also heavily damaged state buildings such as Municipality, State Hospital, Duzce High School and University (Tekel) Building (Duzce Valiligi, 2002).

2.1. Relocation process after the earthquake

Relocation of damaged villages is quite common in Turkey. The decision to relocate is usually based on three factors: 1) when the old location is at risk for future disasters, 2) when the old location is completely destroyed and therefore to remove the debris and rebuild on the same site will take too much time, and/or 3) when there is a chance to relocate to land owned by the government, since it is generally preferred not to have to pay for the land. The decision to relocate is made by the ? MPWS ?, often with input from several ministries. In general the geology of the area and the availability of land are the primary facts that it should be taken into consideration for relocation, and social aspects such as rootedness in place or connections between the new and old settlements, that issues might be considered as less priority. The outcome is that the site plans of all post-disaster settlements are similar although the regions and communities have cultural and social differences (Arslan, H. and Johnson, C. 2009).

Sometimes relocation requires the expropriation of land that belongs to the private owner. Since private ownership is protected by the constitution, this often leads to some problems. For example in Duzce, a two-year delay in the expropriation of land to build a road which is meant that people are relocated to the 8000-unit settlement outside the city. They had to travel 14kms to reach the city, rather than using a direct road which would be 4 kms (Arslan, H. and Jhonson, C. 2009).

Method

In this study the physical and social reconstruction processes after two devastating earthqauke is to be interpreted in order to understand the selected case in a broader and deeper way through psycho-social effects on the human-environment relations. Research had a focus on randomly selected samples from the former environment within a number of 50 non-relocated people who were lived in the city center and another 50 relocated people who were resettled involuntarily 8 kms faraway from the the old city center.

In order to investigate the psychological and social attachment of the earhquake victims in their current environment a semantic differentiation survey was conducted. The survey included the visual features of the old and new environments and the features are also investigated through the the settlers how to define them. The Duzce city, affected from the 1999 Marmara and Düzce earthquakes, was selected for the case study. The three dimensional determinants of the research is defined and it is based on different perspectives of the place attachment analysis (Figure 2).

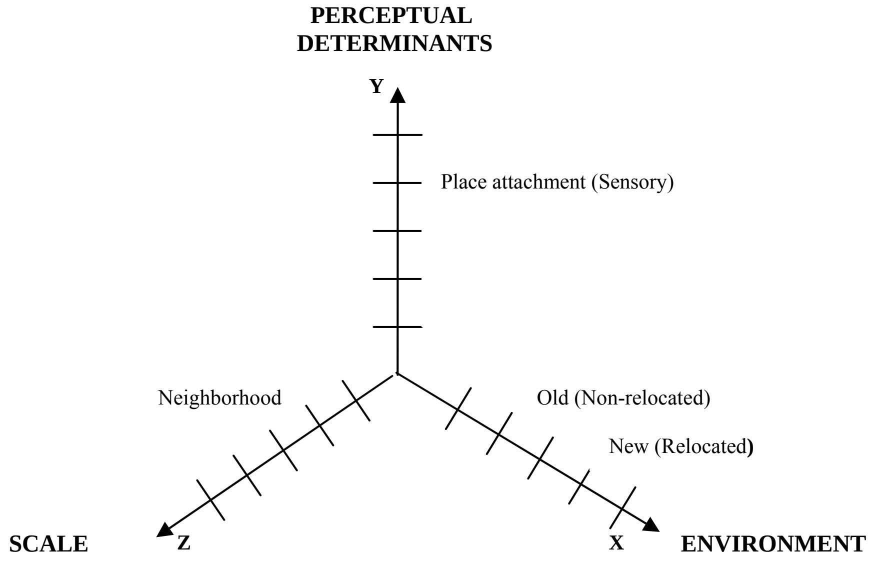


Figure 2. Perceptual determinants due to place attachment perspectives in different environments and scales

Y axis in Figure 2 illustrates the perceptual determinant of place attachment perceived by the disaster victims. The concept of place attachment is used in the research to determine the victims level of attachment of to their new environments by using two groups which one of it was the relocated victims and the other was the non-relocated. X axis refers to the relocation and non-relocation status of the disaster victims according to their old and new environs. On the other hand Z axis defines the different scales of the environments in neighborhood level.

3.1. Research Scope and Research Question

The research scope covers social and psychological aspects of post disaster reconstruction within the context of relocation and the traumatic impact of the disaster. The case study of the research mainly focused on answering the specific questions of; what kind of a environmental place attachment relationships exist between the relocated group and their new constructed environment? What kind of a environmental place attachment relationships exist between the non relocated group and their changing, despite the non relocation status the environment also reconstructed by the victims (eg. new houses)? Given all this the hypotesis is outlined and determined like that; the group with the experience of post disaster relocation had higher level of attachment to their environment than the non relocated group.

3.2. Sampling and procedures

The population of the research is the Duzce city center and the permanent housing site constructed after the earthquake and 8 kms far away from the Duzce city center. The permanent housing site consisted from 14 regions and 7000 housing units with an approximate population of 30.000. Beside the Duzce city center had a population of 66,624 according to 2000 census.

3.3.1. Sample Selection

The independent variables; gender, age, occupation, education level, damage status from the earthquake, years of residence and number of relocation are evaluated according to relocation status of the earthquake victims. The sample size covers the whole population and were calculated approximately 96 people but rounded to 100 people during the implementation phase. The total population size of the sample was arround 100000 people.

Research sample is consisted of Duzce City Center and Permanent Housing site concerning 20 neighborhoods from the Duzce City Center and 5 neighborhoods from the permanent housing site (Bahcelievler, Camlıevler, Yesiltepe, Esentepe ve Guzelbahce) are selected (Table 1).

Table 1: Case Study Sample

Sample	District /Village	Group(s)	Sample Size
Düzce/Center	All Neighborhoods (20)	Non Relocated	50 people
Permanent Housing Site	All Neighborhoods (5)	Relocated	50 people

Also the frame of the sample included the following attributes;

- All the victims are selected the age over 12,
- The indiviuals had lived one year before the earthquake in Düzce, and they were resident in the earthquake region during the 1999 earthquakes and they were living in the city,
- The families selected among the earthquake victims are relocated from their old settlements to a newly constructed one or those not relocated from their old settlements.
- The second group also had the sense of transformation in the existing old environmnet altough they have not experienced in the relocation process like first group.

3.3.2. Data collection procedures

Babbie (1998) states that the most useful and common objectives of social research as the examination, definition and explanation of the title or the event. Despite this, developing a strategy should be the appropriate response to the research questions in order to get valid and reliable results.

- For performing the goals of the study, the research method of semantic differentiation were used in order to evaluate the psycho-social attachment levels of the new environment (Table 2).

Table 2: The data collection procedure

Level	Region	Data collection method
Neighborhood	New and Old Neighborhood	Semantic Differentiation

3.3.3. Implementation of Semantic Differentiation (Image Evaluation) as a Data Collection Tool

Data collection tools were consisted of a questionnaire conducted from the victims with face to face interview technique. Survey application takes approximately 10–15 minutes. The aim of the study is the correlation of the existing place attachment of old and new environs with an understanding of the impact of trauma created by the earthquake. In this phase, the dependent variable place attachment is tried to be evaluated clearly and data collection phase is ended in this way. The hypotesis related with post disaster relocation was tested with an emphasis on social attachment levels that they focused on gender and age differentiations. This method reveals comparatively high level of knowledge from large number of respondents.

The semantic differentiation covers the evaluation of the visual perception of the victims for the old and new neighborhood. Before the application previous and new information and photographs about the city's housing pattern was obtained. Through these photos and information the pre earthquake Düzce traditional neighborhood and housing patterns were modelled in the computer. After modelling an image which is aimed to assist earthquake victims, caused to share their opinions and to notify the general pattern of the old neighborhood and housing (Figure 3). Information and photographs are obtained for the new permanent housing site modelled again with in a computer. An overall image for new housing site has been obtained with this method. Images are obtained about pre-and post-earthquake settlements in 2 minutes duration were given to the victims in order to analyze these images. Then the old and the new environmental image evaluated by the victims according to their idea through the adjective pairs (Figure 4). First of all the victims prefer one of the pairs of adjectives or they were asked to indicate if they are undecided. If the victims were undecided about the assessments other adjective pairs were introduced.

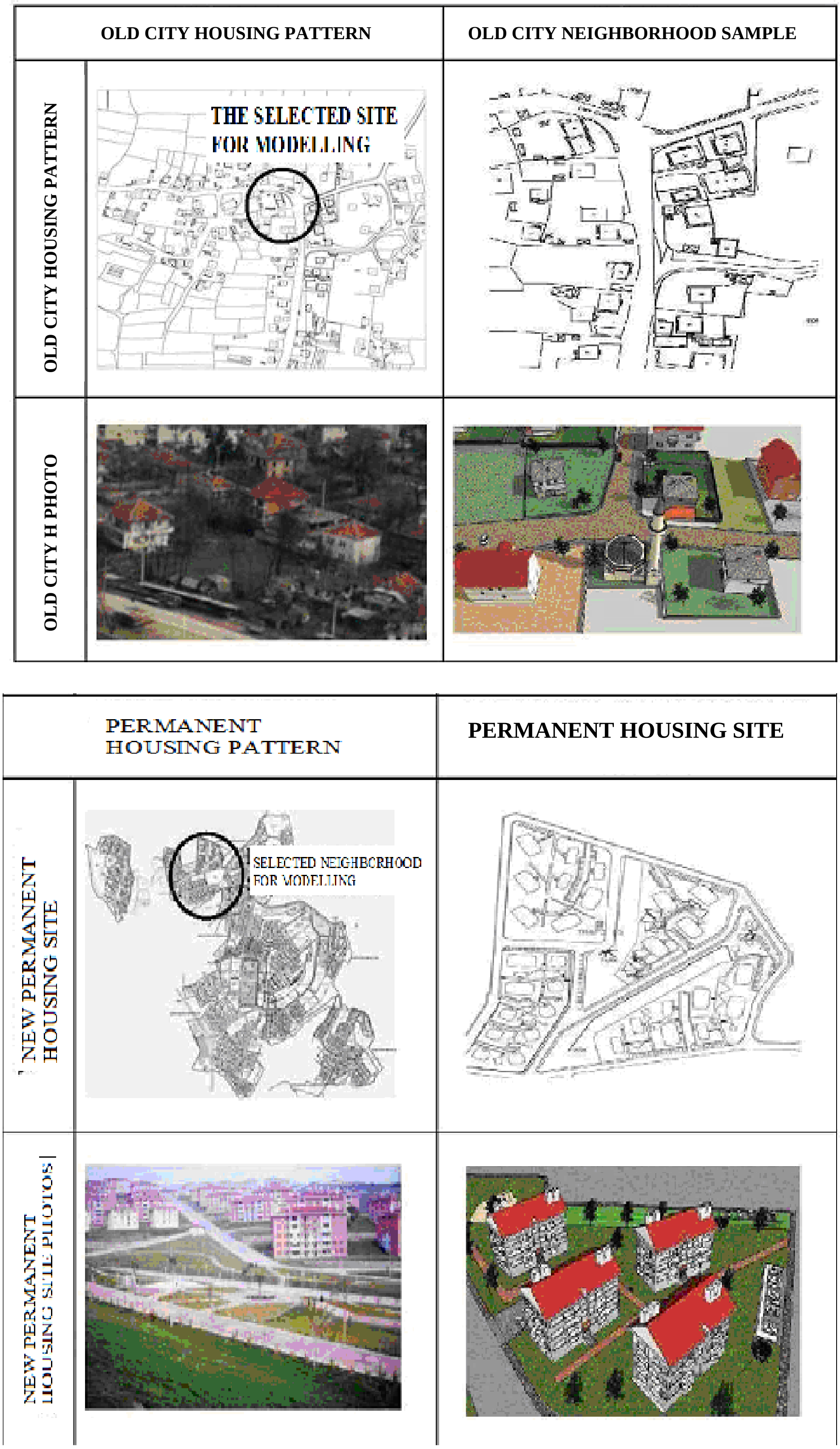


Figure 4. Modeling of images obtained with the old-new patterns of housing settlements in Duzce

Victims choose the adjectives and rate them as "too much", "very much" or "a little" in the form. This procedures used in all adjective pairs until the end. The procedure is also mentioned above and it was repeated for the new housing image.

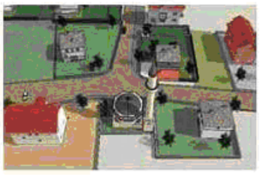
IMAGE NR	ADJECTIVE PAIR	OLD AND NEW NEIGHBORHOOD MODEL
1	Ordinary-Original Open-Close Complex-Simple Intensive-Less Intensive High-Low Disturbing-Non Disturbing	OLD NEIGHBORHOOD MODEL 
2	Ordinary-Original Open-Close Complex-Simple Intensive-Less Intensive High-Low Disturbing-Non Disturbing	NEW NEIGHBORHOOD MODEL 

Figure 5. Old-New Housing Site General Models and Images

4. Findings

The evaluation of Figure 6. according to relationships between the old and new settlement clearly shows the lack of perceptual parameters of the old settlement in the new one. The disaster victims have similar perception just about the closeness and privacy parameters. It can be pointed out that the physical and socio-spatial data of the old settlement generally have not been used in the new settlement.

ADJECTIVE PAIR	OLD NEIGHBORHOOD MODEL (NON-RELOCATED)	NEW NEIGHBORHOOD MODEL (RELOCATED)	RELATIONSHIP
Ordinary-Original	Ordinary	Original	(-)
Open-Close	Close	Close	(+)
Complex-Simple	Complex	Simple	(-)
Intensive-Less Intensive	Intensive	Less Intensive	(-)
High-Low	Low	High	(-)
Disturbing-Non Disturbing	Non Disturbing	Disturbing	(-)

Figure 6. The correlation of perception of old and new settlements model

General perception of the new environment relating to the evaluation of the image by the victims can be seen in Figure 6. Negative changes have shown with (-) while the positive have shown with (+). The correlation of the general images and the detailed images clearly shows that there is no serious deviation in the perception of the victims. The only deviation is in the parameter of the disturbing environment. The cause of this change is based on the children playground area that had a positive impact on the users. So the children playground area can be regarded as an important physical element that breaks the disturbing part of the physical environment.

4. Results

The model results are obtained from the study that it represents old and new neighborhood perceptual parameters of the victims show that the height and closeness of the old environment this sense also continues in the new environment. The other parameters such as simplicity, originality and less intensity does not exist in the new environment. Thus the hypothesis is verified as there is a lack of place attachment in the new environment.

The study also reveals that the reconstruction process in neighboorhood level had an impact on the sensorial perception of the victims. This shows that the existing relationship is between physical and social reconstruction. Thus in order to make decision in post disaster reconstruction of neighborhood this case study reinforces that the level of place attachment should be determined. This also emphasizes that the decision makers are tended to avoid from relocation. The community participation may boost the reconstruction activities and help to reduce place attachment problems.

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Monitoring European human security: quantitative and qualitative multi-risk assessment on affected people, damages and impact

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Abstract

No technology can prevent natural hazards. However, the disaster situation can be mitigated by prevention measures, early warning tools and adequate monitoring of past experiences and coordination of relief efforts. Only a close dialogue between Earth Observation (EO) developers and responsible authorities can enable timely responses to global security challenges. Support to decision makers at the different stages of the emergency cycle is the major concern of EUROSENSE products in multi-risks management during the prevention phase of the crisis.

While remote sensing information inform precisely about extent and exposure to specific risks, the link to the specific population is still a critical step for future research. Knowing firstly where people are and, secondly, if they are vulnerable to specific risks are two major research questions that are still to be addressed by European projects. This paper states the challenges of Remote Sensing technology and the involvement of EUROSENSE in several thematic projects (Geoland, G-Mosaic, Globe, Safer) within GMES (Global Monitoring of Environment and Security).

To address the first question population distribution models are developed by EUROSENSE in the G-Mosaic project. Population density map integrates demographic data from statistical sources with land use information using EO data. This spatial link to population data is an initial step to other socio-economic statistics. While population information is of poor quality, models assumptions help to identify the spatial pattern of the distribution by indirect factors.

The second question refers to analysis of risks and vulnerabilities. Geospatial technologies provides technological support to authorities in the prevention and post-crisis management phases of emergency cycles such as flood, industrial crisis, earthquakes, … Geospatial tools are developed to better represent energy linkages, water flows and risks, urban sprawl and imperviousness of European cities. Applications of Remote Sensing techniques in multi-risk mapping are demonstrated.

Keywords

Human security, Risk cycle, Spatial technologies, Earth Observation, Population Distribution

1. Introduction

During the past half decade, perceptions of regional and international security have changed dramatically (Burnley et al. 2009). In parallel of these changes, the European Commission (EC) together with the European Space Agency (ESA) initiated Global Monitoring for Environment and Security (GMES). As the “S” of this acronym states for “Security”, one of the purposes of this programme is to provide information to address some of the security related concerns. EUROSENSE has been part of several GMES projects to provide risk and security related information to respective local, regional and national authorities. This paper refers to the evolution in security definitions, in Earth Observation (EO) services and specifically in geo-spatial products to address users’ needs.

In the “human security” paradigm, risks refer to the survival of people, their livelihood and dignity. Human security is also inseparable from development and poverty. Daily safety and survival need to be assured from natural hazards and environmental degradation; the issues related to climate change are increasingly relevant for human security (UNDP, 1994). Only a close dialogue between Earth Observation developers and responsible authorities can enable timely research responses to global security challenges, which in themselves lead to modification of human security research policy. In such a dialogue, geospatial concepts and earth observation techniques have to be integrated into technologies to address policy makers’ needs and to test scenarios of political changes (Burnley et al. 2009).

No technology can prevent natural hazards. However, the disaster situation can be mitigated by prevention measures, early warning tools and adequate monitoring of past experiences and coordination of relief efforts. Space technology should be able to provide accurate, timely and relevant information to better understand and measure Human Security. The support to the responsible authorities at the different stages of the emergency cycle (Figure 1) is the major concern of EUROSENSE products. This paper demonstrates a concept of multi-risks asset mapping to address decision maker’s demand for geospatial information by using Earth Observation (EO).

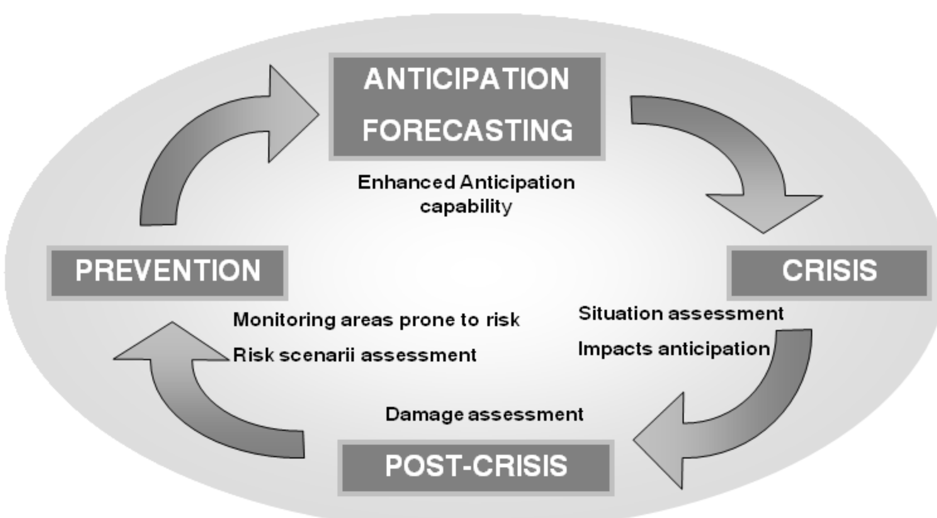

Figure 1 Emergency cycle

While remote sensing information inform precisely about extent and exposure to specific risks, the link to the specific population is still a critical step for future research. Knowing firstly where people are and, secondly, if they are vulnerable to specific risks are two major research questions that are still to be addressed by European projects.

To address the first question, population distribution models are developed by EUROSENSE. A population density map integrates demographic data from statistical sources with land use information. This spatial link to population data is an initial step to other socio-economic statistics. While population information is of poor quality, models assumptions help to identify the spatial pattern of the distribution by indirect factors. Land use information is crucial in such model. Section 3 illustrates a modular approach of population distribution mapping using EO data.

The second question refers to analysis of risks and vulnerabilities. Geospatial technologies provide already technological support to authorities in the prevention and post-crisis management phases of emergency cycles such as flood, industrial crisis, earthquakes, … Geospatial tools are developed to better represent energy linkages, water flows and risks, urban sprawl and imperviousness of European cities. Section 4 demonstrates the concept of multi-risks.

Section 2 will discuss theoretical concepts surrounding the two definitions of security. We highlight the focus to human security definition on risk to the state or to the individual and mention the consequences for scientific responses in spatial technologies. In this section, the challenges to Remote Sensing technology and the involvement of EUROSENSE in several thematic projects (Geoland, G-Mosaic, Limes & Safer) through the GMES evolution will be stated. Section 3 addresses the first question of knowing where people are with an example in the G-Mosaic project. Section 4 focuses on the second question and the emergency cycle to propose applications of remote Sensing techniques in flood risk / multi-risks analysis.

2. Security Definitions and Spatial technologies

A wide body of literature has developed around the concept of security, from state security to human security. It has commonly been defined in relative terms, by reference to an object at risk, threats to that object and measures which may be taken to safeguard the object (Burnley et al. 2009). As review by these authors, “Security” has been defined negatively as, the absence of threats and the perception of threats to survival, or positively as, the fulfilment of human needs, aspirations and potential (Sen 1999).

2.1. Security definitions

After World War II, security concepts were framed by the Cold War. The object at risk was automatically the state, which was the primary international actor. In an anarchic international environment the responsibility of the state was the protection by military means of state borders, territory and citizens. Maximisation of power was seen as the best defence for states against the “other” beyond the state border (Lynn-Jones and Miller 1995).

The Post-Cold War era has witnessed a shift in focus from security of the state, conceived in terms of power, autonomy, territorial integrity and sovereignty to one which relies on concepts of universal, indivisible, interdependent human rights, recognised and protected by international law enforced by states and international institutions. The nuclear stalemate, as well as the increased focus on people and their needs have led to a shift towards conceptualisation of security as multi-scale, inter-dependent and requiring a multilevel response not only by states, but by international institutions like the UN and by regional organisations like the EU, NATO and OSCE. The United Nations definition of human security is a rights-based definition, addressing well-being of people (UNDP 1994).

2.1. Geospatial technologies for human security

The quantitative analysis of human security benefits from geospatial technologies. Earth Observation (EO) provides high precision measures of spatial entities and events. Geographical Information Systems (GIS) allow to quantitatively process geospatial information. Earth Observation data has progressively become a source of updated geospatial data that when combined with field information can be used as a visual tool for the decision makers in negotiations (Starr 2002). EUROSENSE has been participating in several thematic projects (Geoland, G-Mosaic, Globe, Safer) in the evolution of European services using EO data such as in the GMES (Global Monitoring for Environment and Security).
In recent years, there has been a growing consensus that the EU must address issues of political, economic and human security, internally and externally. On this basis, notable elements of European security relevant policy have been developed in the lst fifteen years. In the meantime, GMES was established to support the following (Jasani et al.. 2009):

- Europe's environmental commitments, within the EU and globally by contributing to the formulation, implementation and verification of the EC environmental policies, national regulations and international conventions
- Other policy areas, such as agriculture, regional development, fisheries and transport are also considered
- Common Foreign and Security Policy (CFSP),
- Policies relevant to European citizens' security at EC and national levels (border surveillance).

These aims were carried out with the following general principles:

- Production and dissemination of information in support of EU policies for Environment and Security
- The mechanisms needed to ensure a permanent dialogue between all stakeholders and in particular between providers and users and
- The legal, financial, organisational and institutional frame to ensure the functioning of the system and its evolution

EUROSENSE is involved in a wide range of GMES services. Even before the so-called GMES, we constantly developed satellite derived services to support objectives of EC initiatives to respond to human security principles. The line of services related to urban land use/ land cover, change detection, soil sealing and urban environment have been initiated in the GMES/GUS first phase of GSE projects, then the GSE land (GMES Service Element-Land financed by ESA). Geoland 2 consortium aims at developing land operational products to better represent e.g. the urban environment to support urban planners. The Security services, defined in the frame of the Global Monitoring for Security and Stability (GMOSS) Network of Excellence, were specified, developed and tested at the European level in the SABOCO (Satellites in Border Cooperation, ESA contract) and LIMES (Land /Sea Integrated Monitoring for European Security, EC FP6) projects. The G-Mosaic (GMES services for Management of Operations, Situations Awareness and Intelligence for regional Crises) project adapts these services to the international context by identifying and developing products, methodologies and pilot services for the provision of geo-spatial information in support of EU external relation policies. The development of early warning systems that was the main stream of GeoCrew (GEO Crisis Early Warning) has been pursued by two EC projects: WIMAAS (Wide Maritime Area Airborne Surveillance) and Globe (Global Border Environment). The RISK-EOS – Risk-Earth Observation Services of the GMES Service Element (funded by ESA) has been followed by the SAFER (Services and Applications For Emergency Response).

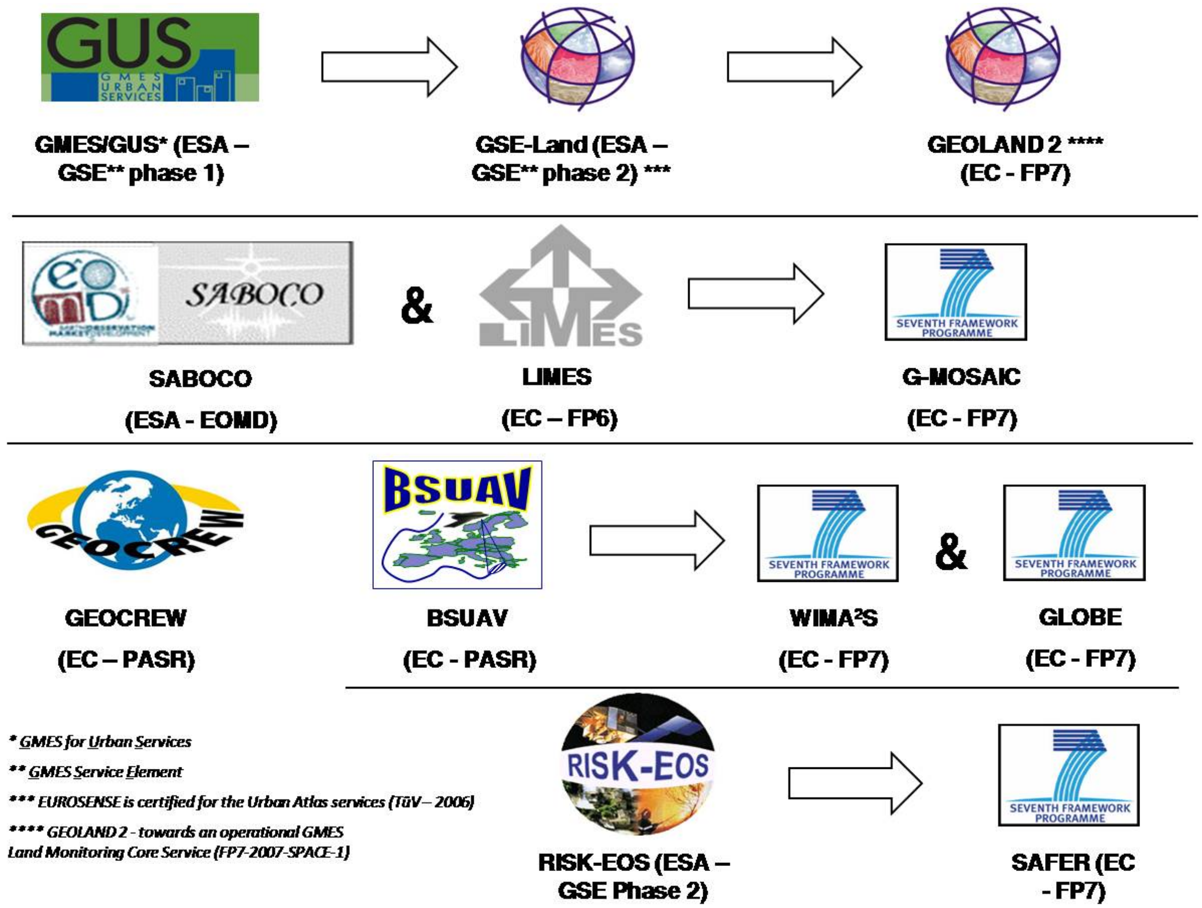

Figure2 : EUROSENSE involvement in GMES projects

The applications developed in EUROSENSE using EO and GIS technologies are distinguished in different segments. EUROSENSE provides specific satellite images in close discussion with the users about their real needs and technological capacities. The Land monitoring segment of the society is one on its strength, developed in the GMES/GUS and the GSE-land providing mapping tools for different political and private users. The multi-risks concept services will be discussed in this paper (see section 4). The environmental segment and mainly the maps produced with thermographic camera are recently intensively requested by urban planners. The vitality of trees and the monitoring of the urban greenness is a regular product of the company to support urban planners with aerial photos derived information. The company has developed a large expertise in agricultural control in several projects in support to the EC Agricultural Policy. In the whole branch of projects issued after the GMOSS Network of Excellence, including LIMES and G-Mosaic, EUROSENSE has developed specific geo-spatial tools in support to land border management or control of illegal movements.

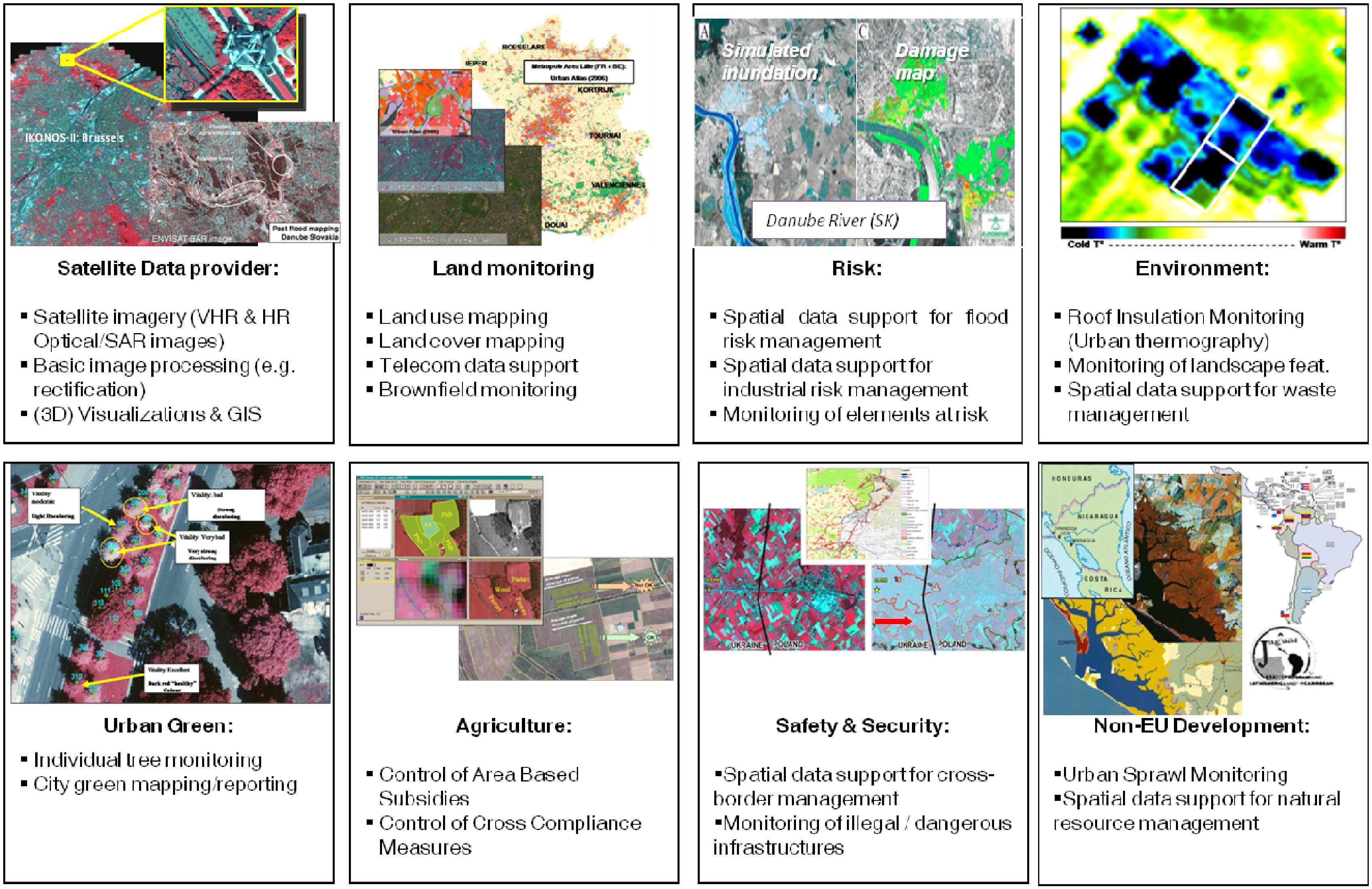

Figure 3: Main segments and themes in remote sensing development in EUROSENSE

3. Combining population and EO data

Deriving a grid-based/raster dataset of socio-environmental indicators from satellite imagery and statistical data is a challenging but promising technique of combining EO and socio-economic information through specific assumption about spatial patterns. Mapping population distribution using EO data is the first step in this process of socio-economic and geospatial data integration. Combined with satellite imagery, statistical datasets can provide a continuous spatial representation of variables such as density of population and even distribution of ethnicity.

Datasets of physical factors like topography, elevation, land cover, natural resources derived from remote sensing data provide spatial environmental indicators in human security models. Geographical Information Systems can integrate and overlay these different datasets and provide spatial indicators such as proximity, size, accessibility, vulnerability or permeability (Stephenne and Pesaresi 2006). The GIS allows to model different spatial characteristics in a whole system based on the conceptual interactions existing between these characteristics. The model is a tool to predict and simulate “What if” scenario that helps to better understand the system. The modelling of spatial human security issues is an important challenge in the overall goal of the political geography, geopolitics and international relations.

Population data usually comes from population surveys and other national sources such as censuses. Population estimates take into account birth, death and international migration rates. For some countries like developing countries where security issues are particularly important these figures can be subject to error. Within the G-Mosaic project, EUROSENSE produced a population distribution map to estimate the number of people living in conflict areas and the geographic distribution of population possibly related to land use changes in the specific case of the Democratic Republic of Congo (DRC).

The population distribution map is derived via a disaggregation of modelled population figures for 2010 from the Gridded Population of the World v3 ((Source: Center for International Earth Science Information Network (CIESIN), Columbia University; and Centro Internacional de Agricultura Tropical (CIAT)). This disaggregation is done following a weighted procedure that is determined by Land cover information and location, area and type of villages. Total population figures are projected in a1 square kilometre grid.

The main input data are:

- Landsat data from 2005-2009
- Gridded Population of the World v3 – modeled figures for 2010 (Source: Center for International Earth Science Information Network (CIESIN), Columbia University; and Centro Internacional de Agricultura Tropical (CIAT). 2005. Gridded Population of the World Version 3 *future estimates* (GPWv3*fe*).
- Land Cover classification from 2000 ("Carte de l'occupation du sol de la République Démocratique du Congo, UCL-Geomatics (Louvain-la-Neuve, Belgique) 2006".)
- Ancillary data from RGC (Le referéntiel géographique commun en RD Congo): Point layer populated areas based on GPS, satellite and existing maps, Roads, Rivers and lakes

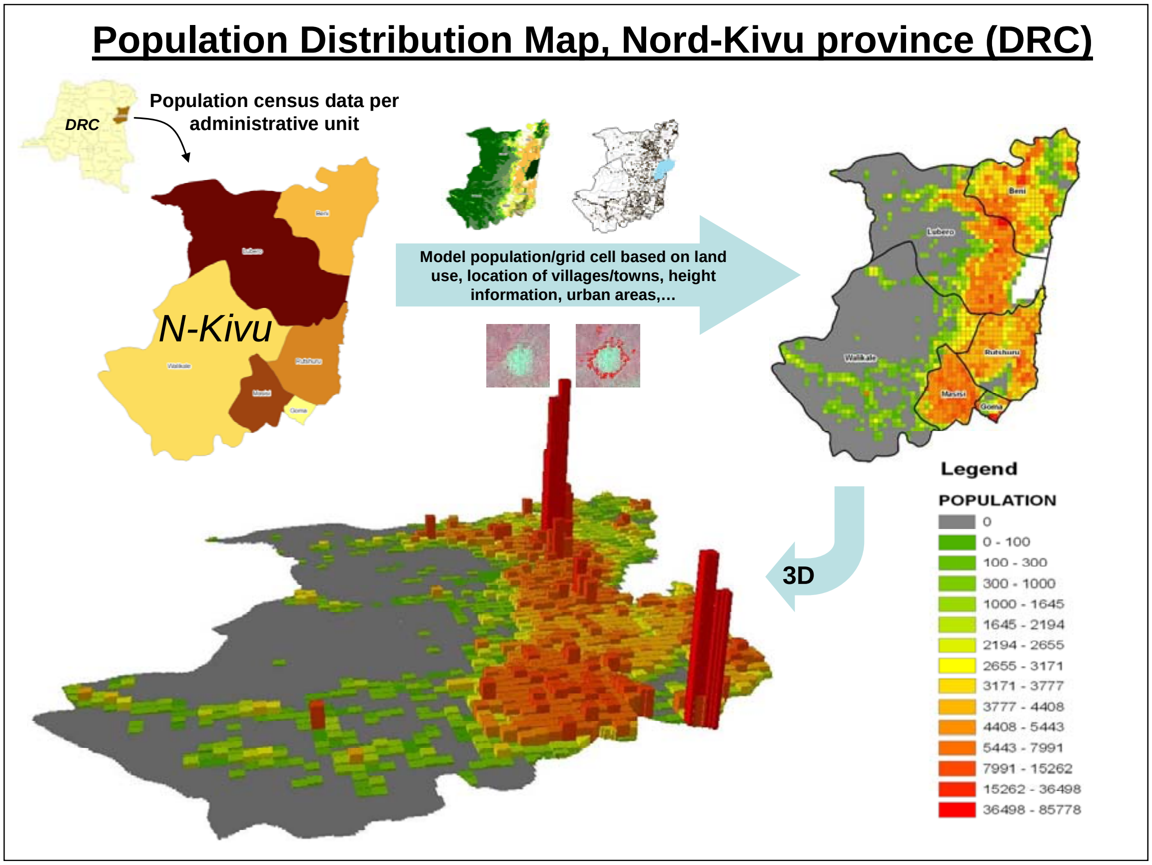

Figure 4: Population distribution map of EUROSENSE. The legend shows population figures per km^2.

The result of this process has been compared to Landscan disaggregation of census count. This worldwide population distribution dataset (Landscan 2008) has been provided by partners in G-Mosaic project (Joint Research center, EC).

A visual comparison between the LandScan dataset and the G-Mosaic population map shows that there are many differences between the datasets:

- The different approaches in their respective production are resulting in different products. Compared to Landscan, the modular method proposed by EUROSENSE in G-Mosaic clearly focus the spatial assumptions more on populated areas than on road to derive the pattern of population distribution.
- While the Landscan data is a black box, the developed model allows the integration of local and up-to-dat information. When new census population data becomes available, the model can be easily updated with this new information. B

It is clear that the lack of good validation data is a real difficulty in these regions. The absence of reliable and actual regional population census data is hampering both calibration and validation of the model. Nevertheless, the visual validation shows that the G-Mosaic population model is taking in account the known populated places, the delineation of large populated places based on satellite imagery and the population density linked to Land Use classes. Together with the fact that the sum of the cells in the EUROSENSE G-Mosaic population map equals the population in the

GPWv3*fe* dataset for that region, we can assume that, in lack of reliable validation data, the developed population map can be accepted as a usable product for the area.

4. Multi-risks concept in the crisis cycle

Knowing where people are, as proposed in the population distribution map is the first step in addressing human security. The second aspect in human security is addressed in the fourth section of this paper and refers to the analysis of risks and vulnerabilities.

The effective handling of a crisis requires a precise and spatial understanding of the different crisis situations, their possible impacts, mechanisms and actors (Voigt et al. 2009). EUROSENSE mainly developed services and products in the natural category of crisis, and specifically in this paper we refer to flood risk analysis services extended with multi-risk services applicable on a European scale. These risk products illustrate the type of EO and GIS developments that could be proposed to responsible authorities at the different stages in the crisis cycle but mainly in the prevention phase according to European norms such as the EC flood directive.

Designed with and for the responsible authorities in the frame of the SAFER (Services and Applications For Emergency Response) project, EUROSENSE's flood risk analysis services offer several customized services consisting in the production and maintenance of geo-information to support decision making. EUROSENSE mapping products help in preventing risks and deaths related to flood events and in setting up responsible policies. The large river systems of Central and Eastern Europe make these areas vulnerable to floods. By combining EO data with exogenous data and modelling techniques, EUROSENSE developed customized products in Bulgaria and Slovakia in support of flood risk management. These are replicable in all Europe.

Within the “multi-risk concept”, EUROSENSE spatially combines quantitative and qualitative socio-economic losses caused by natural hazards. These assets maps are indispensable to support decision making and prevention measurements in risk management. Figure 5 illustrates this multi-risk concept. The development of these assets maps meets different challenges: ensure (i) the harmonization at European level and outside the EU, (ii) the multi-risk transferability, and (iii) the delivery of dynamic multi-media or multi-format products to interact with users. The potential damage can be expressed in several ways: either quantitative (e.g. economical damage and affected people), or qualitative by analysis of the impact (e.g. on the environment).

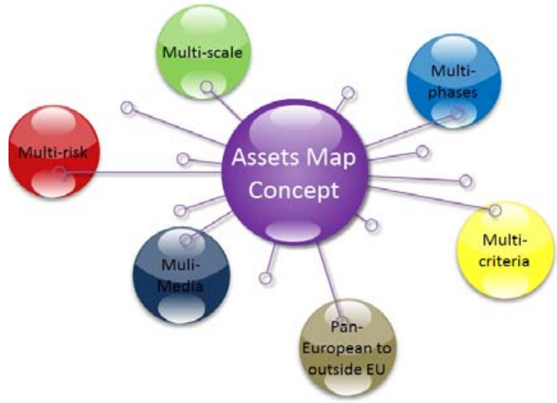

Figure 5: EUROSENSE Multi-risks concept of Assets mapping

Assets Mapping (AM) services integrate multi-criteria (either quantitative e.g. economical damage and affected people, or qualitative e.g. Impact on environment) into EO based geo-information models of risks to be used by emergency planners. Three scales of generic products are proposed within SAFER:

- Basic European Assets Map (BEAM) : scale < 1/100.000 - Resolution: 10m
- Higher Resolution Assets Map (HiRAM): 1/100.000 < scale < 1/10.000 (e.g. 1/40.000) -Resolution: 5m
- Detailed Assets Map Plus (AM+) : 1/10.000 < scale - Resolution: 1m

Challenges in the development of AM maps are (i) agreement on a multi-scale approach applicable at the European level and outside EU, (ii) multi-risk transferable, (iii) access to input /source data), (iv) dynamic multi-media or multi-format to interact with users.

The described products are produced in the frame of the GMES-project (Global Monitoring for Environment and Security) SAFER, funded by EC (European Commission). SAFER will reinforce the European capacity to respond to emergency situations: fires, floods, earthquakes, volcanic eruptions, landslides, humanitarian crisis. Referring to the recent floods (July 2010) in the Siret basin in Romania, the SAFER products of EUROSENSE will be further developed for this region. Besides SAFER, EUROSENSE is actively involved in several other GMES-projects including the development of the European Urban Atlas product (Geoland2).

5. Conclusions: Geospatial concepts and Tools to support EU security policy

At the level of research, ongoing changes to the map of Europe caused changes to the European security research strategy. A specific geospatial security research strategy is part of the current FP7 (EC Frame Program 7, and related projects) but also included in the plans of FP8. All this contributes to a more coherent definition by the EU of its security interests, of a coherent EU security concept and of instruments to implement such a concept.

This paper claims that geospatial technology and geospatial concepts can help in monitoring European human security in addressing two questions where people are and if they are vulnerable to specific risks. In fact, the cartographic representation and threat scenarios produced by geospatial scientists are requested by decision makers to improve their information. Earth Observation and complementary geospatial technologies integrate the current information flow to decision makers. Researchers have the responsibility to both use geospatial concepts and methods and communicate these concepts and the results of the analysis in a suitable way to decision makers. The use of GIS with its user friendly interface and tools provide information products in the form of maps help in this coordination process.

Several existing links between security policies such as the "Flood directive" and geospatial analysis have been highlighted in this paper by two particular examples. Evidence-based theories that explain security threats require models and qualitative and quantitative data on their causes. If operational products are developed, number of technical challenges are still to be solved by the research community.

Remote Sensing products developed through GMES research projects at the European level should be extended and specifically developed to address International Human Security. For humanitarian aid, development and environmental reasons, European Commission should get technical spatial information about risk to human. This means to make the spatial link between population/ assets and risks. Human security research would allow Europe to address issues in its Neighboring countries but also global challenges such as climate change and forest conservation. Geospatial technologies promote European research in developing countries where accurate information is significantly missing. Geospatial technology related to human well-being can support the European policy on the International sphere.

6. Acknowledgement

The authors would like to thank JRC partners in G-Mosaic for the exchange of information.

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Managing an emergency situation involving chlorine near Sibiu

Author: Lt. col Balcu Cosmin, Head of Sibiu County Inspectorate for Emergency Situations

S.C. Apa-Canal S.A. is an economical agent that has as main activity treating and delivering water, it also collects and purges residual water from the city of Sibiu. The agent collects water from various sources and disinfects it with chlorine. Due to its high quality no further treatment is needed to the water. The water is collected from three surface sources: Gura Riului, Sadu and Steaza – in conservation.

The water is treated with chlorine and that represents an important risk concerning the city of Sibiu. The main treating plant is located just a few hundred meters from Sibiu and has a storage capacity of fourteen tons of chlorine. The usual quantity of chlorine present on site is nine tons and every month they use 3.6 tons of chlorine.

The operator has a major accident prevention policy and has implemented several safety measures. In case of chlorine spill there is a system that neutralizes the substance. The contaminated air is aspirated into a tower and treated with soda tiosulphate and circulated until turned clean to release. In case of minor damage the recipient is submerged in lime solution.

This study aims at pointing out the risks involving such a quantity of chlorine so close to a large city and at revealing the safety measures that can prevent a major accident.

Maramures County - and its critical infrastructure

Author: Col. Nour Eugen, Deputy, County Inspectorate for Emergency Situations Maramures

Abstract: Maramures County, one of the most beautiful county, situated in the northern part of Romania, historical place, ceased by tourists for its UN heritage has also its risks that have to be taken into consideration. The paper presents the particularities of the county, the main risks and correlation with the existing critical infrastructure and its protection. Recently introduced as concept, the critical infrastructure protection concept is necessary to be developed and split by levels of responsibilities. A proposal shared responsibilities between agencies at the county level is presented to be use for further development.

SENSOR DATA MEANING EXTRACTION FOR EMERGENCY RESPONSE

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Keywords

Meaning extraction, Sensor data processing, Wireless Sensor Network, Emergency Response

Abstract

Wireless Sensor Network is an emerging technology that has demonstrated great potential in providing critical information from environments to facilitate emergency response. Sensor nodes deployed in the monitoring field can detect emergencies such as fire incidents with minimum human attention and maintenance. During the period of monitoring, a large amount of data can be collected. However, it remains a major challenge to make sense of the collected data, i.e., to extract the relevant knowledge from the raw data. This paper presented the research undertaken on meaning extraction from sensor data for facilitating ER. A state-of-art literature review on meaning extraction has been undertaken. A comprehensive analysis on what can be defined as “meaning” in the context of emergency response is provided. The research undertaken for extracting an example of “meaning”, the real-time development of an incident, is discussed in detail. An in-network aggregation-based contour mapping approach was proposed to extract distribution of sensor readings at perception level. Simulation results showed that the proposed in-network aggregation-based contour mapping can save energy consumption while maintains acceptable accuracy in comparison to contour mapping based on sensor data without aggregation.

1. Introduction

Wireless Sensor Network (WSN) is an emerging technology that has demonstrated great potential in providing critical information from environments to facilitate emergency response. A WSN consists of large arrays of battery-powered nodes, each of which can carry different types of sensors to monitor the environment and transmit data wirelessly. Sensor nodes are typically small-size, low-cost and low-power consumption. WSNs have been used in emergency medical care (Gao et al., 2008), in-home healthcare (Stankovic et al., 2005), civil infrastructural health monitoring (Kottapalli et al., 2003), emergency evacuation (Barnes et al., 2007). These applications have proved the capabilities of WSN in improving the efficiency of Emergency Response (ER).

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However, it is a challenge to make sense of the large amount of collected sensor data. A variety of data mining techniques have been proposed to find patterns from sensor data. Typical data mining tasks are such as classification, prediction, location optimization. The results of these data mining tasks are extracted prediction models, classification, or location for facilities. However, these patterns, although considered as "knowledge" from a technology perspective, are not the knowledge that users require to facilitate their tasks. Therefore, it can be argued that there is a need to build the link between what has been considered as "information" in the existing research and the information actually required from a real application. Therefore, although WSNs can be deployed as a data collection method for many different applications, as Römer (2008) stated, "it remains a major challenge to make sense of the collected data, i.e., to extract the relevant knowledge from the raw data."

Meaning extraction is an emerging technology that identifies elements of information contained in datasets that imply meaning in the context of application and can be interpreted by the users to facilitate their tasks. Meaning extraction is a necessary step to make sensor data work for ER. On one hand, as the analysis of the features of sensor data demonstrated (Yang et al., 2010), sensor data is meaningless unless associated with time and location. On the other hand, individual sensor readings, even if they have been cleaned, are not what Incident Commanders (ICs) expected to see. Requirements from both the features of sensor data and ER applications have demonstrated the necessity of extracting meanings and semantics of sensor data in order to provide support for ICs.

It can be argued that the process of making sensor data work for ER is not complete until all three steps are accomplished: (1) it needs to be properly pre-processed, (2) it must be stored and managed efficiently, and (3) meaning must be extracted from the data prior to its presentation to the emergency responders. Out of the three steps, meaning extraction brings most directly added benefits to ICs' situation awareness. Endsley (1995) demonstrated the importance of situation awareness in decision making in dynamic environments, and presented a theoretical model of situation awareness that consists of three levels: perception of elements in current situation, comprehension of current situation and projection of future status. This paper targeted the issue of meaning extraction for emergency response. It describes a comprehensive analysis on what can be considered as "meaning" in the context of ER, and the study undertaken for extracting an example of the possible meanings: the real-time development of an incident.

The rest of the paper is organised as follows. Section 2 reviews the state of art of the existing research in meaning extraction. Section 3 analyses what can be considered as "meaning" in the context of ER. Based on the analysis, the real-time development of an incident was chosen as the targeted example of "meaning". Extraction of the real-time development of an incident was studied at the perception level of situation awareness in Section 4. The study of extracting "the distribution of sensor readings" using an in-network aggregation-based contour mapping approach was presented in detail. Simulation results were analysed in Section 5. Finally, the contributions of the research contained in this paper are concluded and future work is suggested in Section 6.

2. The State of the Art in Meaning Extraction

Meaning extraction has been applied in a wide variety of domains, e.g. natural language processing, web semantics analysis, as well as text mining. In the context of natural language processing, the part of sentence has been considered as "meaning", e.g. Subject part, verb part, object part, and adverb part (Bajwa, 2010). In the context of web semantics analysis, the similarity distances of literal objects has been considered as "meaning" (Cilibrasi and Vitanyi, 2006). In the context of text mining, acronyms and their meanings has been considered as the object of data mining (Kempe, 2006). According to the various contexts of applications, different information from data has been considered as "meaning". This demonstrated that meaning extraction is highly domain-specific. As a result, the meaning extraction methods utilised are highly related to the specific meaning extraction problems.

In the context of meaning extraction on sensor data streams, the typical way of defining what information conveys "meaning" is to represent it in the form of meta-data, features or frequently occurred patterns. Kariya and Kiyoki (2005) used output from taste sensors to compute meta-data of taste impression, which implies the relations between different food and preferences. Hunter and Colley (2007) proposed an online unsupervised learning method to analyse human behaviour in real-time by extracting features that can represent places visited and routes taken between places from sensor streams. Dong and Calvo (2009) addressed the problem of the interestingness of the automatically-extracted patterns (association rules) and proposed to integrate user-specified interests to filter the large amount of statistically significant association rules.

Despite the wide applications of meaning extraction, there is very limited research on meaning extraction in the context of ER, even less research on meaning extraction from sensor data for ER. Wickler and Potter (2009) proposed to derive features from given sensor data which will be or be very close to information useful for fire-fighters, e.g. the height of smoke layer in a room, as a necessary step to provide decision support. However, there is a lack of a comprehensive analysis of what can be considered as "meaning" that applies to ER in general and the detailed technology proposal to extract the "meaning". Hu et al. (2007) focused on extracting flood area for emergency response of flood disaster. However, the proposed method is based on radar data, which has different features from sensor data. There is no other research in this category according to the author's best knowledge.

The existing meaning extraction methods typically utilised statistical methods, including Markov Logic (Bajwa, 2010), Bayesian networks, decision trees, logistic regression, neural network etc. However, statistically significant patterns may not be of significance in the context of ER because emergencies such as fires are usually events of low probability. There is also a lack of research on meaning extraction for on-site ER. Therefore, there is a need for a meaning extraction method for on-site ER.

3. Ways of Conveying "Meaning"

This section analyses what information can be considered as "meaning" in the context of ER in terms of extracting it from sensor data. Sensor data can facilitate ICs and their command support team to better achieve their goals by providing them the ability of seeing inside the building and getting the required information during the mobilisation phase (on their way to the premises).

Our field studies with UK Fire Brigades identified that the following pieces of information be considered as "meaning" in the context of ER:

- The occurrence and characteristics of an incident

The issue of the availability of information immediately after an incident has been revealed both in the literature and in interviews with ICs. "There is a significant lack of information about the scale of a disaster in the immediate aftermath" (Manoj and Baker, 2007). Therefore, extracting the occurrence and characteristics of an incident based on sensor data and providing them to the emergency response crew during the mobilisation phase can fill in the gap of lacking information about an incident in the immediate aftermath. It can also improve their situation awareness and facilitate early planning and preparation.

More specifically, it is proposed that the occurrence of an incident can be represented by an alarm associated with confidence, whereas the characteristics of an incident can be represented by the time, the affected area, the type and the severity of the incident.

- Real-time development of an incident

The lack of available information about an incident in the immediate aftermath is followed by large amounts of imprecise information (Manoj and Baker, 2007). The interviews with ICs revealed that the imprecise information is due to a lack of ability to retrieve the required information via reliable technology means. Hence, providing the real-time development of an incident can enable ICs to have better situation awareness, and facilitate their dynamic risk analysis.

More specifically, situation awareness analysis suggested that the real-time development of an incident can be represented in three levels, perception level (multiple granularity of the distribution of sensor readings in real-time), comprehension level (the distribution of level of seriousness in real-time), projection level (the direction, speed of incident development; the projected distribution of level of seriousness; the projected potential risks).

Meaning can be conveyed by a number of ways. However, this paper only concentrates on the extraction of one of the examples: real-time development of an incident. More particularly, it describes the detailed process of extraction at the perception level and comprehension level.

4. Extraction of Real-time Development of an Incident at Perception Level: Distribution of Sensor Readings

This section describes in detail the study of extracting real-time distribution of sensor readings, which represents the real-time development of an incident in perception level. Based on the understanding that in-network aggregation can provide benefits of reduced energy consumption on data transmission, an in-network aggregation-based contour mapping approach is proposed to extract the real-time development of an incident at perception level.

Without loss of generality, the scenario is considered where a WSN consisting of N nodes are deployed in a polygon plane at a certain density to monitor incidents. Sensor nodes are battery powered, thus present energy constraints. Each node is fixed at its location but can communicate with other nodes within a certain range. It is assumed that sensor nodes know their geographical location information, either during the deployment stage or through RF-based beacons. It is also assumed that the WSN is organised in a tree network topology where the sink is the root node and each parent node can perform local processing of its children.

The proposed in-network aggregation-based contour mapping approach consists of three steps: sensor node level preparation of observation, multi-granularity aggregation and reconstruction of contour maps at gateway.

Sensor Node Level Preparation of Observation

At each sensor node, observations are taken and checked whether they are valid. Invalid observations will be rejected. Data cleaning algorithms can also be applied at this level to improve the quality of the observed data. However, the details of data cleaning are not the focus of this paper. After being validated and cleaned, observations will be prepared and transmitted to its parent node.

Multi-granularity aggregation

At a parent node, the observations that are in the neighbourhood and have similar values are aggregated according to the desired temporal and spatial granularity. The aggregation rule at the parent node is formally defined as follows:

Observation from sensor node s_i and observation from sensor node s_j is aggregated if

- the time coverage of sensor node s_i is the same as the time coverage of sensor node s_j
- the distance from sensor node s_j to s_i is less than a threshold C, denoted as $dis(s_j, s_i) < C$
- the difference between their values is within a threshold D, denoted as $v_{s_j} - v_{s_i} \le D$.

The output message of the aggregation contains three parts, denoted in the format of <*v*,*t*,*r*>, where v is the aggregated value in the range of (v_{min}, v_{max}), t denotes the time coverage of the aggregated value, and r is the region of the aggregated value represented by a polygon that covers all the nodes for the aggregated value *v*. The aggregated value *v* falls in the range of $v_{\min} = v_a - \sigma$, $v_{\max} = v_a + \sigma$, where v_a is the average and σ is the standard deviation. The average v_a is calculated by equation (1), where *T* and *R* represent the desired temporal granularity and spatial granularity respectively, $v_{(s,t)}$ represents the value of node *s* at time *t*.

$$v_a = \frac{\sum_{s=1}^{R} \frac{\sum_{t=1}^{T} v_{(s,t)}}{T}}{R} \qquad (1)$$

The aggregated time coverage *t* is the same as the time coverage of readings from each individual sensor node. The aggregated region *r* is represented by the merged polygon denoted as $r = r_1 \cup r_2 \cup \cdots \cup r_R$, where r_i, i=1, ..., R represents R numbers of regions that are aggregated.

Consider a simple example shown in Figure 1, a network of 36 sensor nodes is deployed in a grid. They are organized in clusters of four spatially adjacent nodes, with the cluster head marked in grey background, e.g. s7 is the cluster head of s1, s2, s7 and s8. Each sensor node takes observations of temperature, e.g. the in-network observations at 11:00 are as shown in the top right corner of each square in Figure 1 (a). Figure 1 (b) demonstrates how the multi-granularity aggregation is achieved. For simplicity, the desired temporal granularity and spatial granularity is assumed to be 1 and 4 respectively, which means the sensor data are aggregated within each cluster for each time instance.

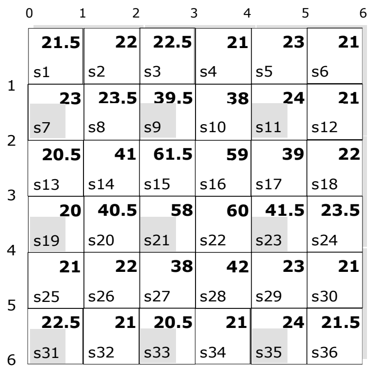
For instance, s1, s2, s7 and s8 are within a threshold distance to each other (the same cluster), the difference between their readings are less than 5 ℃, therefore, their observations can be aggregated together. The output of their cluster head s7 consists of the average value of the four (22.5 ℃), the time it represents (11:00) and the region it represents, denoted by the coordinates of the vertices of the region. In the cluster of s3, s4, s9, s10, the observations of s3 and s4 can be aggregated together because the difference between their readings are less than 5 ℃, however, s9 cannot be aggregated with s3 and s4 because the difference between their readings are greater than the threshold (5 ℃), neither can s10. Nevertheless, s9 and s10 can be aggregated together. Therefore, the output of the cluster head s9 consists of two lines: the average reading of s3 and s4 (21.75 ℃) and the time and region it represents, as well as the average reading of s9 and s10 (38.75 ℃) and the time and region it represents. Similarly, aggregation takes place in other clusters, and the output of all the cluster heads is shown in the right column in Figure 1 (b).

Reconstruction of Contour Maps

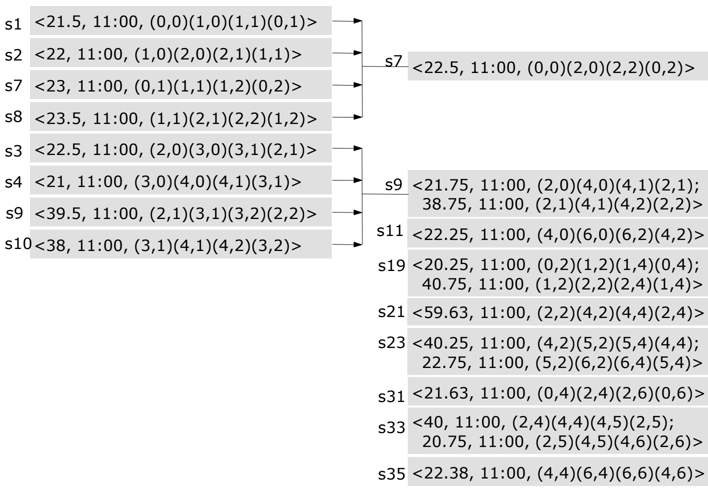
Upon receiving the collection of output messages from the WSN, contour maps can be reconstructed by

- scanning the output messages <*v*,*t*,*r*> and sorting them in descending order of *v*;
- merge the regions where the difference between their *v* is within the threshold D;
- assigning each <*v*,*t*,*r*> a colour code, the higher *v* is, the higher the saturation of the colour is;
- constructing the isoline of each region, and filling the region with the assigned colour.

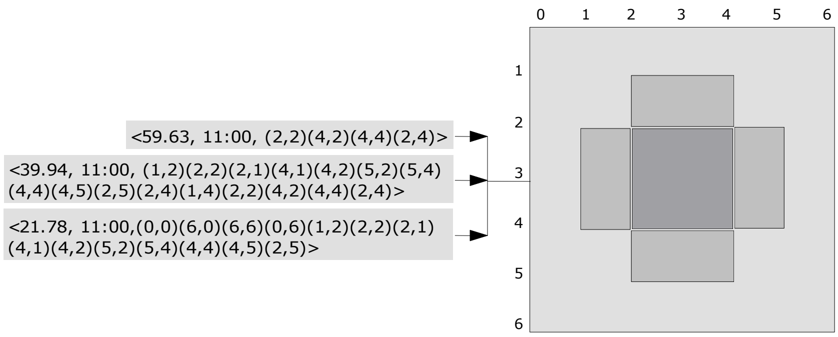
Consider the simple example again, a user can collect output messages by attaching a computer to the sink node of the network. There the collection of output messages shown in the right column of Figure 1 (b) is sorted and merged, the result of which is three regions organized in the descending order of value *v*, with the time and region it represents. Assigning 75%, 50% and 25% grey to the three regions respectively, the contour map of the temperature distribution in the monitored region at 11:00 can be reconstructed, and the result contour map shown to the user is as demonstrated in the right column of Figure 1 (c).



(a) Sensor node level observation



(b) Multi-granularity aggregation



(c) Reconstruction of contour maps

Figure 1. An example of in-network aggregation-based contour mapping approach.

5. Simulation Analysis

The performance of the proposed in-network aggregation-based contour mapping approach was compared to constant monitoring of sensor data without aggregation. The aim of the simulation was to analyse the energy saving benefits of the proposed approach and ensure that in-network aggregation does not add unacceptable error in the resulting contour maps.

Simulation Setup

The simulation system considered the scenario of monitoring fire emergency events from a 200×200 network of sensor nodes. Each node has four types of sensors (temperature, smoke, CO, flame). Grid deployment is assumed for the simplicity of the simulation. The block diagram of the simulation system is shown in Figure 2.

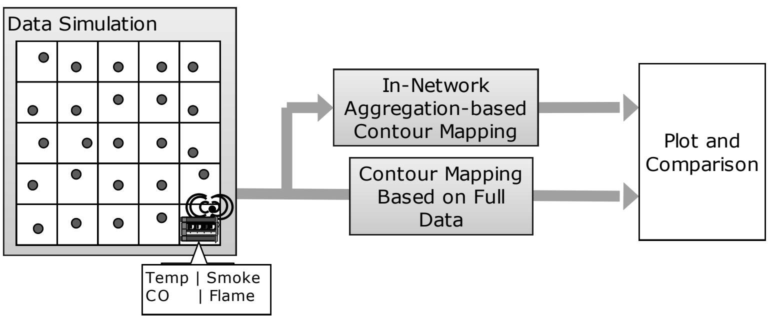


Figure 2. The block diagram of the simulation system.

Data stream from the network for a time duration of 300s was simulated. An example plot of simulated data from one sensor node (including temperature, smoke, CO and flame readings) is shown in Figure 3. One event was added during the duration of simulation, represented by the sharp increase on sensor readings.

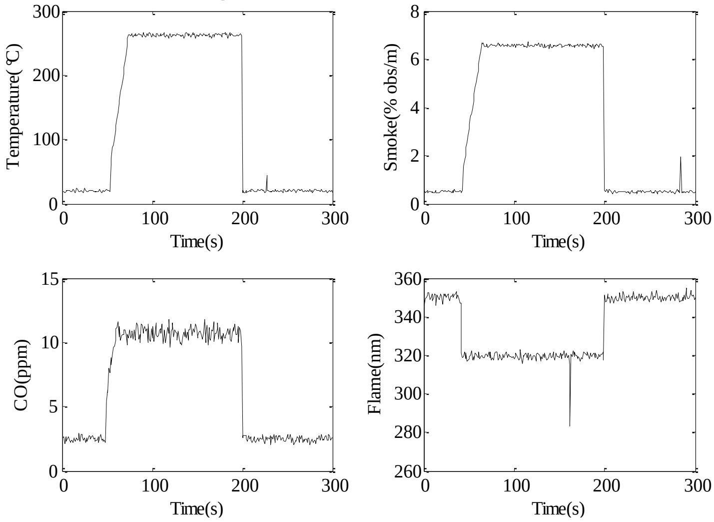
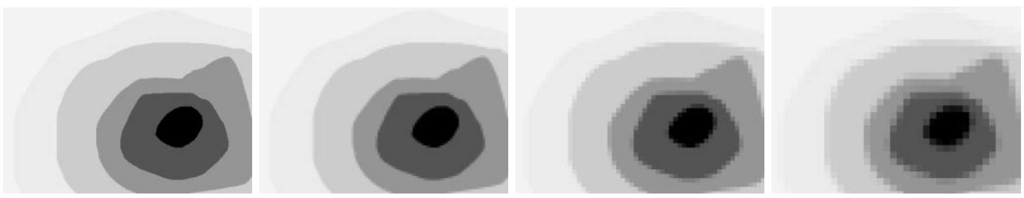


Figure 3. An example simulated data for a sensor node in a 5×5 network for the duration of 300s.

<u>Performance Evaluation</u>

The performance of the proposed in-network aggregation-based contour mapping approach was compared in comparison to contour mapping based on full data from the WSN on two metrics: the mapping accuracy, the data transmission cost.

Figure 3 demonstrate the mapping accuracy of the proposed in-network aggregation-based contour mapping approach in comparison to contour mapping based on full data. Figure 4 (a) shows the output of contour mapping based on full data, whereas Figure 4 (b)-(d) demonstrates the output of the proposed in-network aggregation-based contour mapping approach at granularity level of 4, 9, 25 respectively. The value of granularity level means the number of nodes on which the aggregation applies. As shown in Figure 4, in comparison to contour mapping based on full data, the mapping accuracy of the proposed in-network aggregation-based contour mapping approach with a granularity level up to 25 is still within an acceptable range despite minor reduction.



(a) Full data (b) Granularity=4 (c) Granularity=9 (d) Granularity=25

Figure 4. Example contour map plots.

However, for the minor reduction of mapping accuracy introduced, a significant saving on the data transmission cost was achieved by the proposed in-network aggregation-based contour mapping approach, as shown in Figure 5. The network size is measured by the maximum hops required for a node to transmit a message, in other words, the depth of the tree network topology. The data transmission reduction is measured by the difference on the total number of message forwarding required to collect the data for contour map construction. For example, under the condition was granularity =4, when the network size varied from 5 to 20, the data transmission cost reduction was from 4096 to 2.09×10^{13} number of message forwarding.

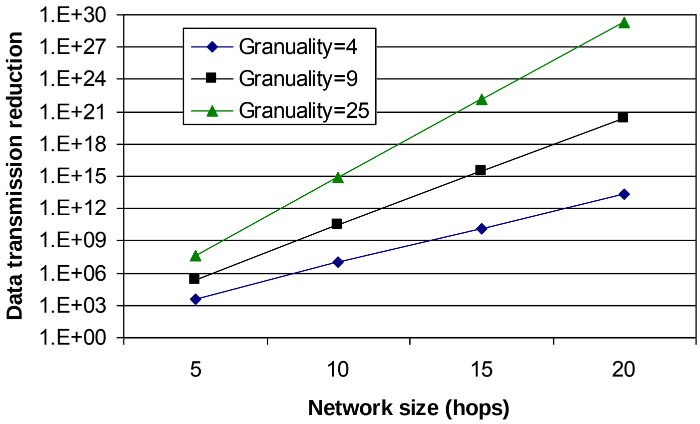


Figure 5. Data transmission reduction against network size.

6. Conclusions and Future Work

This paper presented the research undertaken on meaning extraction from sensor data for facilitating ER. It provided a comprehensive analysis on what information can be considered as “meaning” in the context of ER. Examples of “meaning” are 1) the occurrence and characteristics of an incident, and 2) the real-time development of an incident. This paper targeted the problem of extracting the real-time development of an incident from sensor data. An in-network aggregation-based contour mapping approach was proposed to extract a distribution of sensor readings at perception level. Simulation results showed that the proposed in-network aggregation-based contour mapping can achieve significant reduction on data transmission cost in comparison to contour mapping based on sensor data without aggregation while still maintaining acceptable accuracy.

The contributions of the research contained in this paper can be summarized in two-folds. Firstly, by the comprehensive analysis of what can be considered as “meaning” in the context of ER, the design space (sensor data processing approaches) is linked to user space (the interpretation of information). Secondly, the proposed contour mapping approach for extracting the real-time development of an incident performs multi-granularity in-network aggregation, in contrast to collecting full data from WSN. Therefore, it can achieve significant data transmission cost reduction. Such characteristics as requiring low data transmission cost thus low energy consumption make the approach suitable for an on-site emergency response system where the requirement of computation efficiency and reliability is high whilst resources are limited. Providing the real-time development of an incident extracted from sensor data to the emergency responders during their response to an incident can bring improved situation awareness, thus can lead to a better result of ER.

The situation awareness of emergency responders consists of three levels: perception, comprehension and projection (Endsley, 1995). This paper only covered the extraction of real-time development of an incident at perception level. Therefore, future work will investigate on extracting real-time development of an incident at comprehension and projection level.

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A STUDY ON QUICK-HIT APPROACH FOR RA AND BIA IN BCP

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Keyword

BCP, RA, BIA, Quick-Hit, Staged-Development

Abstract

Business continuity planning (BCP) activities include policy development, planning, mitigation, training, and evaluation. Risk assessment (RA) and business impact analysis (BIA) are necessary for establishing the contingency plan and are traditionally conducted by a staged development approach. However, the approach in general spends more time compared to the scheduled time during the BCP project because of education, survey and analysis. Also this took a loss financially, resulting from the low quality of the plan. The facts will be shown after analyzing the BCP projects of other business firms.

This paper is to introduce a quick-hit approach as a recommended alternative when obstacles arise in the RA and BIA on business environment. This approach is composed of process, components, and outputs and illustrates the results of the Quick-hit and the staged-development approach in terms of BCP projects.

The suggested approach is an alternative and efficient method for the RA and BIA when dealing with limitation of time, small project budget, low quantity of disaster records, and small size of business firms.

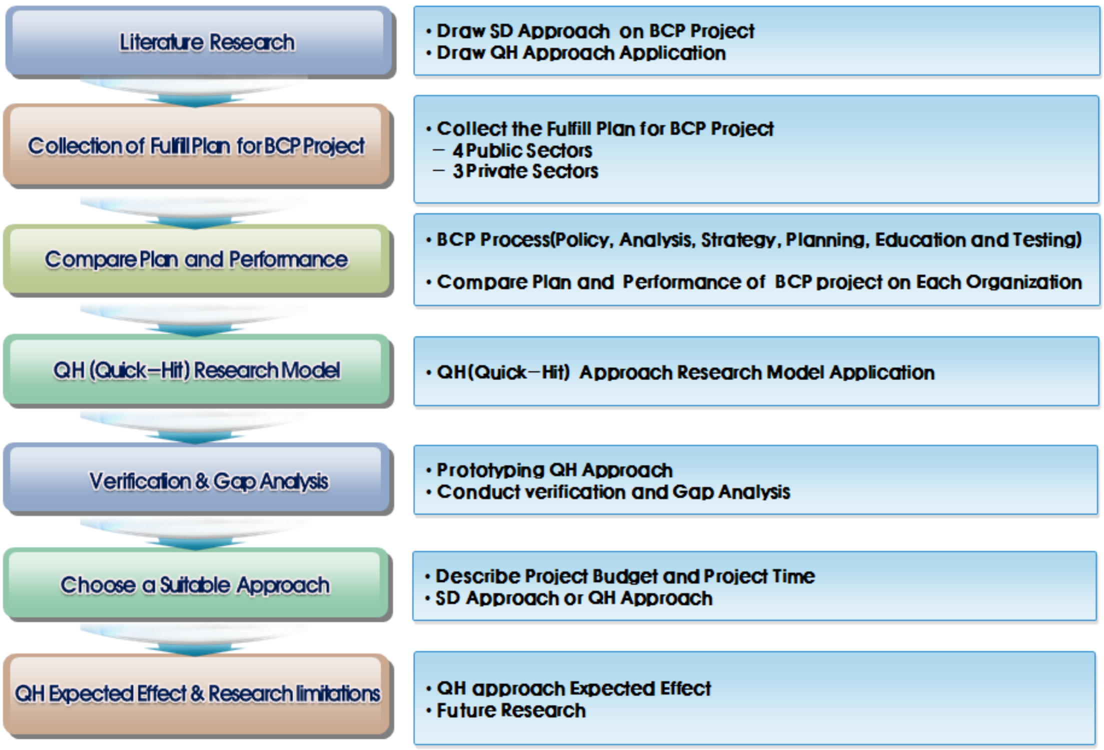
1. Introduction

There have been severe economic and social causalities in many parts of the world due to various disasters. Not only there are abnormal accidents like terrorism but there are possibilities where minor incidents can develop into a massive disaster. Even in Korea, there are increasing incidents that harm our social safety that are caused by economic crisis, influenza A(H1N1), pandemic, and cyber terror etc. In order to prevent natural, human and social disasters, national government and private organizations are actively seeking to establish a systematic strategy and method based on Business Continuity Planning (BCP) for business continuity.

Currently, public and private sectors are working to establish BCP. However, in order to set up BCP, a lot of time and human resources such as professional experts are required for policy establishment, planning formation, mitigation activities, education and training as well as evaluation and management. Moreover, small sized businesses lack the understanding of BCP importance, and human resource to establish BCP. Thus, this study will examine BCP standard process by country through Staged Development (SD) approach in order for BCP establishment. Then the data on planning and the accomplishment of Risk Assessment (RA) and Business Impact Analysis (BIA) process that require the most time and human resources will be comparatively analyzed. By investing the problems in RA/BIA process, Quick-Hit Framework will be proposed in order to effectively control these problems. Finally, results of Quick-Hit (QH) approach will be reviewed.

The key content of this study can be summarized into six domains as shown in [Illustration 1]. First, literature review will be processed for theoretical base study to apply the SD approach and QH approach for BCP project. Secondly, data for BCP project implementation will be collected for BCP RA/BIA process targeted to public and private sectors. Thirdly, the planning and results of risk management of a particular organization will be analyzed based on the collected data. Fourth, the Prototype will be established based on the research model which is developed from thorough literature review. Fifth, the GAP examination will be progressed following the BCP project rooted in the SD approach. Lastly, this study will describe the expected effects of QH approach and limitations of this research.

[Illustration 1] Research Method & Flow



2. Literature Review

2.1 BCP Process

BCP process by country is categorized by the factors shown in [Table 1]. Each country BCP process goes through the following procedures: policy establishment, risk analysis, strategy, planning, education and training, evaluation and management. The process also provides a standard policy to all institutions for disaster prevention or to minimize damage and restore back in a systematic and timely manner when faced with severe crisis. BCP processes for each country are as describe in [Table 1].

[Table 1] Domestic & International BCP Process

Business Disaster Mitigation Activity Planning Standard Establishment	BS25999	IPOCM (Incident Preparedness and Operational Continuity Management)	ASIS SPC.1-2009 (American Society for Industrial Security)	NFPA 1600	ISO 31000
2.1.6 Arrangement of Disaster Mitigation Related Organization	2. Understand of Organization	**6 Planning**	**3 TREMS AND DEFINITIONS**	5.2 Laws and Authorities	5.1 General
2.2 Disaster Mitigation Activity Operational System	2.1 Business Impact Analysis	6.1 General	**4 ORGANIZATIONAL RESILIENCE (OR) MANAGEMENT SYSTEM REQUIREMENTS**	5.3 Risk Assessment	5.2 Communication and consultation
2.2.1 Disaster Mitigation Activity Organization	2.2 Indispensable Requisites Understanding for Continuity Secure	6.2 Legal and other requirements	4.1 GENERAL REQUIREMENTS	5.4 Incident Prevention	5.3 Establishing the context
2.2.2 Function of Disaster Management	2.3 Risk Assessment	6.3 Risk assessment and impact analysis	4.1.1 Scope of OR Management System	5.5 Mitigation	5.3.1 General
2.2.3 Disaster Management Administration & Financial		6.3.1 Hazard, risk and threat identification	4.2 ORGANIZATIONAL RESILIENCE (OR) MANAGEMENT POLICY	5.6 Resource Management and Logistics	5.3.2 Establishing the external context
		6.3.2 Risk assessment	4.2.1 Policy statement	5.7 Mutual Aid/Assistance	5.3.3 Establishing the internal context
3 Disaster Mitigation Activity Plan Establishment		6.3.3 Impact analysis	4.2.2 Management Commitment	5.8 Planning	5.3.4 Establishing the context of the risk management process
3.1 Disaster Risk Management			4.3 PLANNING	5.9 Incident Management	5.3.5 Defining risk criteria
3.1.1 Hazard Distinguish			4.3.1 Risk Assessment and Impact Analysis	5.10 Communications and Warning	5.4 Risk assessment
3.1.2 Risk Assessment		6.4 Incident preparedness and operation continuity	4.3.2 Legal and Other Requirements	5.11 Operational Procedures	5.4.1 General
3.1.3 Impact Analysis		**7 Implementation and operation**	4.3.3 Objectives, Targets, and Program(s)	5.12 Facilities	5.4.2 Risk identification
3.1.4 Mitigation of Disaster Hazard		7.1 Resources, roles, responsibility and authority	4.4 IMPLEMENTATION AND OPERATION	5.13 Training	5.4.3 Risk analysis
3.2 Disaster Mitigation Activity Plan Establishment		7.2 Building and embedding IPOM in the organization's culture	4.4.1 Resources, Roles, Responsibility, and Authority	5.14 Exercises, Evaluations, and Corrective Actions	5.4.4 Risk evaluation

• Business Disaster Mitigation Activity Planning Standard Establishment

The object of the establishment and management of the Business Disaster Mitigation Activity Planning is to strengthen corporate disaster mitigation and gain business continuity. Moreover, it directs the following processes: disaster management standard system, disaster mitigation activity planning establishment, disaster mitigation activities, education and training. At the same time, it describes the definition, rules, scope and steps of disaster mitigation activity evaluation [12].

• BS25999-1, BS25999-2(United Kingdom)

BS25999 is composed into two parts, BS25999 Part1 is about guidelines and recommendation for business continuity [2] whereas Part2 describes all the necessary conditions to obtain certification for established business continuity system [3].

• ANSI/NFPA 1600

General standards are regulated for disaster/risk management and business continuity program [7].

• Risk Management-Principles and Guidelines (ISO 31000)

General rules are prescribed to manage business risk [10].

• ASIS International

It is composed of the same elements (policy, planning, establishment and management, performance evaluation, corporate manager review and etc) as the all hazards risk management systems draft best practices standards ISO/PAS 22399 [1].

• IPOCM (Incident Preparedness and Operational Continuity Management)

It is a framework that provides overall management process to verify potential effects threatening institutions and minimize its effects [5].

2.2 Definition and Process of RA and BIA

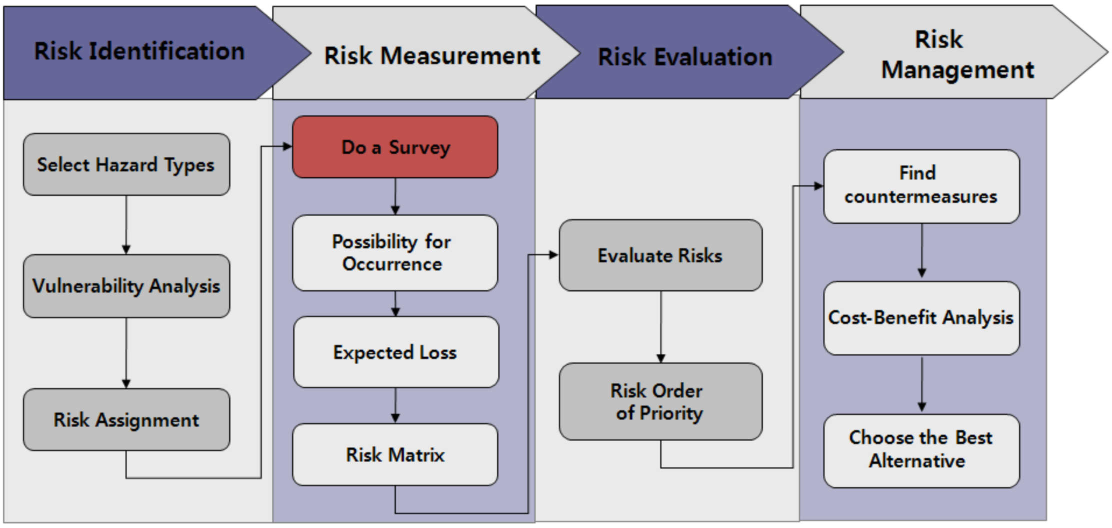
Risk Management is the basic step in BCP process that is performed by targeted organizations. This paper defines that risk management includes risk assessment (RA) and business impact analysis (BIA).

• Definition and Process of RA

Risk Assessment is defined as the quantitative and qualitative evaluation of all the possible factors and unexpected management environment both internal and external like disaster, hazard, threat and vulnerability that can create damage and loss to a particular agency [12].

Since RA may occur or may not occur based on the possibility, all available types, factors, and threats of risk of a targeted agency must be selected and defined. Furthermore, there must be solutions to mitigate, prevent, response and restore from the selected risk. At the same time, this stage reflects the process where the agency's risk can be identified, risk can be measured and countermeasures to mitigate risk can be selected in order to assist its BCP activities. Finally, RA aims to provide solutions by deducting potential risk of a particular agency and to use it the basis information for risk management plan (strategy, planning, mitigation resolution, etc)[4][8] [12].

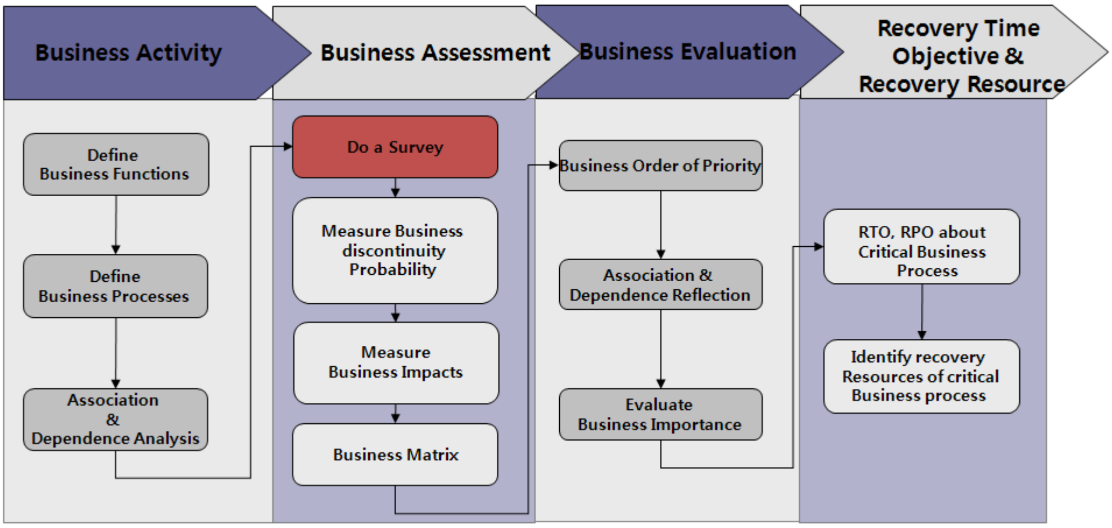
[Illustration 2] RA Process



• Definition and the Process of BIA

Business Impact Analysis (BIA) is the process to identify the potential losses that are caused by the core process and its suspension/break [12]. The purpose of BIA is to provide the data to support business continuity to overcome the losses when a risk that has been previously analyzed and expected occurs in the core sector. In addition, BIA scrutinizes the impact in between business by considering the importance and speed of assigned work. Moreover, BIA concentrates on determining the business priority, minimizes the financial losses through rapid restoration in order to maintain business continuity [12].

[Illustration 3] BIA Process



2.3 Staged-development and Quick-hit approach in terms of BCP projects.

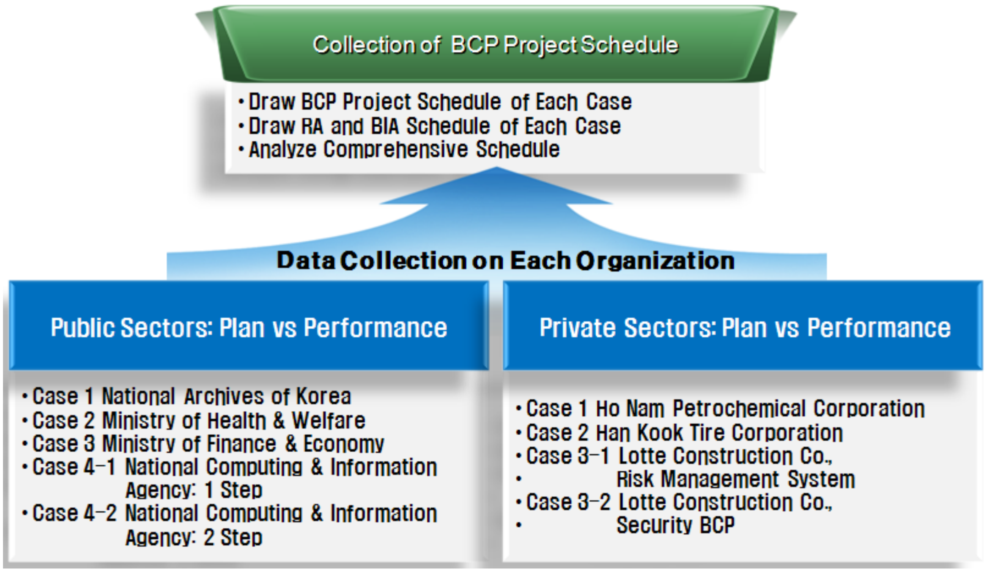
SD approach bases on the stage development. The advantage of this approach is that risk that can be arisen during the development phase can be minimized by satisfying all the client requirements by stage based on stage development process [9]. Furthermore, it moves to the next stage only when each level has been completed.

Although SD approach can be managed easily with clear cut process for each stage, a lot of time is required for analysis and it is hard to manipulate/edit once the analysis is complete. Despite possessing basic resources (labor, capital and time) to develop the BCP program, it is challenging to satisfy all the core requirements of the client. Quick-hit approach can clearly identify client needs in a short time period [9]. When general analysis method is used, there may in different understandings between the business and the client. But, QH can assist communication between the client and the developers that reduces the risk for the project. Moreover, QH's advantage is that it can easily apply recent technology.

3. Data collection for targeted organization performing risk management

The project schedule of planned risk management of the BCP project based on traditional BCP process (SD approach) and the actual project schedule implemented must be compared. Therefore, the data have been collected from organizations (both public and private sectors) that precede the existing BCP project (Refer to [Illustration 4]).

[Illustration 4] Data Collection on Public & Private Sectors

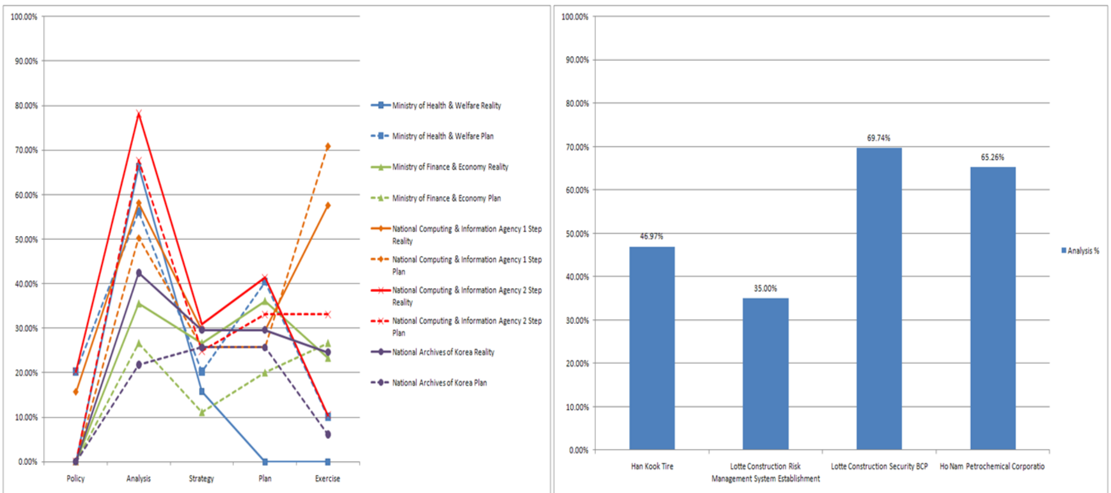


4. Evaluation of planned vs. performed for risk management

Based on the collected data (4 public and 3 private organizations), implementation plan of the BCP process by stage has been evaluated. First, the scope of the project (policy, analysis, strategy, planning, education and training) has been selected. Second, the Work Breakdown Structure (WBS) by stage of BCP process vs. the entire WBS had been examined for each organization. At the same time, the change management when the actual BCP is implemented is reviewed according to WBS.

Like the reviewed result [Chart 1], the analysis process schedule takes up 50.3% of the entire project schedule. The analysis stage also impacts the projects schedule by 11.6% more than the initial schedule (WBS). As a result, it has a great impact on the implementation of other BCP process (policy, strategy, planning, education and training). Therefore, in order to resolve problems such as over supplied resources for risk management and the delay of the initial schedule (WBS), a new solution is needed to efficiently develop the analysis stage. In this study, the Quick-Hit approach that can identify the core risk factors and evaluate the impact is recommended.

[Chart 1] Comparison of Plan and Performance



5. Research Model

For an efficient risk management, QH approach framework is needed as a base. Thus, the developed framework shown in [Illustration 5] is proposed for use to set off from the traditional BCP process of surveying the practical manager.

[Illustration 5] Research Model

Base on the QH approach framework procedure, targeted organization and interviewees such as decision-makers or CEOs or managers are selected for interview to process the risk management.

5.1 Organization for Risk Management

It is the process to select the organization which will conduct risk management and identify risks that exist in the organization. In order to verify the risks, the hazards that impact on businesses through vulnerability analysis must be identified on the limited hazard scope. Indeed, in this work area, the organizational charts, business activities and various hazards are deducted.

5.2 Interviewee Selection

Interviewee selection is the stage after identifying the risks, where interviewees for RA/BIA are chosen. Targeted interviewees are individuals who process the core decision making process of the organization like CEOs and executive managers. Therefore, in the interviewee selection process, the responsibilities and roles of the interviewee at the organization must be described.

5.3 Risk Management Interview

Risk Management Interview is the stage where the interviewee is asked about the identified risks of RA/BIA. The following questions are asked in this order: risk existence (What can be wrong?), the probability of the occurrence (What is the likelihood that would go wrong?) and the result (What are the consequences if it goes wrong?)[6][11]. Therefore, in order to make progress the risk management interview, the interview schedule and the interviewee selection must be prepared ahead of time.

5.4 Result Analysis

The Interview result is the stage to combine the interview results and analyze it. In the result analysis, risk identification, risk evaluation, and business impact analysis are verified.

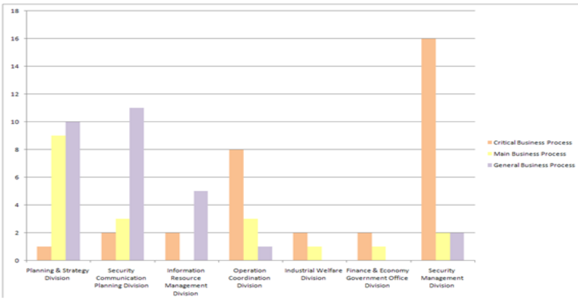
6. Research Model Inspection and Gap Analysis

In order to verify this research model, the targeted organization(Case 4-1) has been selected for risk management (A:planning and strategy department, B:security communication planning department, C:resource management department, D:general operation department, E:industrial welfare department, F:public administration and finance department, G: security management department) in order to proceed the interview for the representatives (seven) for each department to evaluate business impact and risk analysis. [Chart 2] is the result after evaluating the business impact based on data collected in Case 4-1 through SD Approach and QH Approach. In the business impact analysis, there are barely any differences in the results of SD Approach and QH Approach while their similarities are highly correlated. The results for risk SD Approach and QH Approach are categorized similarly and with high correlation.

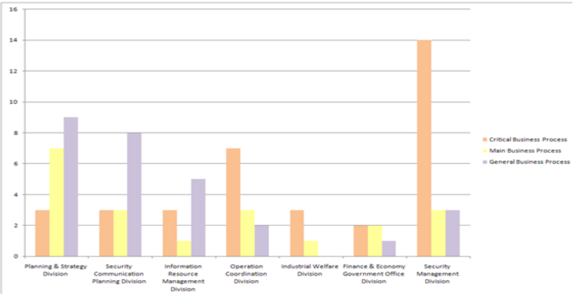
[Chart 2] RA Result of SD Approach and QH Approach

Case 4-1 Business Impact Analysis Of Each Division

Business Classification (Division)	Staged development approach Number of Each Business Level			
	Critical Business Process	Main Business Process	General Business Process	Total
Planning & Strategy Division	1	9	10	20
Security Communication Planning Division	2	3	11	16
Information Resource Management Division	2	0	5	7
Operation Coordination Division	8	3	1	12
Industrial Welfare Division	2	1	0	3
Finance & Economy Government Office Division	2	1	0	3
Security Management Division	16	2	2	20
Total	33	19	29	81



Business Classification (Division)	Quick-Hit Approach Number of Each Business Process Level			
	Critical Business Process	Main Business Process	General Business Process	Total
Planning & Strategy Division	3	7	9	19
Security Communication Planning Division	3	3	8	14
Information Resource Management Division	3	1	5	9
Operation Coordination Division	7	3	2	12
Industrial Welfare Division	3	1	0	4
Finance & Economy Government Office Division	2	2	1	5
Security Management Division	14	3	3	20
Total	35	20	28	83



- Critical Business Process : Relatively Highest Business Impact due to Risk on Case 4-1
- Main Business Process : Relatively Intermediate-Level Business Impact due to Risk on Case 4-1
- General Business Process : Lowest Business Impact due to Risk on Case 4-1

Case 4-1 Overall Risk Analysis

Applicable Common Risk

Staged Development Approach (Rank Order on Twelve Classes of Risk)			
1	201	Human Aspect	Fire(Inside)
2	301	Technical Aspect	Building/Construction Collapse & Water Leak
3	202	Human Aspect	War etc State of a National Emergency
4	302	Technical Aspect	Blackout, Electrical Shock Obstacle
5	203	Human Aspect	Terror(Environment, Cyber, Nuclear, Biochemistry, Hostage), Arson, Destruction, Deforcement
6	303	Technical Aspect	A Radiation Accident
7	204	Human Aspect	Building/Facilities Destruction
8	101	Natural Aspect	Earthquake(Over Five Degrees)
9	102	Natural Aspect	Explosion
10	205	Human Aspect	Group Vacuum(Outflow, Resignation, Accident etc)
11	304	Technical Aspect	A Thermo-Hygrostat Obstacle
12	305	Technical Aspect	Communication Equipment & Network Obstacle

Quick-Hit Approach From Worker Representative Interview (Twenty-two Classes Order of Priority)	
202.State of a National Emergency(War etc)	Facilities (A)
217.A Radiation Accident	
102.Explosion	
101.Earthquake (Over Five Degrees)	
104. Typhoon	
203. Terror(Environment, Cyber, Nuclear, Biochemistry, Hostage), Arson, Destruction, Deforcement	
103, 201. Fire(Outside, Inside)	
221.Integrated Center SPoF(Single Point of Failure)	
301.Building/Construction Collapse & Water Leak	Base Equipment(B)
308.Safety Devices Obstacle – Access, Watch, An Alarm Device	
304,306.Conditioning Facilities Obstacle	
310, 309, 302. Power Supply Obstacle	
206.Trespass System Resource & Unauthorized Access	System/Security (C)
207.Shoulder Surfing	
212.Misuse of Classified Information/Circulation, Record/Data Lose	
210.Hacking/Virus Circulation	
305. Communication Equipment & Network Obstacle	Network (D)
205. Group Vacuum(Outflow, Resignation, Accident etc)	The Number of People(E)
208.The Misuse of Power, Fraud & Impersonation	
214.Sabotage	
211.Supplier Bankruptcy & A Halt in Production	Subcontractor (F)
213.Product Supplier Collusion	

7. Conclusion

In this study, two methodologies, SD Approach, the traditional risk management process and the other proposed QH methodology are compared. According to the study results, since QH approach is similar to SD approach, either RA and BIA methodology can be selected. Particularly, QH approach can overcome budget and time limitations when preceding the BCP project and can be applied by small and medium sized companies. Business that is targeted for BCP projects may carry on research project cheaply and by the need targeted business can select risk management methodology that is appropriate in their culture to manage risk. This study applies QH Approach theoretically. Although protocols are developed only certain targeted organizations are selected, sample must be extended to inspect organization to find out the best solution.

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ICT (INFORMATION AND COMMUNICATION TECHNOLOGY) DRIVEN ADAPTIVE C3 (COLLABORATION - COORDINATION - COOPERATION) - M3 (MAN - MACHINE - MANAGEMENT) FRAMEWORK IN EMERGENCY

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KEYWORDS:

Disaster Management, Orchestrization, Coordination, Collaboration, Cooperation, Communication, Complexity, Actors, Activity, ERP, Parameterization, Project Management, Prevention, Mitigation, Preparedness, Response, Recovery, PAI Architecture.

ABSTRACT:

Disasters have caused great property and infrastructure loss, unwanted disruption to socioeconomic systems and tragic loss of human lives. An emergency when occurs will always be so different manifesting more and more uncertainties.

Conventional approaches / systems are too simplistic to coup up with such real world situations Researchers are putting considerable efforts for more effective utilization of emerging technologies, the design approach is however conventional.

The role and the true potential of ICT in 'Critical Social Systems' is yet to be explored, which has great opportunities to ultimately evolve 'ICT Driven Social Systems' leading to a 'Paradigm Shift' in visualizing virtual systems of future.

This paper presents a framework of a system driven by ICT for Disaster Management (DM). A layered architecture is suggested, considering heterogeneous clusters of actors and activities towards a technology-management solution to manage disaster, which is of prime concern today.

New concept of Orchestrization is proposed defining 3Cs i.e. Collaboration – Coordination – Cooperation and their importance towards implementing effective and efficient relief operations by multi- agencies involving M3 i.e. Man – Machine – Management.

INTRODUCTION

In our research context the Disaster Management (DM) is taken as Project Management which can be defined as conglomerate of actors and activities and processes designed to prevent and/or lessen hazardous effects of disaster."

Further the disaster period can be divided into three phases for management that is Pre-Disaster, During-Disaster and Post-Disaster.

To address disasters in a fast and highly efficient manner, the optimal provision of information concerning the situation forms an essential pre-requisite. This highlights the need for Intra- and Inter-Organization network and communications at several stages with real-time processing of relevant information.

Nikam (2008) elaborates the management cycle of the Disaster by the following fig. 1. The various phases include prevention, preparedness, response, recovery, mitigation and risk reduction.

Fig. 1: The Disaster Management Cycle

Since Disasters themselves are heterogeneous in scope and hence difficult to be managed, Annoni (2004) explains that there is a need for an objective centric approach[2] wherein the actor's empowerment is adoptive and floating. The main objective here is to optimally utilize the available resources at the right time, right place to the right people.

CURRENT RESEARCH PARA - -DIGM :

Mohanty (2005) pointed that advancement in ICT (Information & Communication Technology) in the form of Internet, GIS, Remote Sensing, satellite-based communication links; is helping a lot in disaster risk reduction measures.

These technologies have been playing a major role in designing early warning systems, catalyzing the process of preparedness, response and mitigation.

ICT tools are also being widely used to build knowledge warehouses using internet and data warehousing techniques. These knowledge warehouses can facilitate planning & policy decisions at all levels.

Similarly, Wattegama and Chanawongse(2007) indicated that GIS-based systems improve the quality of analysis of hazard vulnerability and capacity assessments, guide development planning and assist planners in the selection of mitigation measures .

Different communication systems and equipments have also become indispensable for providing emergency communication and timely relief and response measures. Issues of Ad-hoc communication networks[5] are also well addressed by Meissner, et al.(2002). Researchers Vogt, et al.(2010) have also raised importance of ICT alignment and governance techniques.

New techniques of ERP (Enterprise Resource Planning) as a solution is also suggested by Scalem, et al.(2005) to manage disaster like an enterprise. This addresses the entire needs of an enterprise, taking the process views of the organization to meet the organizational goals, tightly integrating all functions of an enterprise.

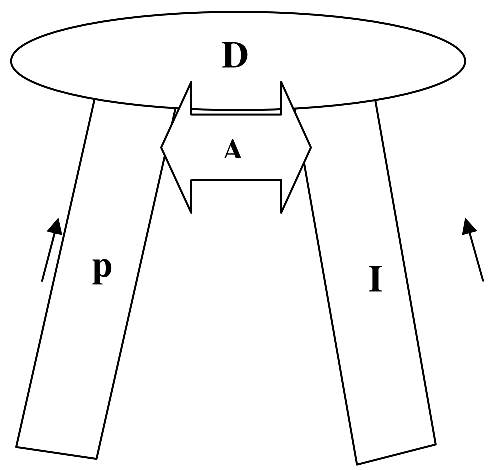
Project management group of Kubicki, Guerriero and Halin(1996) trying to address uncertainties in areas like Civil Architecture & Construction Projects etc., are recognizing social aspects like Communication, Coordination, Cooperation and Trust to visualize new systems. However, the approach is still not completely explored.

In general till now ICT has been utilized as a support tool for Disaster Management, but the need of today is to have ICT driven technologies for the best performance.

SYSTEM ARCHITECTURE:

In order to have ICT as driving technology new system architecture is to be evolved. As we have already undertaken disaster management as a project management, we can visualize the disaster management as multi layer structure.

This paper proposes the following architecture (fig. 2) denoted as “PAI Architecture” for disaster management.



D- Disaster P- Planning

A-Adoption I- Implementation

Fig. 2: PAI Architecture for DM

The scope starts with the “Planning” of various infrastructure, services, database and resources required to prevent, mitigate or manage the disaster. It involves various actors and activities with multiple assignments and team building.

As it is obvious that disasters are of diverse characteristics, nature and it is very difficult to know in advance its size/type and effects so there is a need of “Adoption stage”. The overall system has to be restructured and customized according to the disaster and subsequent needs. The information flows from planning to adoption taking the disaster assessment into account.

Tasks →

Layers ↓

PLANNING	**ADOPTION**	**IMPLEMENTATION**
History	Disaster Assessment	Scheduling of Task
Database	Adaptation	Rescue identification
Geographical Maps	Resource & Services needs	Disaster Mitigation action
Resource Maps	Prioritization of Tasks	Impact Assessment
Resources & Services Availability	Activity Chain Management	Deployment of medical aids
Infrastructure Maps	Mobilization of rescue teams	Deployment of Food and water
ICT Plan	Mobilization of comm. Equipments	Deployment of shelters
Communication Networks	Logistic and Traffic Control	Firefighting and safety arrangements
Sensor Networks	Resource Configuration	Active Database of victims
Categorization of Disaster	ICT ad-hoc networking	Ad-hoc arrangement plan execution

Table 1:
Mapping Task in PAI Architecture

Only after this "on the fly" customization of the overall action plan right implementation and success of disaster management activities on the field can be achieved.

Looking to the proposed architecture we can summarize the tasks required to be performed / addressed at various layers as mentioned in Table 1.

ISSUES AND CHALLENGES:

As could be pointed out here that the existence of the communication infrastructure alone does not ensure efficient and effective disaster management.

The existing Disaster Management (DM) approaches are developed using available ICT growth quite unstructured and are usually centralized in nature with the instructions following from some sort of fixed hierarchy. This results in the poor resource management and hence causes inefficiency & ineffectiveness at the end.

For the whole exercise to be the most effective, stakeholders, players and organizations involved have to react not only coherently, efficiently and individually, but also in a manner: collaborated[9], coordinated and cooperated as also stated by Malone and Crowston(1990). To incorporate all these characteristics the architecture in figure 1 is to be modified.

ROADMAP:

Our research aims to realize the proposed PAI Architecture with 3Cs - an integrated architecture with novel approach of "Orchestrization" of activities and tasks using 3 Cs to satisfy the above-mentioned problem as described in fig. 3.

Three social factors "3Cs" i.e. Collaboration –Coordination – Cooperation have been identified which are essentially responsible for a coherent, effective and efficient Management of Disaster involving Men and Machines.

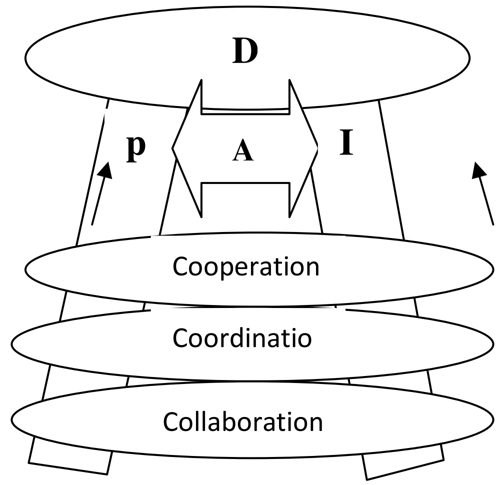


Fig. 3:
PIE Architecture with 3Cs for DM

Now, there is a challenge to extensively define the scope of these 3Cs along with parameterization and mapping of 3Cs in terms of Information & Communication Technologies at every layer; and among layers too.

Following issues regarding Rules, Memorandum of Understanding, Authority, Mutual Interest, Time, Place, Person, Trust, Transparency, Extra Efforts, Crossing Boundaries, Multi Skills, Authorization, Advance Information Flow etc. are to be recognized distinctively.

ANALYSIS:

Badiru (2008) has introduced a formula for cooperation complexity based on the statistical concept of permutation. Permutation is the number of possible arrangements of *k* objects taken from a set of *n* objects. The permutation formula is written as:

$$nPk = n!/(n-k)!$$

Thus, complexity function f(n) for the number of possible permutations of 2 members out of a team of *n* members is estimated as:

$$f(n) = n(n-1)$$

Fig. 4 shows the relative complexity plot of 3Cs as a function of team size without ICT and then after adopting ICT.

Here we found that if we can identify all the actors in certain groups according to their activities/tasks/roles and using ICT for communication, then the said complexity can be reduced considerably as follows:

$$f(n)^{ICT} = g(g-1)(n/g)(n/g-1)$$

Where g is the no. of groups formed.

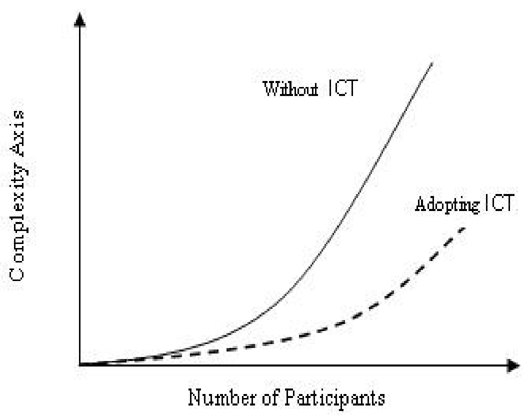


Figure 4: 3Cs Complexity Plot

In all 3Cs, complexity increases exponentially with an increase in the number of actors(Men) and activities(Machines) or when more people, equipment and services are involved.

This indicates the need for a more structured approach for implementing the techniques of project management of this type. It is also felt that ICT circumvents this issue and reduce the complexity to a large extent.

PROOF OF CONCEPT:

The roadmap clearly indicates the direction of design of effective ICT tools for Disaster Management.

It shows enhancement in design methodology by classifying design in three phases namely “Planning”, on line “Adoption” to save time and effective “Implementation” by transforming simple communication between actors into a group communication with properties like Collaboration, Coordination and Cooperation which become the basis for ICT format design and protocol design. Fig.4 shows the result of the analysis for proof of concept which promises a definite improvement in the system.

CONCLUSION:

In this paper we have reviewed the literatures and our preliminary findings show that there is lots of work to be done to make ICT as more effective enabler in Disaster Management.

The domain of Disaster Management demands different approaches because each emergency or disaster is unique. Therefore the disaster management plan and execution should change according to the scenario. Thus flexible and reliable ICT solutions should be developed to overcome these issues.

The proof of concept will drive new ICT design and will help build ICT tools that enable us to utilize the technologies effectively and efficiently for Disaster Management.

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SEISMIC RISK VERSUS REAL ESTATE RISK FOR THE BUCHAREST HERITAGE BUILDINGS

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Abstract

With about 2 millions inhabitants and more than 110,000 buildings Bucharest can be ranked as the mega city having the highest seismic risk in Europe due to (i) "occurrences of earthquakes originating repeatedly from the same (Vrancea) source" (Ch. Richter), 1977 (ii) soft soil condition in Bucharest characterized by long predominant period (1.4¸ 1.6s) of ground vibration during strong Vrancea earthquakes and (iii) high fragility of tall reinforced concrete buildings built in Bucharest before WWII and even before the 1977 Vrancea earthquake disaster. The paper presents historical earthquake losses and lessons learned versus present day challenge of conservation of Bucharest heritage buildings. It is emphasized that the price of 1m^2 terrain/land in historic center of Bucharest, as well as in its green residential areas, "inspires" a high rate of demolition of historic masonry structures in protected urban areas of the city. The paper presents examples of seismic risk class I buildings (whose strengthening was forgotten) versus examples of frequent demolition of low-rise old masonry buildings in central Bucharest.

Keywords: earthquakes, Vrancea, damage, protection, heritage buildings

Introduction

The Vrancea region, located where the Carpathians Mountains Arch bends, at about 130km epicentral distance from Bucharest, is a source of subcrustal seismic activity, which affects more than 2/3 of the territory of Romania and an important part of the territories of Republic of Moldova, Bulgaria and Ukraine. The city is located in the Romanian Plain, between the Danube and the Carpathian Mountains, in the meadow area of two rivers, Colentina and Dambovita, which cross the city from NW to SE.

Bucharest is the capital city of Romania and the main administrative, economic and cultural center of the country.

The first written record of the city comes from XVth century. Placed in a space of confluence of civilizations, Bucharest evolved by assimilating European and Oriental influences, displaying a natural capacity of integration that supported its vocation or a city between the Eastern and Western worlds.

Building damage during major historical earthquakes

1802 earthquake

The 26 Oct 1802 earthquake (M_{G-R} = 7.4 ± 0.3) is considered to be the strongest Vrancea subcrustal event; there is no precise information on causalities but some information on damages.

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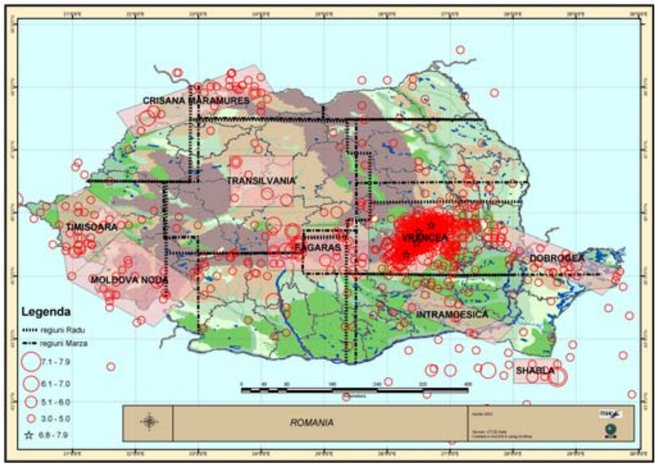


Figure 1. Romania: Location of the epicenters from 984 to 2003 and seismic regions

During the 1802 earthquake, in Bucharest many bell towers and towers of churches felt down and several churches were destroyed (included Cotroceni monastery and St. Spiridon Church). Half of Coltea tower collapsed and the remaining part was seriously damaged; most of wealthy residences were heavily damaged and some of them collapsed. At Brasov, many chimneys felt down and houses and churches were damaged. The earthquake was felt in Transylvania, Sibiu, Sighisoara and Banat, in Timisoara. The earthquake was felt in Poland, Bulgaria, Turkey and Russia. In Cernauti some houses were damaged. In Lvov Armenian church was cracked and the bells ring alone; light damages occurred even in Moscow.

<u>1829 earthquake</u>

“Wednesday night […] a strong earthquake happened in our capital, […] no house in Bucharest remained without damages; all walls were cracked and some cases felt down; roofs and chimneys were destroyed”, Curierul Român, Bucuresci, No.15/27 Nov 1829. During the earthquake of 26 Nov. 1829 ($M_s = 6.9$), Bucharest suffered the most, documents indicating that 115 houses become unsafe and 15 of them were being heavily damaged and later demolished. At Campina a church collapsed. In Sibiu and Iasi many walls were cracked. The earthquake was felt on a large area: Transylvania, Banat, Bulgaria, Poland and Ukraine.

<u>1838 earthquake</u>

The following description of the effects of 1838 earthquake effects in Bucharest is given in the book "Voyage dans la Russie Méridionale et la Crimée par la Hongrie, la Valachie et la Moldavie", par M. A. de Démidoff, Illustré par Raffet, E. Bourdin, éditeur Paris. 1841 & 1854, page 144:“ Chaque année, le sol de la Valachie est ébranlé par deux ou trois secousses de tremblement de terre plus ou moins sensibles; mais, malheureusement, on a à noter, tous les huit ou dix ans, quelque atteinte réellement désastreuse de ce fléau. On conserve encore le souvenir du tremblement de terre de 1802, qui renversa la tour du monastère de Koltza; de celui de 1829, qui ébranla fortement la plupart des édifices de Bukharest. Depuis que ces lignes sont écrites, une secousse plus violente que toutes celles dont le souvenir attriste encore le pays, a pensé engloutir Bukharest. Tout à coup, le 11-23 janvier 1838, c'était le soir, la ville s'ébranle; les plus solides monuments chancellent; plusieurs maisons s'écroulent; toutes son endommagées, et, dans tout ces ravages, plusieurs hommes perdent la vie.”

In Bucharest, the Police report mentioned: 8 deaths, 14 injured and 36 collapsed buildings. Many other buildings (especially the larger ones among which was the Royal Palace) were heavily damaged.

The engineer Gustav Schuller, counselor of the Great Duque of Saxa, who was in Romania at that time, was asked by Romanian Government to make an investigation in the epicentral area.

He indicates a maximum intensity IX in the area of Vrancea mountains, Focsani and Ramnicu Sarat where many villages were completed destroyed. Schuller concludes: ”all the stone masonry buildings were heavily damaged and some of them especially the churches and other large buildings become unusable.

The earthquake was felt on an extended area in Europe: Ukraine, Poland, Bulgaria, up to Constantinople and to North East of Italy.

Figure 2. M. Anatole de Démidoff, “Voyage dans la Russie Méridionale et la Crimée par la Hongrie, la Valachie et la Moldavie”. Illustré par Raffet. Ernest Bourdin éditeur, Paris, 1841

<u>1940 earthquake</u>

“The November 10, 1940 earthquake put damages all around Romania and throw the people in mourning”, Comptes Rendus des Séances de l’Académie des Sciences de Roumanie, 1941.

In Bucharest the most significant loss was the complete collapse of RC framed Carlton building, the highest RC building (47m, 12 storeys) in Romania at that moment. Until Nov 24, 136 people were found dead in the rubble of that building. Several high-rise RC buildings in Bucharest were very severely damaged: Belvedere, Wilson, Lengyel, Pherekide, Brosteni, Galasescu. Other important buildings in Bucharest suffered important damage: Justice Palace, Romanian Atheneum, Opera, National Theatre, CEC Bank, Postal Palace.

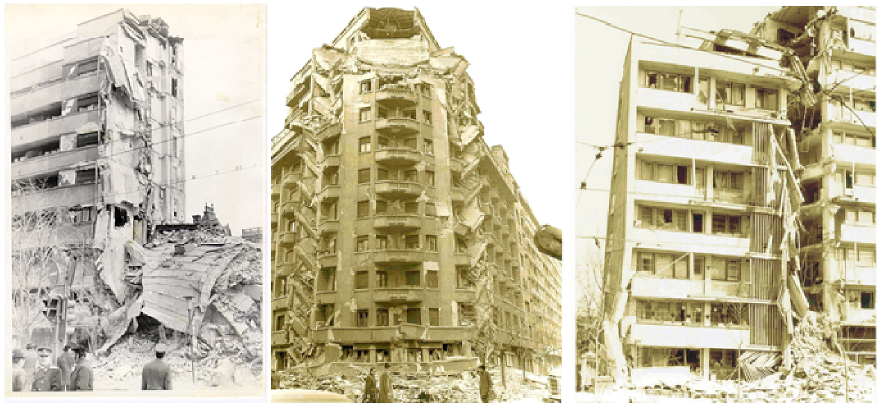
Two zones of maximum seismic intensity were identified: one in the area of Focsani and Panciu and the second one in the area from Campina to Bucharest. In those areas the seismic intensity was over VIII close to IX, on Mercalli-Sieberg scale. In Panciu no building was standing after the earthquake (Timpul newspaper of 12 Nov.1940).

Since the earthquake was a deep event (about 140km depth) it has been felt on about 2 millions square kilometers i.e. to the East: in Odessa, Cracovia, Moscow; to the North: up to Saint Petersburg; to the West: up to Tissa river and to the South: up to Istanbul.

<u>1977 earthquake</u>

The March 4, 1977 (Gutenberg Richter magnitude M_{G-R} = 7.2, moment magnitude Mw=7.5) was the most destructive earthquake in the history of Romania. This earthquake:
· killed 1,578 people including 1,424 in Bucharest;
· injured 11,221 people including 7,598 in Bucharest and 3,723 in the rest of the country;
· destroyed or seriously damaged 33,000 housing units in high-rise apartment flats and conventional type dwellings (35,000 families, more than 200,000 persons homeless);
· caused lesser damage to 182,000 other dwellings;
· destroyed 374 kindergartens, nurseries, and schools and badly damaged 1,992 others;
· destroyed 6 university buildings and damaged 60 others;
· destroyed 11 hospitals and damaged 2,288 others hospitals and 220 polyclinics;

· damaged almost 400 cultural institutions (theatre, museums, etc.);
· damaged 763 factories;
· directly affected over 200,000 people. (Fattal, Simiu, Culver, 1977).



(i) Typical collapse of pre-war world II RCbuildings (ii) Lizeanu building, built in '60s
Figure 3. Collapse of the building soft story at the ground level

International experts dispatched in Romania in the aftermath of the earthquake reported as follows:

"The unusual nature of the ground motion and the extent and distribution of the structural damage have important bearing on earthquake engineering efforts in the United States." Jennings & Blume, NRC&EERI, Washington.

"It was felt on an area of 1.3 million squared kilometers and caused damage over an area of about 80000 km2 within which the most frequently occurring intensity did not exceed VII (MM). Much of the damage was caused to old multi-storey reinforced concrete buildings of 6-12 storeys. These structures have a fundamental period of the order of 0.7-1.6 s, which places them on the ascending branch of the Bucharest spectrum. Progressive damage during the earthquake should have caused a lengthening of their period and an increase in the lateral forces acting on them. In contrast, rigid structures of large panel or frame construction with shear wall, of the same height, as well as 1-3 storey masonry dwellings, suffered little damage." (Ambraseys, N.N., 1977)

Vulnerability of buildings in central Bucharest

Reasons of vulnerability

The explanation for the location in the city centre of the most fragile or vulnerable RC tall buildings in Bucharest as well as of 29 (from 32) tall RC buildings collapsed during the 1977 comes from the Plan of Urban Development of the city of Bucharest issued in 1935 by the Municipality of Bucharest. The Plan recommends the city center for the tallest buildings within the city i.e. for buildings having 6-7 full storeys plus 2-3 setback storeys (roof height of the building smaller or equal to the street width). The lack of mass vertical-symmetry, lack of structure horizontal-regularity, accumulated damage during the 1940 earthquake, low strength concrete (mean of compressive strength <200 daN/cm^2), soft ground floor due to commercial use of the floor (no infilled masonry walls) and dynamic characteristics clearly explain the collapse of buildings in the center of Bucharest. Presently, 127 tall RC buildings built before WWII were randomly identified by authorities and structural engineers as "seismic risk class 1" buildings, i.e. buildings supposed to collapse or to be very severely damaged during the next earthquake similar or larger than 1977 one. The number of fragile high-rise RC buildings in the city centre of Bucharest is probably two times larger than the existing number of identified buildings having "seismic risk class 1". Many of recognised most vulnerable buildings in the city centre are still not yet identified as being very vulnerable. In spite of the high cost of adequate retrofitting of the fragile RC high-rise buildings located in the centre of Bucharest, there are architectural and historical heritage constrains – after the Bucharest demolition large campaign of ’80 – suggesting that more demolition should be not allowed in the city center.

Unfortunately even today, the lessons learnt in 1977 were still incompletely understood. Examples of those unlearnt lessons are given below.

Lesson 1: " A systematic evaluation should be made of all buildings in Bucharest erected prior to the adoption of earthquake design requirements and a hazard abatement plan should be developed." by G. Fattal, E. Simiu and Ch. Culver, 1977.

Lesson 2: " Tentative provisions for consolidation solutions would preferably be developed urgently", by Japan International Cooperation Agency, June 1977

Lesson 3: "…Bucharest is sited on deep alluvium.... Much of the damage was due to soil amplification associated with deep layers of silty clay, loess…Such sites would provide sufficient chances of dangerous amplifications in the shaking of such buildings." by H. Tiedemann, 1992;

Lesson 4: "Bucharest had been microzoned as part of UNESCO Balkan Project, with microzones denoting three levels of risk. The worst destruction occurred in the lowest- risk microzone." by G. Berg, B. Bolt, M. Sozen, Ch. Rojahn, 1980

Lesson 5: "Ground motion spectrum should be provided corresponding to each soil condition. A considerable number of strong motion seismographs will be required for the above purpose." by Japan International Cooperation Agency, June 1977.

On March 30, 1977 the national strategy for strengthening the buildings damaged by the 1977 earthquake was established by the Romanian Government in the letter to the Municipality of Bucharest of the General Inspector for Construction of Romania as follows: "The retrofitting of buildings must provide: (i) For the old buildings - the same resistance the have before 1940 earthquake (when they survived!); (ii) For the new buildings - the same resistance the have when they were designed." The above Governmental Order was further explained in the letter to the Technical University of Civil Engineering, Bucharest from General Inspector for Construction of Romania and General Director of Central Institute for Research Design and Coordination for Construction, July 11, 1977, as follows: "Retrofitting of the buildings damaged by the 1977 earthquake will consist of strict local repairing of damaged elements. Additional measures for seismic protection are not allowed." The 1977 Romanian Government strategy for repairing damaged buildings has proved as a regrettable mistake.

Seismic risk reduction strategy and programs

The present day national programs for seismic risk reduction in Romania are focusing the following there objectives: (i) Strengthening of fragile buildings in Bucharest, (ii) Upgrading the code for seismic design of buildings and structures and (iii) Seismic instrumentation of Romania. In present, Bucharest about 20 % of building stock has been built before World War II, less than 40 % has been built before the 1977 big Vrancea earthquake and over 40% after the 1977 event.

Currently, the list of buildings which have been included in class 1 of seismic risk at the Ministry of Development, Public Works and Housing contains 392 entries / addresses which could be grouped as it follows (per cent of the total buildings which undergone technical evaluation:

(i) Tall buildings	≥ GF + 9F	under 3%
	≥ GF + 7F	16%
(ii) Low buildings	≤ GF + 4F	57%
	≤GF+ 1 F	17%

After 10 years from the start-up of the building consolidation program for the buildings included in Class 1 of seismic risk, of the initial number of 127 entries on the list- buildings over GF + 4F, 19 are located on Calea Victoriei and Magheru and Bălcescu boulevards, Figure 5. Most of them are considered city architectural heritage:

- 10 buildings (of which 5 above GF + 7F) are fully consolidated;
- 6 buildings (of which 4 above GF + 8F) are under consolidation;
- 12 buildings (of which 7 above GF + 7F) have the plans for consolidation ready.

Calea Victoriei 2-4 Calea Victoriei 101 A-B Calea Victoriei 124

Figure 5. Architectural heritage buildings in central Bucharest: tall RC buildings built before 1940 in city center (examples)

Taking into account the risk matrix in Table 1, even Seismic vulnerability class 2 building but Importance & exposure (class 1 buildings must be considered as Seismic risk class 1).

Table 1. Seismic Risk Matrix indicating seismic risk classes (1, 2 and 3)

Seismic vulnerability/ fragility class	Importance & exposure class			
	I Essential facilities	II Hazardous buildings	III General buildings	IV Minor buildings
1	**1**	**1**	**1&2**	**3**
2	**1&2**	**2**	**3**	**3**
3	**3**			

The *Historical Monuments List,* 2004 (prepared by the *INMI*, *National Institute for Historical Monuments)*, contains 26 cultural heritage palaces in Bucharest. From those, the following "seismic risk class 1" palaces might be considered for priority strengthening: (i) Multistory steel structures: *Ministry of Transport, Constructions and Tourism*; (ii) Multistory reinforced concrete structures: *Romanian Government Palace* and *City Hall* of *Sector 1*, Bucharest; (iii) Masonry and reinforced concrete buildings: *Royal Palace i.e. National Museum of Art of Romania* (central building) etc. Only the *Palace of Justice* and *Telephone Palace* are now fully retrofitted, Figure 6.

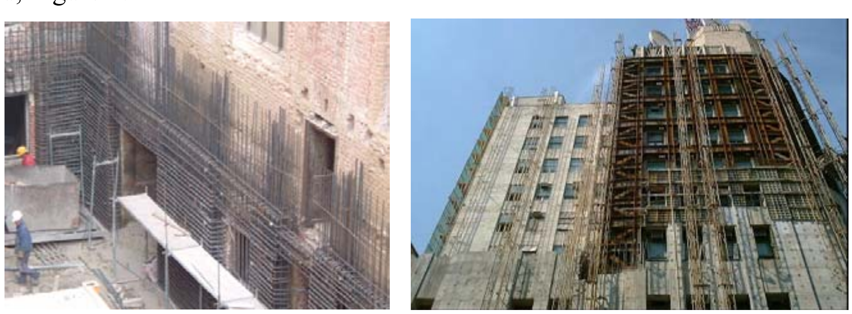


Figure 6. Retrofitting of the Palace of Justice - left (2006) and Telephone Palace - right (2002)

There are more than 200 orthodox churches in Bucharest and from those almost half are listed as architectural heritage, Figure 7. Most of the old churches need structural strengthening and immediate rehabilitation. In the case of seismic upgrading of architectural heritage buildings, the central role of the state has to be replaced by new partnership models with private sector, international donors as UNESCO, Council of Europe, World Monuments Fund and civil society at large. One major issue is the deterioration and/or loss of a number of historic buildings and cultural assets due to the lack of financial resources to prevent further deterioration.

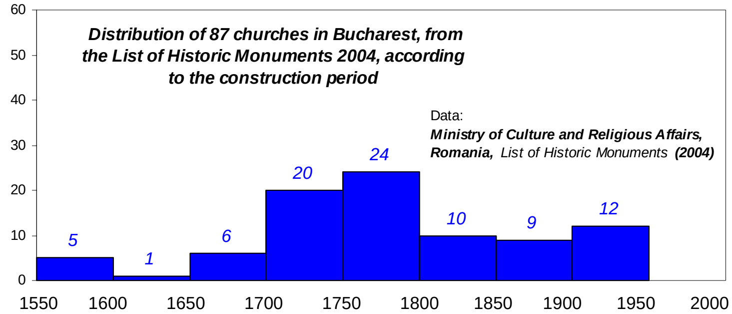


Figure 7. Distribution by age of the churches listed as architectural heritage according to the list of Historical Monuments, Bucharest 2004

Present day challenge of conservation of Bucharest heritage buildings

Unfortunately for the cultural, historic, architectural and urban of Bucharest, it is nowadays proved that the most important factor contributing to the disappearance of the beautiful buildings in the protected areas of Bucharest is the very deliberate of certain architectural ambitions and, above all, the speculations on the real estate market going on at this time. The applicable legislation in force on protection of the historic monuments, under the authority of the Ministry of Culture and Religious Affairs and the protection of buildings located in „protected areas" under the authority of the Ministry of Development, Public Works and Housing / the Ministry of Transportation, Construction and Tourism and the city planning managed by the local administration is finally leading to a protection close to zero for the buildings which are purely formally located in areas and generally referred to as „protected".
The present day picture of Bucharest with (i) over-night demolitions of historic buildings which have not undergone seismic damages, located in downtown areas of the capital and in elegant and non-polluted areas, and with (ii) sky scrapers which emerge at random and with no logic, although approved by the local and central authorities, all over the city, including the protection areas of historic monuments, mixing with low-level buildings and causing traffic problems and irresoluble parking problems (now or in the future), is alarming and indicates the utter destruction of Bucharest, the gravity of which shall by far exceed that undergone during the communist time.

The examination of the information made available for the buildings in Bucharest reveals the following conclusions:
1. The initial purpose of the technical and seismic assessment program of the buildings in Bucharest that were damaged during the earthquakes in 1940, 1977 and 1990, was to make a Priority List for consolidation and insurance of the inhabitants' security with respect to the buildings showing serious bearing structure damages.
2. Over the recent years, the list was updated with a very large number of low buildings, with only a few levels, generally having bearing or mixed structure (brick walls and concrete) and boards sometimes made of wood or metallic profiles and brick bolts. Such buildings could be included in the same seismic vulnerability class as the tall ones - those which collapsed in 1977 – but they cannot be definitively regarded as part of the same seismic risk class for the mere reason that, considering the seismic history of 1977, they can generate in case of a major earthquake similar to that from 1977, totally different human, economic and structural consequences from those caused by the collapse of the multi-leveled concrete buildings collapsed on March, 4th, 1977.
3. Since more than 50% of the list of buildings in Bucharest falling under Class no. 1 of seismic risk are low buildings below GF + 4F (17 % are buildings of GF and GF + 1F) and since only 6 buildings of the 392 on the list are under Priority Group nr. 2, we can infer that the initial

purpose of the priority list for seismic consolidation has been altered and deviated to other obscure intentions.

Currently, the „red spot" signifies an „invitation" to eliminate many buildings under Class no. 1 of seismic risk located in the central areas of the capital or residential neighborhoods in the northern area of the city, and others (1 m^2 of land costs 3000 - 7000 Euro / m^2!). Unfortunately, the various seismic risk class 1 low-rise buildings are systematically planned to be demolished –not to be retrofitted-. Such buildings have fragile brick bearing structure, easily to tear down and, thus, have become very „attractive" for real estate speculations intended to offer free lands for future investment in tall buildings, 3 to 8 levels above the general height of the area/neighborhood.

<u>Buildings subject to demolition / demolished located in "protected areas"</u>

Visarion 8, building

The building was finished in 1911, and the urban renewal plan for Lascar Catargiu Blvd., between Piata Romana (the Roman Square) and Piata Victoriei (Victory Square), was implemented in the period 1895 – 1899, in the French Academy spirit, according to design delivered by architect I.D. Berindei. The building is also part of the protected area of Dinu Lipatti House, 12 Lascăr Catargiu Blvs., a historic monument, the List of Historic Monuments 2004, entry no. 615/B-II-m-B-18330. The building is located in a "protected area" yet, it has benefited from no protection at all. The roof burnt at the be-ginning of 2007 and man, to the present state of utter ruin, has systematically damaged the building, Figure 8. The „Collapse Hazard" sign placed on the facade of the building in March 2007 made a clear statement with respect to the destined end of that elegant building from the very heart of Bucharest. The application to declare the building a historic monument filed by the National Institute for Historic Monuments (no.351/23.03.2008) was rejected by the National Commission for Historic Monuments. Unfortunately, existing law on protected areas in Romania cannot legally prevent the demolition of the buildings located in such areas.

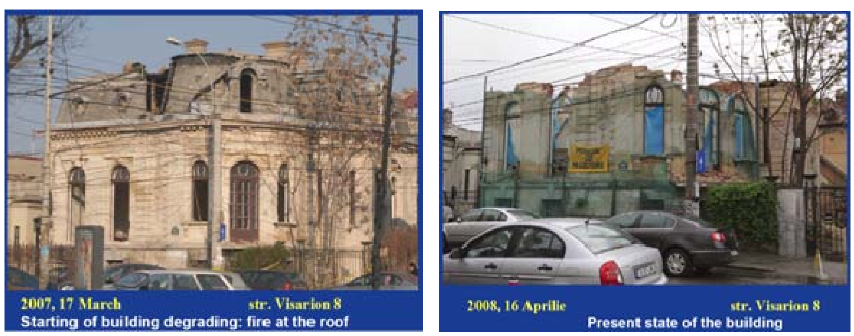


Figure 8. Bucharest heritage building in the city center intentionally prepared for demolition

<u>Tall buildings located in the „Protection area" of historic monuments</u>

Tall building next to „Saint Joseph" Cathedral

„Saint Joseph" Cathedral in Bucharest was started in 1875 and finished in 1884, during the reign of King Charles I. The famous architect, Dr.Friedrich Schmidt from Vienna, planned the cathedral. The company Mayer from Munich made the paintings and stained glasses of the cathedral, while the altar was sculpted in Rome. The tall building under construction next to the cathedral is 4UG+GF+18F, height: 75m, POT=53%, area: 1059mp. The procedures of permits and developing the city planning dossier, location and erection of the tall building at the address: general Berthelot no.11-15, sector 1 – commenced in 1999 and the circumstances surrounding the start-up of the construction work – in 2006- has been generating controversial discussions. Justice is following to give a resolution with respect to the legitimacy of the construction. Until then the site work is interrupted. The huge building by the cathedral

„Sfântul Iosif" is contempt to the city planning common sense and a mockery to the neighboring historic monument.

Buildings within protected areas / historic monuments subject to demolition due to technical expertise and listed in class no. 1 of seismic risk

Victoria Arcade, Academiei St.

Approximately 10 year ago, the Ministry of Public Works and Territorial Planning (MLPAT) under Minister Nicolae Noica, promoted the concept „building subject to technical expertise listed under class no. 1 of seismic risk" (symbolised by the „red spot") to ground the need for urgent consolidation of buildings made of reinforced concrete built before the World War II in the uptown of Bucharest- building which caused over 1400 deaths during the tragic earthquake on March, 4th, 1977. At present, the symbol „building subject to technical expertise listed under class no. 1 of seismic risk" has become one of the most irrefutable reasons to demolish buildings in the downtown area of the capital and in protected areas, disregarding completely the primary meaning: priority for seismic consolidation and security. The deliberate use of the symbol „class no. 1 of seismic risk" in order to demolish old buildings may results into the total extermination of historic pieces of beautiful architecture of the capital.

Historic monuments demolished due to listing under class no. 1 of seismic risk

MICM Building demolished in 2007

Figure 9. MICM building, Calea Victoriei, Bucharest

Industrial buildings burnt and damaged, located on large areas of land

Asan Mill (Moara lui Asan), Obor, Bucureşti

Asan Mill, built in 1853, is the first steam mill in Romania. It is an industrial architectural monument under category A, the List of Historic Monuments, 2004, code B-II-m-A-19692. The building is made of bearing walls with wooden boards. The mill was lewd on May 14th, 2008 for a thorough and rapid extermination of the wooden boards and roof ridge. The walls show signs of local degradation of bearing walls, deliberately caused by man, Figure 10.

Figure 10. Bucharest intended fire and intended destruction for "encouraging" self collapse of the Asan Mill, industrial heritage, 1853

<u>Degradation of the general appearance of the city by the advertising posted on the facade of buildings located in "protected area"</u>

George Enescu 27 St, building

The facades of such buildings should be protected and not aesthetically mutilated. Unfortunately the Romanian legislation is not so restricted.

An excerpt from the *Law 554/20 "For preservation of the aesthetic appearance of the capital and other localities"* is: marking or posting on the walls, on the facades of buildings under public or private property, on historic and architectural monuments, and on any other type of buildings of unauthorized inscriptions [...] shall be fined a minimum 500 to maximum 2500 lei (120-600euro) and shall be liable to cover the expenses required to return the respective building to the aesthetic appearance.

Figure 11. Façade of an historical building

The visual content of Figure 8 to Figure 11, presenting typical situations of aggression against the built-on heritage of Bucharest calls for an urgent amendment of the legislation on protection and the real estate policy on demolition of buildings-historic monuments or buildings located in „protected areas" in Romania. Beautiful buildings of former Bucharest were lost for good, either on approval of the Department for Culture, Religious Affairs and National Cultural Heritage in Bucharest, (i.e. the building on Str. G. Clemenceau Nr. 8 - 10), or with the approval of the National Commission of Historic Monuments (the building on str. Visarion nr. 8, corner with L. Catargiu Boulevard).

Conclusions

The urban development of historic and protected areas of Bucharest in the European Union cannot be achieved by adding top levels, demolition or skyscraper insertion. The capital urgently needs the support of the population and, moreover, a new political strategy of central and local administrations to preserve, repair and develop the city to the benefit of its inhabitants and to conform the cultural and historic value and identity as European city.

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Biography

Dr. Dan Lungu is professor of structural reliability and risk analysis at Technical University of Civil Engineering in Bucharest. Dr. Dan Lungu served as the General Director of the National Institute for Historical Monuments from 2006 to 2010 and of the National Institute of Building Research, INCERC from 2001 to 2006.

SEISMIC RETROFIT OF HISTORIC IASI CITY HALL BUILDING USING SEISMIC PROTECTIVE DEVICES

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Keywords

Iasi city hall, seismic retrofit, historic building, base isolation, performance based engineering, high performance engineering, unreinforced masonry

Abstract

Romania's Iasi City Hall was originally constructed in the 1810's in neo-classical Viennese style. It was modified in 1860's and turned to the city hall in 1891. It is considered a cultural heritage building and was the Romanian Royal Family residence. The building framing is comprised of reinforced concrete floors, unreinforced masonry (URM) bearing walls, and stone masonry foundations. URM buildings are quite susceptible to earthquake damage. Iasi City Hall is no exception, as evidenced by damage during the 1977 Bucharest earthquake. The damage included large diagonal cracks in the URM walls, which were repaired by grout injection. The building did not experience large accelerations during the 1977 event. If a larger event, comparable with the intensities required by the current edition of the Romanian seismic code, occurs at this site, the result will be extensive damage and loss of functionality for the building. For this structure, the use of seismic isolation provides the optimum retrofit solution since 1) the reduced seismic demand would protect vulnerable structural and non-structural components, and 2) this option would eliminate the need for alterations above grade, thus preserving the historical features of the building. A system of isolators and sliders were used for the retrofit design. Analysis showed that the retrofit was effective, and the existing members would be able to resist the seismic demands resulting from said retrofit.

Introduction

<u>Building description</u>

Iasi City Hall, formerly known as Roznovanu Palace, is located in the second-most populous city in Romania (see Figure 1). It was originally constructed in the 1810's in neo-classical Viennese style, and its facade was decorated with marble statues of mythological characters such as Diana and Apollo. It was modified in the 1860's and turned into the city hall in 1891. In 1893-94, a second story was added to the structure. It is considered a cultural heritage building and was the Romanian Royal Family residence for a short period during the 1800's. During WWI, the building hosted the headquarters of ministries. A fire in 1958 destroyed most of the second floor, which was restored afterwards, in part, by replacing the original

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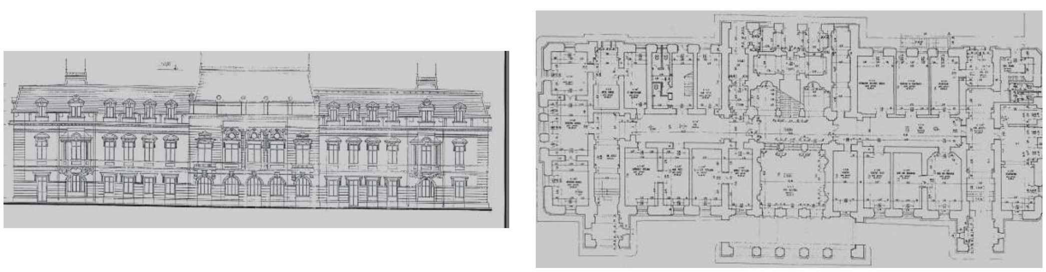
wood floors with new reinforced concrete floors. In 1969, the city administration moved back into the building again.

Figure 1. Iasi City Hall (2010)

Structural system

The building framing is comprised of unreinforced masonry (URM) bearing walls with stone masonry foundations. It has a partial basement, ground floor, second floor, and attic level. The building is nearly rectangular, and has a total floor area of approximately 4400 m^2. The building is approximately 15 m tall. The interior URM wall thickness is 400 to 600 mm, whereas the exterior URM walls are 100 to 170 mm thick. The floor diaphragms, originally wood-framed, currently consist of reinforced concrete slabs spanning between URM walls. The structure has a number of unreinforced masonry chimneys. Figure 2 presents an elevation and plan view of the building.



a. Front elevation b. Plan view

Figure 2. Architectural drawings of the building

Earthquake performance

The building was damaged during the 1977 Bucharest earthquake. There were large diagonal cracks in the URM walls, damage to portions of wood diaphragms and cracking of the chimneys. The URM walls were repaired by grout injection, reinforced concrete slabs replaced the wood floors, and the chimneys were anchored with steel ties.

Since this building is a low-rise structure that uses stiff URM walls, it is expected that its fundamental period is much smaller than the transition period and, as such, it would experience the largest spectral acceleration during seismic events. Condition assessment and seismic evaluation (Miyamoto and Gilani, 2007) indicated that this building would experience damage during major seismic events. Hence, in order to preserve this historic building, it must be seismically retrofitted.

Background on seismic isolation

For historical or essential facilities, base isolation provides an attractive retrofit option. Using this option, alterations of the superstructure is significantly reduced or eliminated. Instead, the structure is de-coupled at the foundation level, since isolators are installed beneath the existing columns or walls. In the past two decades, many buildings in the United States, New Zealand, Japan, and Europe have used this technique. The seismic retrofit of the Bucharest City Hall currently underway also uses this technique.

There are two basic isolation systems: one uses elastomeric rubber (either high-damping rubber or lead-core), and the other uses metallic sliding surfaces (flat or pendulum sliders) to resist and dissipate seismic forces. Base isolation relies on the concepts of structural dynamics to modify the response of the building and reduce the seismic demands on the structure. For isolated structures, the structural period is shifted away from the high-energy portion of the seismic spectrum and predominant frequencies of typical ground motions. In addition, since the isolators are considerably softer than the structure they support, the deformation of the first dynamic mode (and the large participating inertial mass) is concentrated at the isolated level; thus the response above isolators is essentially that of rigid body motion. The isolation system also introduces additional damping to the structures.

Seismic retrofit methodology for the Iasi City Hall building

Design objectives and performance goals

The design objective for seismic strengthening of Iasi City Hall is to provide a level of performance during the design seismic event consistent with Romanian building code P100 (2003) requirements and other international standards for essential facilities.

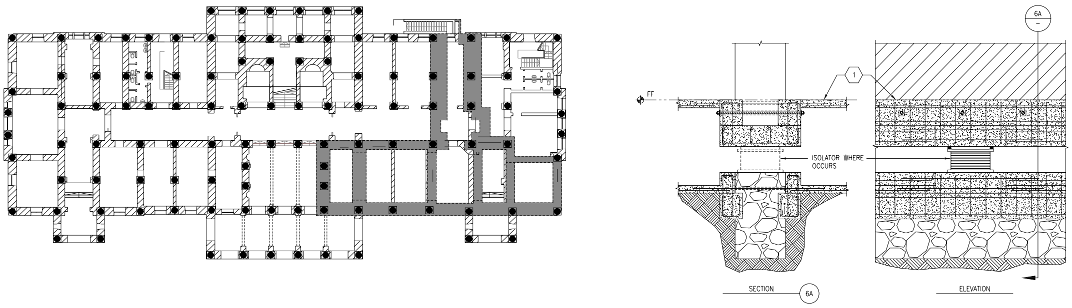
To achieve this objective, the following performance metrics for the design earthquake event were selected:

- Limit inter-story drift ratios of isolated structure to approximately 0.5% to protect nonductile elements
- Limit floor accelerations of isolated structure to approximately 0.15g to protect building contents, structure, and non-structural components;
- Limit base shear of isolation to approximately 0.18g to limit forces on foundations;
- Limit isolated building lateral displacement to approximately 450 mm to prevent pounding with adjacent structures.

It is noted that P100 served as the principal document used for retrofit evaluation. However, provisions of ASCE/SEI 41 (2006) were also checked for compliance. To achieve the design objectives and parameters, it is proposed to seismically isolate the building. This retrofit option was selected because it provides reliable seismic performance, while preserving the historical features of this cultural heritage building. An isolation system consisting of lead-rubber bearings (LRB) and slider bearings were selected to increase the fundamental period of the building to approximately 2.5 to 2.7 sec, and to provide additional damping in the range of 15 to 20%. Given this approach, it is expected that the need for additional strengthening of the structure above the isolation plane would be minimized.

Seismic isolation retrofit

The isolation plane is selected to occur immediately below the ground level of the building. This implies that the basement walls of the building would be situated below the isolation level. A total of 110 seismic isolators are used. The isolators will consist of a combination of 59 lead-rubber bearings (LRBs) and 51 sliders. The geometric arrangement of the isolators has been selected to preserve the current uniform load path in order to avoid adding additional concentrated loads to the vulnerable components (Figure 3a).To install the isolators, the existing walls will be reinforced either side by permanent shoring beams, above and below the future isolation plane. Next, a wall section will be removed and isolators installed. Finally, the remaining wall is cut in order to complete the isolation plane; see Figure 3b.



a. Plan distribution b. Typical detail

Figure 3. Typical detail of isolation plane

Seismic hazard

The design spectrum for seismic action in Romania is based on Chapter 3 of P100 (2003). However, this spectrum was checked against both probabilistic and deterministic site-specific earthquake hazards, and the most conservative spectrum was selected for design.

The P100 design spectrum for Iasi is constructed based on the following: a) peak ground acceleration (PGA) = 0.20g (Figure 3.1 of P100), b) control period, $T_C < 0.7$ sec (Figure 3.2 of P100), c) T_B and T_D are 0.07 and 3.0 sec, respectively (Table 3.1 of P100). The 5% damped response spectrum is then developed based on the Formulas listed in P100. Next, All spectral ordinates are amplified by a factor of 1.4 to account for the building “Importance Class” (as required by Table 4.3 of P100). The solid line in Figure 4 represents the target response spectrum per P100.

The design spectrum for the extreme event (or maximum considered earthquake, MCE) is defined by the International Building Code (IBC 2006) as the lesser of the deterministic event and the probabilistic event with a return period of 2500 years (or 2% probability of exceedance in 50-years). Using the Geotechnical Survey and boring logs by S.C. Project-Lopis S.R.L. (2007) and site-specific seismicity parameters, both probabilistic and deterministic spectra were developed. The spectra are shown in Figure 4 as well. The dashed line represents the governing site-specific spectrum. .

The P100 spectrum (amplified by 1.4 for Important Class) governs for all periods of interest for an isolated building (longer periods). Therefore, the design of all isolation devices, new and existing structural members, was based on the P100 spectrum.

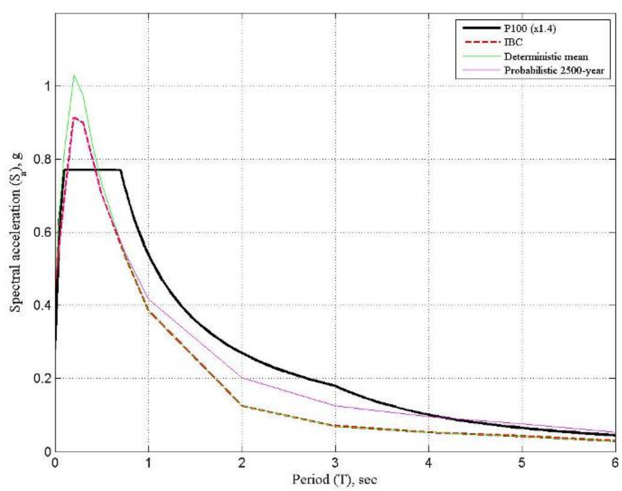


Figure 4. Comparison of the Romanian and IBC design spectra

Analytical model

<u>General model properties</u>

A three-dimensional analytical model of the building has been prepared using the program ETABS (CSI 2010); see Figure 5. The key features of the model are summarized here.

- Material properties. Nominal properties were used for the existing and added elements. All walls and beams were modelled using the cracked sectional properties.
- Wall elements. All dimensions were specified as centreline-to-centreline. Contribution from the wall out of plane stiffness was neglected.
- Seismic loading. The analysis and evaluation was based on the response spectrum loading and load combinations developed and verified with nonlinear response history analyses.
- Isolators and sliders. These elements were modelled using "link" elements. Sample values were selected for analysis. Only the linear link properties are activated for the linear response spectrum analysis.
- 300 Ritz modes were used in analysis to ensure all links were activated and that the prominent building modes (isolated and otherwise) were captured.

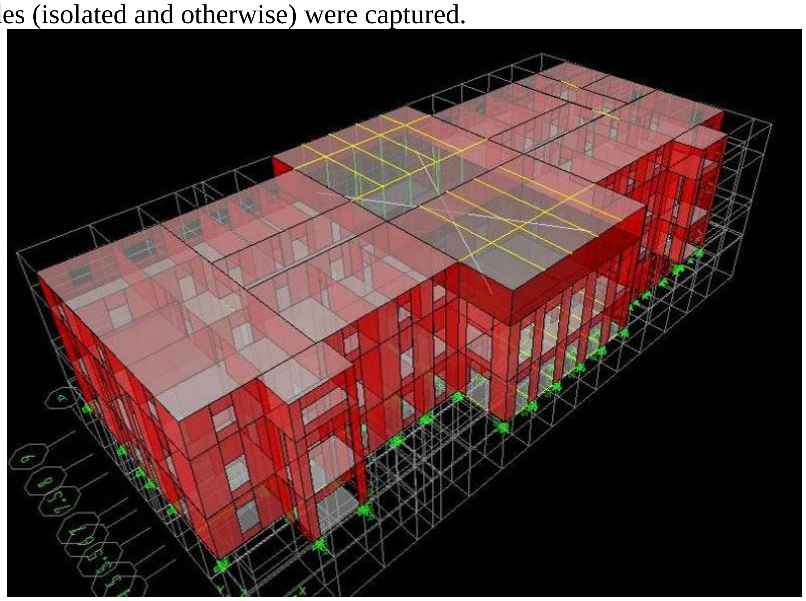


Figure 5. Analytical model of the building

<u>Loading and load combinations</u>

The dead load (inertial weight) of the building is comprised of the self-weight of all permanent structural and non-structural components of the building, including the new concrete slab and the added concrete beams at the isolation level. The total seismic mass of the structure is estimated at 16,800 Mg. Live loads are based on Romanian design code, *Basis of structural design in construction*, CR 0-2005. Per P100 (2007) the directional combinations for seismic loading, and the load combinations of Table 1, were used in design

Analysis results

Table 2 presents the modal properties from the preliminary analysis of the isolated building. It is noted that approximately 95% of seismic mass in each direction participate in the isolated modes, and that the isolated modes have periods of approximately 2.5 to 2.7 sec.

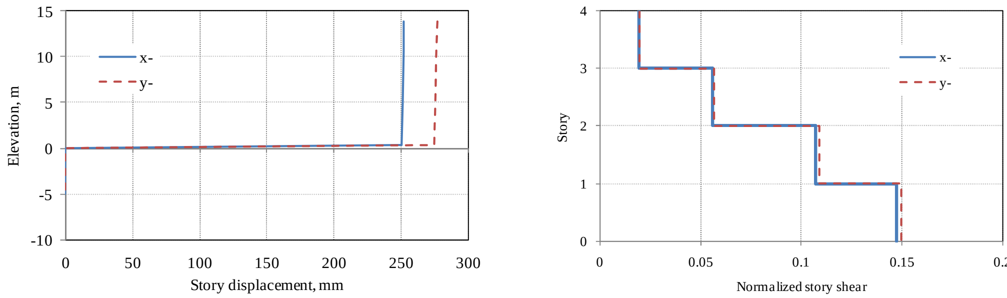
Dead	Live	Seismic load, x-	Seismic load, y-
1.1	0.5	+/-1.0	+/- 0.3
1.1	0.5	+/- 0.3	+/-1.0
0.9	0.0	+/-1.0	+/- 0.3
0.9	0.0	+/- 0.3	+/-1.0

Table 1. Design load combinations

Mode	Period, sec	Participating mass, %		
		x-	y-	θ-
1	2.70	7	50	32
2	2.64	86	9	0
3	2.52	3	36	64

Table 2. Modal properties

Figure 6a presents the computed displacement profile of the building from the response spectrum analysis. It is noted that the displacement is almost entirely concentrated at the isolation level, and drift ratios above and below the isolation plane are in the order of 0.02% or less. As such, the response is essentially rigid motion, with predominant elastic behaviour above the isolation plane. Figure 6b presents the computed story shear profile of the building from response spectrum analysis (normalized with respect to the building weight). It is noted that the maximum "base" shear coefficient just above the isolation plane is approximately 0.15g, thus satisfying the design objective.



a. Story displacement distribution

b. Story shear distribution

Figure 6. Story responses computed from response spectrum analysis

<u>Retrofit design assessment</u>

Table 3 presents a comparison of pertinent response quantities computed from response spectrum analysis and target values. It is noted that the design meets the target requirements and, hence, is satisfactory.

Response	Target value	Analysis value	Pass/Fail
Isolator displacement, mm	450	300	Pass
Story drift ratio	0.5%	0.02%	Pass
Base shear coefficient, g	0.18	0.15	Pass
Story shear, g	0.15	0.15	Pass

Table 3. Design criteria evaluation

Existing member and component evaluation

<u>Overview</u>

The existing unreinforced masonry (URM) walls were evaluated for rocking, shear, and toe-crushing strength at unreduced design spectrum demands using ASCE 41 criteria. Relevant masonry design parameters considered in our evaluation are listed in Table 4.

Response	Target value
Knowledge (*k*) factor,	0.75
Condition of masonry	Good
Lower bound compressive strength	6200 kPa
Lower bound shear strength	180 kPa
Expected strength multiplier	1.3
Component demand modification (*m*) factor	1.0

Table 4. Design criteria checks

In order to assess the building's overall performance, several representative wall lines were selected for detailed evaluation based on their location and tributary loading.

<u>Demand calculations</u>

ETABS was used to determine the load distribution in the building. Lateral loads considered in our design were based on the unreduced design spectrum (x 1.4).

<u>Capacity calculations</u>

The equations in ASCE 41 were used to determine the limiting failure for each pier, whether it be rocking or shear (the minimum of the wall shear and toe-crushing from shear). For the case where shear mode controls, one or more piers reach its shear capacity prior to its rocking capacity. Where piers within a wall line are excessively slender and have correspondingly low rocking capacity, they are omitted from the analysis, and the lateral load from the omitted piers is redistributed to the remaining piers. If the capacity is less than the actual shear in the pier, then the existing wall is satisfactory. For the case where rocking mode controls, the rocking capacity is less than the shear capacity for all piers. If the sum of the rocking pier capacities is greater than the shear along the wall line, then the existing wall line is satisfactory.

Results

The existing URM walls were found to be adequate for the unreduced design spectrum loading. Considering an m-factor of unity was used, all walls are expected to remain in the elastic range.

New member design

New concrete beams are required to support the existing walls, transfer load to the isolators, and redistribute to the existing foundations in a uniform pattern. Beams above the plane of isolation are used to capture the walls with both bearing and clamping force using post-tensioned high strength rods. During the initial stages of the isolator installation, the beams support the loads above by bridging across holes cut into the walls at each isolator location. After installation of the isolator, the remaining walls between the isolators are cut in order to complete the isolation, at which time the upper beams spans between the isolators in order to transfer the loads from above to the isolators. Beams below the plane of isolation are used to distribute the loads from the isolators uniformly to the continuous foundations below. These new beams also widen the bearing area of the existing foundations, providing enhanced bearing capacity. Additional beams were provided at isolators, perpendicular to the bearing walls above and below the plane of isolation, where necessary to provide resistance to P-Delta moments generated during the design seismic event.

New concrete slabs at the ground floor level were designed to span between bearing walls for both gravity loads as well as seismic diaphragm shear loads. New concrete slabs-on-grade are provided below the plane of isolation in order to provide in-plane continuity between walls for seismic loads as well as out-of-plane restraint for retained earth at the building perimeter and basement walls.

The retaining walls at the perimeter of the building and basement stairs are designed as cantilevered walls, restrained from sliding by the new concrete structure at the base of the isolation plane

Verification response history studies

Overview

Nonlinear response history analysis was conducted to verify the results obtained from the response spectrum analysis. The analysis used three strong motion records from previous Romania earthquakes, and analysis was based on the data obtained from the record producing the maximum response.

Analysis ground motions

Three pairs of ground motion, one each from 1977 (Station Incerc), 1986 (Station Iasi), and 1990 (Station Iasi) Vrancea earthquakes were used as seeds for analysis. These motions were selected to be representative of motions expected at the site. The motions were then spectrum matched to the P100 spectrum of Figure 4 and used in analysis. Two component motions for each record were developed. Figure 7 presents one of the pairs of matched records used in analysis.

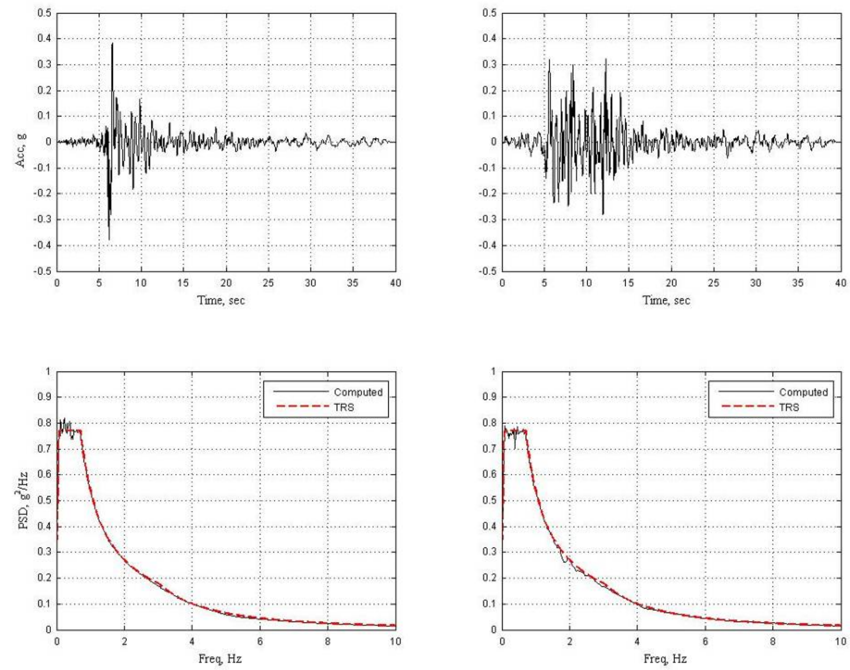
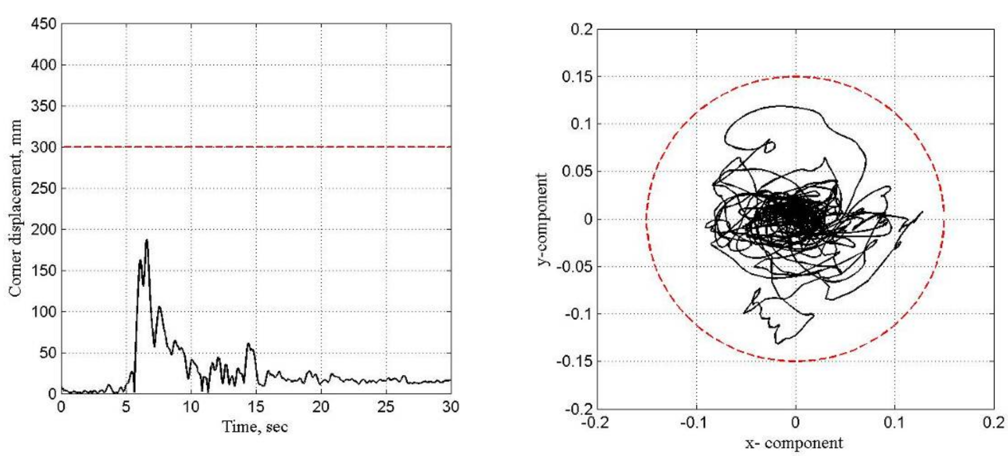


Figure 7. A pair of spectrum-matched records used in analysis

Analysis results

The nearest adjacent building to Iasi City Hall occurs at the S-W corner near Gridlines P and 3, with a separation of approximately 1000 mm. To allow for the motion of the isolated structure, a moat with a width of 300 mm (12 in) is provided around the building perimeter. Figure 8a presents the computed vectorial (SRSS) displacement at the subject corner. It is noted that the maximum computed displacement is well below 300 mm. Figure 8b presents the x- and y-component response of the normalized base shear for one response history analysis (the solid line). The dashed line corresponds to a base shear coefficient of 0.15. It is noted that the computed base shear for the isolated structure is less than 0.15g. The maximum computed horizontal acceleration at the roof level is approximately 0.15g.



a. Displacement response b. Normalized base shear

Figure 8. Response history analysis results

Figure 9 presents the response of a typical LRB and metallic (friction) slider from the analysis. It is noted that both components dissipate a significant amount of energy.

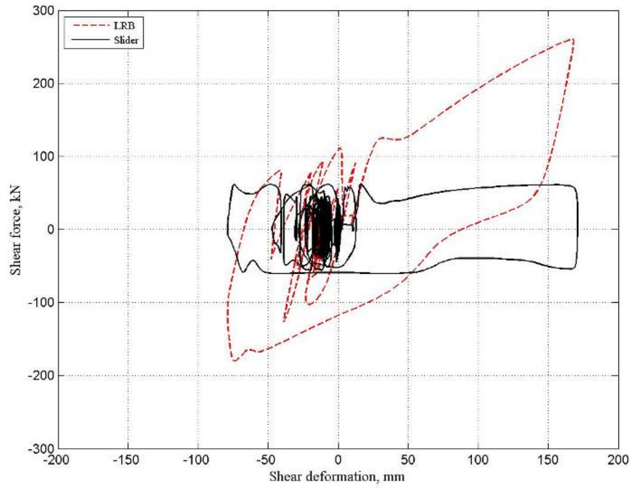


Figure 9. Response of isolation system

Conclusions

The historic Iasi City Hall is constructed of nonductile components. It has suffered damage in past earthquakes and does not meet the current Romanian seismic code requirements. The structure will be retrofitted with an isolation system comprised of LRB and sliders and was analyzed using response spectrum analyses.

- Analysis showed that the retrofit including the addition of the isolation system will significantly reduce the building base shear. The computed base shears, accelerations, and displacements were all within the target values.
- After retrofit, the seismic demand on the existing wall members would be significantly reduced and the unreduced demand on the walls was reduced below member capacities
- Response history analysis using three spectrum-compatible pairs of records selected from the Romanian (and Iasi) strong motion record database showed that the response of the isolated structure was satisfactory, and that the response spectrum analysis results used for design and evaluation of components envelope those obtained from time history analyses and are, therefore, appropriate for use in design.

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EVALUATION OF THE RECENT EARTHQUAKE ACTIVITY ALL OVER THE WORLD

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Abstract
The paper evaluate records of seismographs belonging to the international survey network over the last 30 years, assessing earthquakes frequency in order to detect evolution tendencies to be drawn. A simple linear correlation was used to categorize the trend of the seismic activity all over the world. Commonly the Earth seismic activity is almost constant in terms of frequency of earthquakes (Lăzărescu, 1980). A possible increased tendency of earthquake activity was revealed studying the frequency of the principal earthquake types (such as: great, with the magnitude over 8, major with the magnitude of 7 - 7.9, and strong earthquake type of 6 - 6.9 magnitude on Richter scale), taking into consideration that an earthquake measuring 8 on the Richter scale is 10 times larger in term of ground motion than a 7 magnitude tremor, or 100 times larger than an earthquake measuring 6 magnitude, and so on. The results indicated an unusual increased seismic activity since the 90's, which is in contradiction with the generally constant trend of the previous decade. Facing also a seismic increased vulnerability of the constructions built in the prone areas, decision makers should understand that to save lives, they have to adopt an integrated, comprehensive and multi-hazard strategy for disaster risk reduction, regardless the type of the disaster management procedure. This strategy includes prevention, mitigation, preparedness, response, recovery and rehabilitation. Based on lessons-learning approach, the activity of implementation of an earthquake resilient activity worldwide at local, regional or national level in the areas prone to earthquakes have to be assured by taking into account valuable recommendations of the risk managers involved into decisional planning, as indicated in the research paper.

Sections

Introduction

Over 1 million earthquakes a year can be felt by people on Earth. Large earthquakes and related effects rank among most catastrophic environmental events. Both tectonically active areas of lithospheric plates interactions along their boundaries and intra-plate fault displacements are responsible for rupture yielding seismic waves that shake the ground. Devastating effects of the earthquakes that occurred during the last decades underlines the necessity of a multi-hazard approach regarding the subsequent effect of the tremor waves, such as tsunami waves (Sumatra – Andaman Islands, 2004, NE Japan 2011), soil subsidence and major accidents at nearby chemical facilities (Turkye, Kocaeli, 1999), explosions at petrochemical and nuclear plant, after failure of the cooling system due to power failure, following the 10 meters tsunami wave (NE Japan 2011), submarine landslides (northern coast of Papua New Guinea, 1998), or landslides and soil liquefaction ("earthquake lake" at Sichuan, China, 2008, Christchurch, New Zeeland, 2011). The multi-hazard concept represents a new direction of research in an integrated manner, with applied global implications. The frequency of the disasters appears to increase in the last decades (Fig. 1), and the communities became more vulnerable to the natural hazards, generally due to the complex aspects generated by increased urbanization, land planning and environmental changes. The uncertainties involving the relations between different components of the surrounding environment made more difficult the investigation of each category of natural hazards (Airinei, 1972). Consequently it is necessary to study groups of hazards, not just a single case, and the interaction among them in order to have a clear view of the internal processes and causative factors of the disasters. From this point of view, the disaster seems to be more internationalized, due to global factors which interact and affect the population and the environmental factors.

Thesis

Recently it became relevant that, despite frequent large earthquakes, several countries located in prone areas didn't have strong building codes and many houses are built out of mud bricks and un-reinforced masonry, which do not stand up well to earthquakes. Mud brick didn't resist to the earthquake stress and too heavy tile and cement roofs generally collapsed into many houses. Other factors contribute to the severity of a quake, but earthquake resistant buildings can make a huge difference in the number of damages (Georgescu, 2007). As a result, casualties and damage are much higher than similar earthquakes elsewhere in the world. Therefore recent major earthquakes such as Guarajat, India (2001), Bam-Iran (2003), Sumatra – Andaman Islands (2004), Kashmir-Pakistan (2005), South of Java – Indonesia (2006) or Sichuan, China (2008) led to heavy human casualties, compared with other similar earthquakes all over the world. The same magnitude earthquakes, for example the Northridge quake in Los Angeles in 1994 killed only 57 people and in Kobe Japan in 1995 a similar quake killed about 5,000. Another example could be the earthquake –magnitude 7 - from Haiti, at Port-au-Prince in January 2010, with almost 220,000 casualties compared with a similar earthquake in the next month, in Chile, magnitude 8.8, 500 times higher than the previous one in Haiti, resulted in less than 600 casualties. In case of major tsunamis, which cross an entire Ocean, or so called "tele-tsunamis", i.e the greater earthquake ever recorded by instruments, with a 9.5 magnitude, in Valvidia, Chile (1960), which produced damage in Hawaii and alarm in Japan, it became obviously the "globalisation" of the subsequent effects of the tremors. They can reach any coastal areas all over the world, not necessarily earthquake prone areas, and request dedicated building codes. A similar effect took place following the recent great earthquakes at Sumatra – Andaman Islands (2004), 9.1 magnitude, with damages 1 mile inside the affected coastal areas, with a maximum height of the tsunami wave up to 30m, or the recent NE of Japan (2011), magnitude 9, where tsunami waves inflicted severe damages 9 miles inside the coast areas .The recent catastrophe in Japan exceeds the worst case scenarios previously estimated in prevention measures, especially at the nuclear plants. The maximum possible height of a tsunami wave was estimated at 6 meters high, whereas the height of the wave reached 10 m (the maximum recorded height was 23m for the NE of Japan).

Sources of information

The present analysis is based on data regarding the earthquake frequency and magnitude the world over, (Fig. 1), i.e. USGS (United States Geological Service) data base during the last 30 years (USGS, 2011).

Findings and Discussion

Findings

Decision makers begin to understand that to save lives, they have to adopt an integrated, comprehensive and multi-hazard strategy for disaster risk reduction, regardless the type of the disaster management procedure. This strategy includes prevention, mitigation, preparedness, response, recovery and rehabilitation, therefore the following lessons learnt can be drawn:

Prevention Measures

- The latest tragedies highlighted the importance of the addressing of public buildings (such as: hospitals, schools, fire-fighter units, etc.) in the national earthquake protection policies;

- A multi-hazard approach (earthquake plus tsunami) should be envisaged when response actions are planned. For example, access routes could have survived the earthquake but not the impact of the tsunami or some areas may remain flooded and therefore not able for rescue operations;
- The constructions located in earthquake prone areas, erected before the last building regulation was put into force, have to be inspected in case of not complying with the norms, then have to be retrofitted or rebuild. A special attention should be done for retrofitting the construction for the most vulnerable socio-economical activities, which in case of earthquake could lead to severe loss of life, due to increased damages to the most vulnerable public areas (such as schools, fire-fighters units, hospitals, etc.), and interruption of public services (transportation, gas, electricity, water supply) by damaging the bridges, fall of power lines, pipelines rupture, etc;
- The retrofitting works for all old buildings should take into account the new changing in the building resilience due to earthquake activity, taking into account the building codes for the specific earthquake area wherein the construction is located (for example, in Europe, the general rules for the assessment and strengthening of structures are available in the European Standard, Part 1-4 of Euro code 8, prEN 1998-3, and for other countries, the available guidelines in force). The designers and the constructors of the public units should pay more attention to structural issues;
- As a result of the recent earthquakes, new building codes for earthquakes have to be introduced in the affected countries, including new seismic zoning of the whole country, with the purpose to improve the standards of building execution and maintenance. In addition, any dangerous structural changes implemented over the lifecycles of schools or other public buildings which can weaken the building strength have to be avoided. Therefore an increased activity of inspection should be undertaken regularly, according with the building code in force, in order to interdict any possibility for improvisation or structural changes, mainly for the public buildings. In areas prone to natural hazards, including earthquakes and tsunamis, it is necessary to constantly review and implement the proper building codes for constructions. In particular, the presence of adobe-built houses or improvised makeshift shelters can become disastrous;
- In the coastal areas prone to tsunamis, it is necessary to implement prevention measures such as structural ones: tsunamis walls, sea walls, beach-long protection wall, automatic and manual closing water gates, evacuation routes and signing, establishing safer distances between different land use categories and the coastal line, depending to their economical activity, for minimizing the impact of possible tsunamis, or inexpensive protective lines of trees and dense vegetation, by planting local resistant trees species (for example mangroves in the tropical regions, coconut trees, etc.);
- In addition, non structural measures involve elaboration of tsunami vulnerability and risk maps, implementation of building codes and land use planning in order to define safe areas, education of the population regarding the behaviour in case of a tsunami wave, implementation of a seismic observation network system in relation to the possible detection of the tsunami generated by earthquakes, coupled with installation of alarming systems for the early warning of the population, studies for mapping the hazard vulnerability in the coastal areas characterized by intense socio-economical activity;
- Early disaster events could be further analysed having a look at underwater sedimentary deposits in order to get a full picture of the vulnerability (including the case of marine deltas where new settled sediments once loosing stability can trigger tsunamis waves on the nearby coastal areas);
- Although relatively reduced vulnerability of Stromboli type island (prone to underground landslides due to volcano material flow during eruptions) could be high due to holiday seekers and volcano tourists. Therefore the continuous activities of the volcano should seriously be watched and appropriate vulnerability analyses be performed. The focus should be put on landslides and/or lava flows due to volcanic activities; in addition, a multi-hazard approach could be useful as small earthquakes and/or tremors together with landslides trigger local tsunamis whose potential of destruction should not be underestimated. In the case of Stromboli one could promote structural actions (enforcing parts of the shoreline) and non-structural actions (educating the local population and especially instructing non-residents like tourists of potential signs of tsunamis). In the particular case of Stromboli volcano, which is of small size and not flat, it would be more efficient

to manage an easy but effective concept of early-warning system (for ex., the use of loudspeakers, sirens) together with an evacuation system that allows moving the local population towards safer places in extremely short time;

- The recurrence maximum time period, taken into consideration by nuclear engineers for a tremor in relation with a nuclear facility, that is the 10,000 years quake event, does not necessarily takes place after such a long period of time, and can occur anytime, even today or tomorrow, in the most earthquake prone areas all over the world, represented especially by the Pacific ring of fire, where the recent great earthquakes occurred;
- The usual location for nuclear power plants are nearby large water available resources, sufficiently enough for assuring the cooling of water generated by the reactors, including tsunami prone areas nearby oceanic coastal shores. Consequently a higher location have to be selected for the backup power sources, and other electrical equipment for water pumps used to cool down the nuclear reactors following the automatic shut down due to largest possible tremor event ever recorded in the region, that means generally above 8 or 9 magnitude. Therefore every nuclear plant designs should take into account the resulting effects of this kind of event, including larger tsunamis than before experienced on a specific location chosen for nuclear development;
- Periodical reevaluation of the nuclear power plant safety standards, depending of construction principle type e.g. light water cooled reactor (LWR), graphite-moderated, water-cooled reactor (RBMK), known as the Chernobyl type, heavy water moderated reactor (CANDU or AHWR), advanced gas cooled reactor (AGCR), liquid metal cooled reactor (LMF) or type of the nuclear fuel (uranium 253 and 258 or the most risky plutonium 239); NATECH scenarios (Natural Accidents that might trigger technical disasters) are to be considered, depending of natural hazards in the earthquake prone areas (e.g. landslides which may affect the land stability, storms or tsunamis which can flood the power generators, associated severe draught which may result in a water shortage in case of a water pipelines damage leading to nuclear fuel overheating), in order to avoid the worst case scenarios at a nuclear power plant, a nuclear leak due to melting down of the nuclear core, following failing of the cooling down of the exposed nuclear fuel rods.

Preparedness measures

- The continuously monitoring of the areas prone to natural hazards, including earthquakes could lead to a better knowledge of the risk evolution of facing a possible disaster, also taking into account other vulnerability factors which can increase the probability of a disaster occurrence. Being known that many inhabited clusters could be closely located to an active tectonic area, and before some incipient earthquake activity will began, a detailed seismic analysis is necessary in order to detect the possible underground discontinuities. Generally speaking, even without having a historical evidence of earthquakes, worries can be raised regarding the overall seismic activity of a vulnerable area. In term of exposed population or industrial facilities, if an underneath fault is discovered, subsequent measures can be taken leading to a better preparedness activity for a possible earthquake;
- The proper training of the personnel involved in emergency response and relief during natural disaster is essential for a better management of the emergency situations generated by an earthquake. Therefore constant simulation and drill exercises should be performed by the specialized personnel in order to be prepared in case of a major earthquake or for the possible forwarding aftershocks. An intense training program for the emergency personnel in the exposed areas should be performed using special trained sniff dogs and adequate equipment for increasing the preparedness capacity. Population should be also involved in the training drills, in order to become aware of the basic rules of survival and for recovery actions, to assure a better cooperation with the local authorities involved in the disaster mitigation activities;
- The damage assessment scenarios for inhabited areas located in tsunami prone areas, on the coastal lines, will re-evaluate the mitigation capabilities in case of a real disaster and lead to a better response of the emergency services;
- Countries located in tsunamis vulnerable areas should set their own national tsunami warning system, capable to watch and warn in due time the local inhabitants about any danger of producing

a catastrophic event occurring nearby the inhabited area. For maintaining the awareness and the response capability of an already implemented tsunami warning system, simulation exercises should be periodically organized. Different responsibilities and tasks of the emergency personal involved in monitoring activities are reviewed, assuring the communication in real time of the emergency relief cruses about the probabilities of producing the disasters and assurance of warning the population;

- The existence of the emergency stock of materials and means of interventions, located in the vicinity of the prone areas of natural hazards, including tsunamis, allows an optimized relief activity after a disaster in the region, assuring a successful intervention activity and minimization of loss of lives and damages to the properties. It is crucial to have sufficient stock (including tents, blankets, medicine) available in order to support people that have fled from the tsunami;
- An efficient preparedness measure depends of timely early warnings issued by the authorities following an earthquake with high magnitude, which often constitute the triggering factor for the tsunami;
- Area that had been affected by similar events in the past should create a disaster prevention platform; it could help in better identifying vulnerable areas and/or weaknesses in preparedness activities;
- Evacuation routes should be generated on the basis of flood maps and availability of shelters. If no natural shelters (hills, mounds, berms) are available it is advisable to construct vertical shelters.
- It should be clear that living in houses which are built 1 - 3m above sea levels, a high level of preparedness is required in the case a tsunami hit;
- Already established safety zones, implemented in the planning of the coastal areas, will lower the risk of the highly risk areas, both by earthquakes tremors and tsunami waves, therefore a multi-hazard approach in emergency planning would be advantageous. Preceding disasters, like a heavy earthquake, could (partly) destroy evacuation routes and assembly places; therefore a multi-hazard approach (earthquake plus tsunami) should put particular emphasis on having such routes and places secured. Moreover, the emergency planning should take into account that subsequent disasters or inconveniences may happen and request alteration of early plans, i.e. heavy rainfalls which, in turn, produce landslides and mudflows. Subsequently, people in emergency shelters had again to be redistributed in (different) safe locations;
- In the particular case of Stromboli type volcanic island, due to the continuous activities of the volcano, constant preparedness is absolutely required, that is availability of responsible persons issuing the alarms, instruction non-residents, keeping free the evacuation routes;
- On small islands telecommunication back-up system should be kept operating in order to start rescue operations;
- The nuclear facilities located in the earthquake prone areas should have drilled in advance holes for vent up hydrogen released from the water cooling down reactor. The holes should be positioned at the top of the main building covering the nuclear reactor and containment vessel. This means preventing the hydrogen build up and risk of deflagration which might cause radioactive emissions, in case of core overheating due to breakdown of the cooling system. These hydrogen releases due to radiolysis may take place also because of the nuclear rods exposure in case of lowering down the water level in the cooling water pools with nuclear depleted material found inside the main buildings of the nuclear power plant;
- Every nuclear power plant should take into consideration the availability of a pool of human resources to be used as a supplementary intervention in catastrophic event. In addition, a clean-up facility building located a few kilometers away from the main reactor facilities, including shelters large enough to host the emergency shifts for extended intervention in case of a nuclear incident. Such an action is recommended when the number of the normal available working shift personnel can not assure a proper emergency intervention in case of power failure and reestablishing the cooling down capabilities of a possible crippled nuclear reactor due to the twin action of a large scale tremor and subsequent tsunami event.

Response measures

- The endowment of the rescue teams with special equipments and means of intervention in case of emergency situations is essential for an efficient response, increasing the chance for saving lives and reducing the economical impact of the natural disasters, including earthquakes. In the aftermath of the disaster, many persons can be rescued beneath the rubble thanks to the sniffer dogs and hi-tech ultrasound equipment both from the national level or foreign emergency teams;
- The existence of the communication routes through all remote communities within a prone area for natural disaster, including tsunami, is an essential factor for undertaken an efficient response activity in case of a disaster event;
- For minimizing the pressure of the local community in case of disasters, the existence of an insurance system for the houses and goods against the natural disasters, including earthquakes is very efficient. This is due to the indemnity of the affected people, automatically covered by the insurance companies. The financial coverage of the response action will not be affected, in case of producing some damages. Commonly, in the aftermath of an earthquake, the only compensation of the homeless people in the affected areas are the subvention from the state and foreign aid organizations, in order to assure the economical income for a normal social life. Anyway it couldn't cover always integrally the loss, in the absence of a national-wide efficient insurance system;
- In the hazard prone areas where a certain disaster is present, the recovery activities are difficult to undertake, for example in arid regions there is the possibility that water tubes are broken triggering major damages. Response teams must be ready to get water lines repaired in short time;
- In the rehabilitation phase the focus should be put on economical recovery and social sustainability within the affected communities. Therefore long-term intervention development programs have to be set up in the affected areas, for the benefit of the most vulnerable communities, mainly focusing on income generating projects;
- The multi-hazard feature of the inhabited areas and population vulnerability, as a result of the economical developing, could worsen the condition of the affected population in case of a natural disaster, superposing the effect of more hazards. A prime task of the international assistance in the affected regions is the strengthening of the capacity to respond to future disasters in the area, because some regions could have been already suffering from the effects of other hazards before the earthquake, or to withstand to the associated hazards of the main event (such as aftershocks, tsunamis, fires due to broken gas pipelines or from the damaged reservoirs of the affected boats or cars carried by the waves into the houses walls, liquefaction and landslides, mudflows, etc.);
- A prompt response activity in case of a natural disaster, including tsunami, is related to the existence of an already implemented, "Plan of emergency and intervention", at the level of local and central public authorities. It clearly stipulates the competencies and the activities during each phase of the emergency intervention for rehabilitation and clearance of the disaster effect. The plan should be constantly revised in order to assure the updating of the information with the changes in land planning activities at the level of the community, or modifications intervened in the structure of the emergency staff personal in charge with the response activities;
- Rescue operators have to count with a lot of destruction and uninhabitable houses thus having to maintain a huge number of refugees over a long period;
- The response capability in coastal areas, in the case of a tsunami event, should rely on the effectiveness of the early warning system for tsunami, which allows an efficient preparedness measure. In some vulnerable coastal areas the travel time for tsunami to reach the coastal area is very short (for example the Mediterranean region), generally in less than 10 min after start, due to relatively shallow and low step offshore bottom morphology. Consequently the period of time until the tsunami alert is initiated should be very short, in relation to an existing efficient alarm capability of the population and the emergency relief crews;

– Automatic unmanned (anti-radiation proof for humans) crane coupled with long range powerful water pumps near a water source for spraying at distance large volume of waters, should be available for all nuclear facilities located in the earthquake prone areas, including tsunamis. These special intervention equipments, including remote surveying robots with dosimeters, should be used in the event of a nuclear cooling down operation failure, following larger tsunamis that might drawdown the back up pumps used for emergency intervention. In addition, a longer enough power cable to be switched on at an existing nuclear facility from an outside existing power source, generally a mile longer, should be available to connect by emergency the main nuclear unit of reactors in case of power failure due to earthquake tremor or subsequent tsunamis. Large barge should be available nearby for transporting freshwater in case of a nuclear accident at a plant located at the sea shore, in order to cool down the reactors, because the marine salt water damages irrevocably the nuclear facility.

Information to the public

- In the areas prone to natural disasters, including earthquakes, at the level of the regional or local administration, hazard vulnerability and risk maps should be available for all decisional factors involved in the management of this type of disaster but also for dissemination to the general public in order to be informed about the dangers nearby the inhabited areas;
- The proper information of the population from the vulnerable areas to the earthquakes about the risk reduction issues and the possibility to reduce the vulnerability of their houses by applying correct building codes, is highly necessary. The using of the new building materials, such as iron or iron coated concrete beams, together with the traditional ones such as clay bricks, without respect to any elementary building code, sometimes worsened the strength of a construction, and put an increased risk of the inhabitants. For example, the use of the iron beam for strengthening and to allow the extra-store constructions, together with traditional materials (clay bricks), could increase the vulnerability in case of a possible earthquake, as well as in the case of recently affected areas by earthquakes, where multi-store buildings collapsed and produced more casualties than in a possible destruction of a one store house;
- It is necessary to create a knowledge platform to disseminate information at the local level, to educate people about the risk reduction issues in case of an earthquake. For example, the existence of some water and food supplies, also some vital medicines in case of chronic diseases, available in case of trapping inside a house can increase the life expectancy in case of earthquake, which could produce the collapse of the inhabited house;
- The adequate information regarding the situation nearby an affected area by a recent earthquake lead to a more donor support from the surrounding communities and countries. An information booklet and a Website describing the earthquake effects during the relief operations can bring more donor support and can contribute together with the information press for a humanitarian appeal from the international community;
- The ongoing information of the public regarding the actions to avoid a tsunami wave (such as: the clear indication of the escape routes, the avoidance of the exposed coastal areas during the tsunami, urgent deployment to higher places, etc.) will lead to an adequate behaviour of the population in case of a real disaster, limiting the number of affected individuals;
- The information of the public about subsequent effects of a technological disaster (oil terminals and refineries, mostly located in the tsunamis prone coastal areas) or natural hazards in travel or inhabited area, including tsunamis, and about the presence of other possible accompanied triggered disasters, following an earthquake, such as landslides or rock falls, by all available means (police agents, local broadcasting, tv news, papers, warning panels, etc.), lead to avoid the risk and limits the consequences in the aftermath of a natural disaster;

- The case of Stromboli type islands, visited by numerous foreign tourists, requires permanent, effective and multi-lingual instruction of residents and non-residents, i.e. leaflets let to those arriving, pictograms let in hotel rooms, warning signs put on beaches and nearby paths;
- Populations should be kept informed by local authorities on the possible restriction zone, generally following an accident at a nuclear reactor due to the impact of a twin event of tremor and the subsequent tsunami wave. The restriction zone is declared generally as an exclusion zone for population, excepting the nuclear plant emergency personnel and fire fighter units, and is particularly coffined at a specific distance radius to the crippled nuclear reactor, commonly of value of tens of miles around the radiation source;
- Radiation self detection equipment (dosimeters) for personal use should be available for the population individuals located nearby nuclear facilities, or the persons travelling nearby, for auto monitoring of the radiation doses (e.g. the hourly radiation dose is 0.1 micro Sievers - μSv/hour). In case of exceeding the normal dose, depending on instructions from the emergency supervising personnel, a decontamination procedure is required (e.g. shower with water and soap washing); Food (milk and fresh harvested vegetables) and water nearby a crippled nuclear facility can be immediately affected by a nuclear leakage due to a catastrophic failure of the cooling down the nuclear reactor, or incidents at the nuclear rods being exposed, due to the wind dispersion (e.g. as far as 100 km radius far to the radioactive source);
- Main radioactive isotopes (e.g. Iodine 131, Xenon-133, Krypton-85 and Caesium 137), produced during a nuclear accident due to subsequent tsunami of an earthquake event, can immediately affect the health on long term, due to the carcinogenic effect. Special medication for radiation prevention should be used only on the certified medical surveillance, because the main antidote, for Iodine 131, the iodine salts (e.g. potassium iodine) is available just for a time window of 4 days, when the results are affective (e.g. for avoiding the accumulation in thyroid gland by aerial way), and the self medication with other similar inhibitors (for example iodine salt), can shift the effective period before the radioactive cloud is atmospherically drifting on a certain vulnerable inhabited zone.

Discussion

Contemporaneous seismic activity as well as complementary volcanicity are genetically linked to Cenozoic plate kinematics, involving interacting plates and/or intra-plate rifting steaming from triple junctions. Upper mantle heterogenic seismic structures are intimately related to plate breaking and motion.

A series of natural facts are to be taken into consideration in order to approach the causes of such unusual trend of increasing major earthquake frequency after 1990 which led to destructive earthquakes in "classic" areas but also in areas not specifically known as prone area.

A cause of increasing trend of seismic activity may be induced by internal factors related to global tectonics. It is marked by intracrustal-subcrustal structural, sedimentologic and magmatic processes creating shallow or deep areas for large magnitude earthquakes., e.g. coupling convergence rate, age of subduction, lithosphere type, trench sediment thickness and so on.

Reality or mere coincidence, concurrent supracrustal processes at global scale may affect the Earth's structure and related sensitive tectono-seismic spots. Of them the global warming is considered by a large part of the academic world as major process with implications at atmospheric, hydrospheric, biospheric and lithospheric levels that represents the so-called Critical Zone of the Earth. So far Cenozoic eco-climate change was taken into consideration in order to explain seismic differences of orogenic regions based on sediment thickness, i.e. effect of coupling between tectonic and erosion.

The need for detailed analyses of the effects of the global warming and the assessment of all the aspects of the environmental factors, are due to the necessity to control the natural hazards at the level of the planet Earth, involving the approach of a global analysis. Therefore, to study the interrelation between global warming and the earthquakes can be made just analysing the involved phenomena (earthquakes, global warming, tectonic evolution) at the world scale level, taking into account all relevant aspects of the involved hazards, making reference to the historical evidence and data records.

Useful information can be provided by conclusions of the experts involved in the analyses of the core samples from the ice drillings 3000 m deep in Greenland, performed in early ‘90s. The unusual enriched content of sulphate found in the ice cores at a certain depth proved an episode of unusual intense volcanic activity, which took place at 7000 BC, induced by the tectonic instability due to the rapid defrosting of the continental ice sheet, because of a warmer climatic episode. The paleo-environmental reconstruction of the last major volcano activity occurred on earth, at 7000 BC, was a result of the analyses conducted on the ice drilling samples from glaciers by a research program performed in Greenland, through the European Science Foundation (Zielinski, G. A, 1994).

The analyses of the earthquakes frequency trend all over the globe, in the recent years, correlated with the actual tendency of defrosting the ice from the polar regions (NSIDC, 2005), allow the study of presumable recurrences in future, of a similar event of volcano increasing activity and subsequently tectonic disturbance, as a result of the defrosting evolution of the actual glaciers due to global warming. The possible correlation between the analysed earthquake data and the actual ice sheet evolution, which covers actually 10% of the total crust (where the continental area covered by the ice is reducing due to the increased global temperature), can induce serious consequences over the tectonic stability of the earth, respectively the frequency and magnitude of the related phenomena, such as subsequent volcanoes activity which can be induced by the plates movements and evolution, and generating earthquakes.
According to specific environmental evaluations that claim that the actual trend of global warming is continuing, in the next hundreds of years the continental ice will disappear. The rapid defrosting of the continental ice could lead also to some secondary tectonic effects due to the release of the equivalent pressure of the ice load. If the assumption of the paleo-climatologists is correct, a similar phenomenon, an increased warming episode, like the actual global trend, could lead to an unexpected increased tectonic activity, with unpredicted impact over the humans and surrounding environment. Therefore the actual increased trend of the earthquakes frequency could be a global indicator of the tectonic stress due to rapid defrosting of the continental ice sheet.

Conclusions

The needs for increasing the resilience of the communities all over the world lead to more detailed studies on both small and large scale in order to try to explain the connection among factors which interact naturally on the Earth. The lessons learning activity based on the analysis of the recent tremors data all over the world can improve the preventive, preparedness and intervention means of the earthquake vulnerable areas.

Analysing the possible increased tendency of earthquake activity (Table no. 1), in order to clarify the cause of the unusual increased trend of the earthquakes frequency in certain periods of times after the 90's, a common fact was that all these recently past events surprised the local population as well as local and national level risk managers, because the hit areas were not considered before specific historically earthquake prone zone, so the building codes were not updated for a real seismic zone (including major cities as Kobe or Islamabad). The paradoxical issue of increased trend of earthquakes just after ’90 was never been tackled seriously before. Generally it is considered that just 10% of the total energy from tectonic plates movement are transformed in earthquakes, and remain 90% converted in other forms of energy due to rock displacement and heating up processes (Sciencedaily, 2010). A constant increasing trend of the Earth’s earthquake energy, revealed by our analysis over the last 30 years seismic records worldwide, could indicate a shifting of the remain 90% of the tectonic energy, normally dissipated in plates interactions, towards earthquakes. That’s mean we will witness a future increasing in the earthquake pattern trend, which may have profound implications at a global scale, in our understanding of Earth dynamics.

Another explanation is that, following the global climatic changes, a large part of ice Polls sheet started melting, so large volume of water were released into the ocean triggering potential changes in the global plate tectonic equilibrium. Taking into account that Antarctica (Southern Pole continent) is covered with snow and ice of almost 2000 m height, equivalent in weight of a real continent, whose melting can destabilise the established continental plates equilibrium. These sudden melting (which in terms of geological ages has never been experienced so fast until now in the whole Earth's geological history), might influence the global earthquake trend, a possible precursor of changes in the pattern of global plate tectonic movement. What is however certain is the fact that earthquakes are geological hazards of endogenous origin, and what is uncertain is the global warming itself and the potential influence of exogenous factors over crustal/sub-crustal settings. Consequently, discerning mere speculation from evidence is still a priority.

Furthermore the general lessons have to be implemented urgently by the risk managers involved in the activities of updating and implementing the building codes, seismic risk zoning and regulation, in order to avoid in the future any other misjudges of the earthquakes hazard, for minimizing the loss of human lives and material damages.

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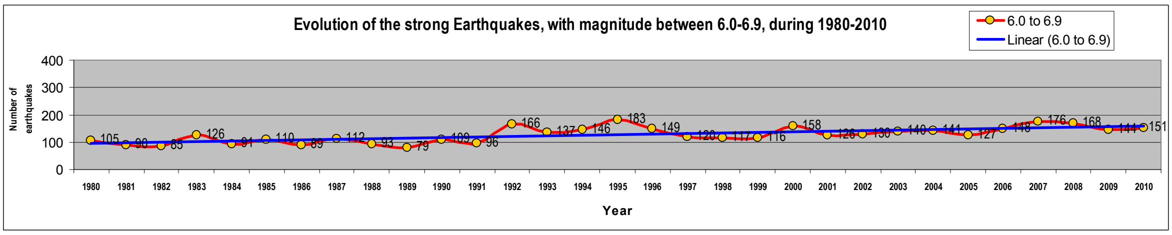
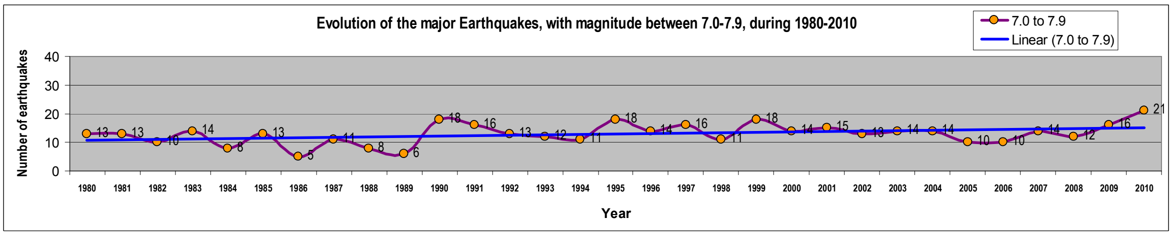
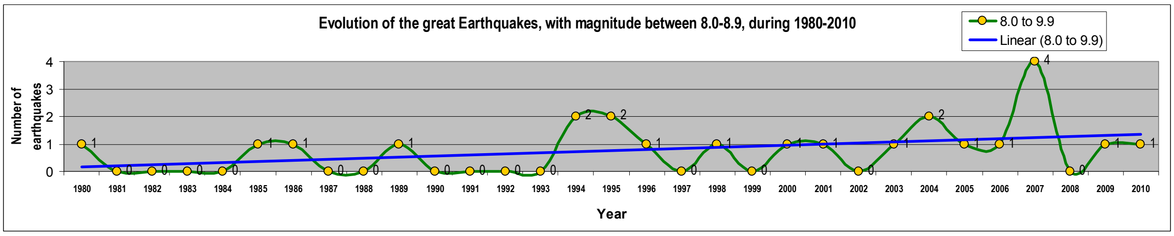
Annex: Fig. 1: Earthquake trend evolution since 80's (blue thick line represents the increased linear trend and the coloured lines the frequency evolution for each type of earthquake category, strong, major or great):







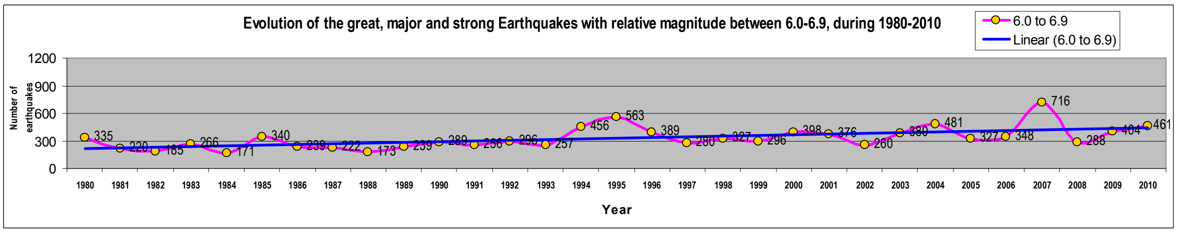


Table 1. Evolution of the Earthquakes frequency (no/magnitude/year) during 1980-2010

Magnitude /year	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**
8.0 to 8.9	1	0	0	0	0	1	1	0	0	1	0
7.0 to 7.9	13	13	10	14	8	13	5	11	8	6	18
6.0 to 6.9	105	90	85	126	91	110	89	112	93	79	109

1991	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
0	0	0	2	2	1	0	1	0	1
16	13	12	11	18	14	16	11	18	14
96	166	137	146	183	149	120	117	116	158

2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
1	0	1	2	1	1	4	0	1	1
15	13	14	14	10	10	14	12	16	21
126	130	140	141	148	148	178	168	144	151

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MEDICAL MANAGEMENT OF ENTRAPPED CASUALTIES IN COLAPSED STRUCTURES AFTER AN EARTHQUAKE

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Abstract

Earthquakes are the most destructive natural disasters. A great number of earthquake's victims are caused by falling buildings. Throughout the world there are various types of earthquake rescue teams. The medical personnel belonging to such rescue teams does not usually specialise in disaster medicine. Advanced Trauma Life Support has been selected as the appropriate treatment basis. When dealing with earthquake victims, medical personnel should always suspect crushing until proven differently. The authors present an overview of the most important elements of the issues regarding the Medical Management of Victims trapped in buildings destroyed by earthquakes, by reference to their own experience of the 1977 earthquake in Romania and the 1999 earthquake in Turkey (in work). The authors propose the establishment of a specialized study in academic medical education and presents their own experience in the
field of Disaster Medicine degree in Romanian medical school .

Passwords – entrapped casualties, medical intervention 1977 earthquake in Romania - 1999 earthquake in Turkey - own experience - disaster medicine degree.

Introduction

Earthquakes are most destructive and dangerous type of natural disasters. Earthquakes occur suddenly and without any warning signs. 90% of victims are produced directly by the collapse of buildings. Secondary events such as landslides, floods, fires and tsunamis cover only 10% of the total number of victims, except for recent events from Indonesia and Japan.

The need for specialization when we deal with this disaster led to the creation of various types of search and rescue teams worldwide.

Medical personnel working in search and rescue teams typically specialize in other areas than in the disaster medicine such as emergency medicine, anesthesia and intensive care, surgery and trauma. Their work is dedicated to disaster medicine only episodic. A treatment protocol will have to adapt the best possible treatment protocols used in other traumatic scenarios. Advanced Trauma Life Support (ATLS) Protocol was selected as basic as is the standard treatment for trauma management that is used in many countries. (29) Whenever possible, examine the patient and will revive. Without doubt, the medical staff must be aware of issues presents by the victims of an earthquake. Most seriously injured victims are entrapped in collapsed buildings.

The assessment and treatment are seriously hampered by very limited space where victims are found. All release the victims that were extricated from the rubble, crushing syndrome may be suspected until it proves otherwise.

"Packing and Shipping" and "golden hour" are terms that do not apply in this situation. Hospitals near the event can be destroyed or be inaccessible (2*)*.

This and other problems specific to the medical treatment that normally occur during extrication of victims of an earthquake and will be presented in detail.

Throughout the decade of the 80s, earthquakes have occurred around 57,500 deaths. In 1990, U.S. Geological Supervision reported that more than 52,000 fatalities occurred worldwide due to earthquakes. Most of these deaths (50 000) occurred in the 1990 earthquake in Western Iran on June 21, 1940 in 68 of the most significant earthquakes occurred in the so-called "ring of fire" surrounding the Pacific Ocean.

Earthquakes occur worldwide, however most deaths caused by earthquakes are distributed only in relatively few regions of the world.

Unfortunately the vast majority of deaths caused by earthquakes (65%) is concentrated in developing countries, which have limited economic resources. Also there is a coincidence of negative factors such as high seismic risk, a greater risk of death due to poor quality of construction and a high risk of ineffective response.

It is generally recognized that time is a particularly important factor, crucial for saving severely injured victims of an earthquake.

Year	Magnitude	Country and area	Thousand deaths
1988	8.8	Armenia Armenia	24.944
1978	7.7	Tabas Iran	18.220
1976	7.5	Guatemala	23
1976	7.8	China Tangshan	242.469
1974	8.8	China	20 20
1970	7.3	Peru - Ankash	56.794
1968	7.5	Iran-Dash-I Biyraz	12
1962	7.3	Iran Buiyn Zhara	12.225
1960	5.9	Agadir Morocco	12 12
1948	7.3	USSR Ashabad	19.8
1939	8.3	Chile Chiltan	28
1939	8.0	Turkey-Erzincan	82.700

1935	7.5	Pakistan-Ouast	25
1927	8.0	China-Tsinghua	40.912
1925	7.5	Italy-Avezzaro	32.61
1923	8.3	Japan - Kanto	142 807
1920	8.5	China-Kansu	200
1917	7.0	Indonesia	15
1908	7.5	Italy, Messina	58
1905	8.6	India Kangri	19

Table 1: The most destructive earthquakes in our century

In contrast to that in United States occurred in far fewer deaths due to earthquakes. The Loma Prieta earthquake recently in 1989 was only responsible for 65 fatalities, which stresses the importance of site specificity in terms of mortality and morbidity.

No	Deaths	City	Date
1	452	San Francisco, California	1906
2	173	Alaska	1946
3	120	Long Beach, California	1933
4	117	Alaska	1964
5	65	Loma Prieta, California	1989

Table 2: Top five by number of fatal earthquakes in the U.S.

The "golden hour" everyday emergencies, is widely cited and accepted (7,8). It was suggested that the disaster does the "Law of 24 golden hours" to rescue severely injured victims (21, 24, 26).

Activities included in disaster planning and response are described in three major phases:

Predisaster Phase

Preparing for rescue and first aid life saving and organizing in predisaster phase the general population, and emergency respondents (fire, police, emergency medical personnel, etc..), and advanced vital support staff from the prehospital settings and medical teams, are initial phase of preparations for a disaster and has a beneficial effect on life-saving efforts in post-disaster phase.

Nonmedical mitigation activities of disaster activities such as seismic design of new buildings or redesigning and enhancing of existing ones (especially hospitals) and nonstructural techniques such as zoning policy of known seismic risk regions can be added to activities that will be phased in predisaster.

These activities constitute the most important injury prevention activities in areas of seismic risk. Advanced warning using scientific means of prediction is not currently available for earthquakes.

Lack of activities mentioned above as a lack of coordinated response to the earthquake when an earthquake happened in Armenia in 1988 led to very negative effects on them below.

The general consensus of researchers and disaster planners intervention is that training programs are generally inadequate in communities subject to these risks.

This inadequacy results from lack of proper evaluation of risks to public health caused by earthquake (3,14).

Proper evaluation of all factors associated with deaths and injuries in such circumstances is essential to determine the needs for support and the correct answer medical system (1).

Analysis of Noji and collaborators (22) of activities in response to the earthquake in Armenia in 1988 found that first responders after the earthquake were relatively nerăniți survivors, volunteers, friends, neighbors and relatives of victims (9) and where over 90% of survivors were released from the ruins of the population (10).

Lack of planning of medical intervention in case of earthquake in Armenia has been revealed and the findings of epidemiological research conducted in this case (6) in which we find:

- 81.5% of those who were rescued were unable to walk unsupported alone, 66.2% of victims were detained for more than one hour, and 49.2% more than 6:00, only 28.2% the victim received first aid at more than one hour after extrication;

- The means used to escape have been represented for 68% of victims of bare hands and only 10.5% were saved with tools and devices;

- Rescue personnel provided was the untrained population for 55.1% of victims and only 10.5% of the victims was provided by specialized formations;

- The first aid personnel were accounted for 32.2% of victims of doctors and 32.2% of victims were not medically assisted;

- First aid was given for 56.5% of victims at the accident scene and during transport;

- 58% of victims were transported by their own means or improvised, and only 10.5% were transported by autosanitarele;

- The total number of victims that required treatment in hospital care required 61.6% and 33.4% other orthopedic care.

The perfect organization of medical intervention prespitaliceşti with high efficiency in saving human lives, requires a number of conditions where assessments of Pretto (25), may lead to prevention of at least 22-25% of deaths that would occur in an earthquake.

Intraevent phase (response)

Intraevent phase response activities includes immediate notification to authorities about events that occurred followed by different levels of response based on rapid assessment of the magnitude of the event and the needs generated by the disaster.

Medical response to seismic events must begin within minutes after the earthquake and can take up to 12 days.

This phase response can be divided into the following subphases:

- initial detection and clearance period of 24 hours (search-rescue) and resuscitation (resuscitation of disaster);
- intermediate period of 1-8 days consisting of rescue and treatment of victims who are still surviving in prison;
- late period of bodies recovery.

The initial phase of response is characterized by intense activity and includes disposal and transport of victims with vital support by hospital facilities intact for definitive treatment. If severely injured victims have a chance of survival they must be saved in the initial phase.

Postdisaster phase (reconstruction)

Postdisaster phase starts after more than 12 days, it is a long reconstruction phase that includes aspects of public health and medical rehabilitation, physical, economic, social and psychological human and physical infrastructure destroyed.

Rescue activities can be classified as

Extreme light rescue

Can be done by victims or self extricated victims and lasts from minutes to several hours after the disastrous event, be effective only to save the victims entraped in buildings slightly damaged.

Easy rescue

Normally is done by people more involved such as firefighters, search and rescue teams, etc. Not usually begin until several hours after the event, the relief effort was mobilized, coordinated and is able to reach on the spot. Both rescue extremely easy and easy rescue can be easily deployed within 24 hours.

Heavy rescue

It is used in cases arising victims entrapped in heavy concrete structures damaged by the event. It is intended to act in postdisaster phase after the response phase, when heavy equipment was transported to a rescue site.

The ability to reduce injuries in case of an earthquake depends on several factors such as:

- inventory of buildings designed and constructed earthquake;
- very prudent use of land;
- the reducing of the density of occupancy of buildings;
- predisaster emergency planning;
- early warning and evacuation;
- timely and effective rescue.

Once there was a seismic event, the first five of these factors are irrelevant. Furthermore they are generally not applicable in major seismic regions of the world especially in underdeveloped economies. Therefore rapid and effective rescue only remain available for reducing injuries.

From all these considerations lead to a rapid and effective relief (time, data of damage to buildings, the number of people incarcerated, the severity of injuries involved), but time is the only factor that may be influenced since the disaster occurred.

Depending on the degree of predisaster planning, resource availability and expansion of damage, rescue teams may not be able to reach the disaster site in a shorter period of a few minutes to several hours (less than 6 hours) after the event.

Moreover unwounded survivors are always on the spot. Time to move them is negligible. In many cases these persons may warn about the number and location of entrapped victims. In Armenia a slight majority of victims entrapped in rubble was met by family members unwounded but untrained (14,21)

This must be some mechanisms to ensure the benefit of underdeveloped people prepare for life-saving first aid to major seismic risk areas.

The unwounded population, currently lack the basic knowledge and skills to engage in providing useful and safe first aid.

By providing training and rescue training of the population resting in seismic risk areas is available a full major adventure first aid.

This resource can be mobilized quickly and be able to determine a significant improvement in life-saving capacity in areas with high risk, vulnerable earthquake of this planet.

Establishing a training program in the rescue of the general population is needed in all countries subject to significant seismic risk.

The purpose of this training is to increase disaster preparedness in areas subject to significant seismic risk.

The rationale of such preparations is that the general population is immediately on the spot and if they have knowledge and skills needed to locate entrapped victims can provide rapid intervention necessary to save lives and reduce complications of wounded imprisoned these statements after the earthquake.

Also reduce the consequences of such training for those carrying out rescue operations.

Acting through the Association for Volunteer Emergency Rescue, an NGO working in Bucharest for over 10 years, we were able to educate these principles over 1,000 people, especially young.

Disabilities

Many victims suffer in entrapment because the impact of traumatic injuries caused by falling objects(20). Head injuries caused by falling objects are ordinary (18, 22).

The most important indicator for such injuries is consciousness. Generally speaking, treatment guidelines for patients with head injury are not different from those provided for victims of traumatic injuries of the skull of other scenarios. Currently, treatment options for a scenario earthquake are limited by small environment where incarceration occurs.

Although intubation and controlled ventilation are indicated as initial treatment for unresponsive victims or victims who may be responsible and have a head injury, intubation using orotraheale rubble should be restricted due to high probability of failure of tracheal intubation.
These include: (1) deterioration of consciousness level, (2) lateralization signs, and (3) seizures. Of these seizures is the only sure sign of an acute brain injury. If the consciousness of a victim under debris damage and the victim is suspected as suffering from a head injury, treatment sequence is: (1) sedation using a narcotic agent; (2) oxygen and (3) intubation and hyperventilation to $PACO_2$ level 28-30 only if the environment allows a relatively safe intubation. If convulsions occur they should be treated with diazepam 10 mg intravenously. Further measures to reduce intracranial pressure once the seizures are occurring: (1) intravenous administration of mannitol, 25-50 g at 4:00, and (2) intravenous administration of furosemide, 20-40 mg at 4:00. Even if the victim has seizures repeatedly at some interval, we do not agree use of pentobarbital even well hydrated victims. Anticonvulsant prophylaxis with phenytoin not be administered to victims still under the rubble.

Victims with head injuries presenting to be suspected of having spinal injuries. These lesions can be normal and the results of earthquake victims who have head injuries. Spine injuries have been reported both victims were able to move and those who could not move when the crash (18).

Spine cord injuries are often associated with structures built with rigid ceilings and roof light.

Primary assessment of entrapped victims

Medical assessment of victims of prison begins when contact is established with the victim. Communication is the first word and then normally becomes visual. Physical contact which allows a doctor / paramedic to continue with a primary survey is the latest in minutes or hours after initial contact. Even if it is physical contact with the victim, a primary medical evaluation may not be possible due to the structural environment in which the victim was imprisoned.

The ATLS approach, verbal assessment focuses on assessing the level of consciousness and the events surrounding the injury. It must be realized even if the victim is fully conscious and cooperative symptoms and may mislead the medical team.

Prolonged crushing member may lead to loss of sensitivity and victim to perceive pain in other parts of the body were less affected.

Crushing injuries should be suspected until proven otherwise. Mechanism producing lesions may have a slight influence on the current state of psychological trauma in any other scenario.

Assumptions that must be considered the primary assessment of victims both before and after Extrication Extrication are presented in Table 3.

Differentiation between those victims still imprisoned and those who have just been release the restrictions come from both the primary assessment and resuscitation as if the victim remains imprisoned. First Review	At the entrappment place	Extricate
Airways	It is assumed compromised airway	Rate
Breath	Assumed damage secondary ventilation dust inhalation and / or toxic gases and direct trauma	Rate
Circulation	Assumed hypovolaemia and crushing injuries	Rate
Disabilities	It is assumed that neurological examination is incomplete	Rate
Exposure	Assume hypothermia, only exposed parts of the body if necessary to save life	Expose and cover

Table. 3: —the assumptions made in primary examining

The results of simulations of different earthquakes scenarios

The following is the results obtained in terms of survival and perhaps their lives in prison if not applicable search and rescue measures in the four simulation models of an earthquake that can occur in the Vrancea area.

No. crt.	Variable	Own simulation	Simulation Munich.re	Simulation Swiss.re	Cresta Motion simulation system
1.	Urban entrapped	3943	1644	3876	17 716
2.	Rural entrapped	93	46	76	220
3.	Total entrapped	4036	1690	3952	17 936
4.	Survivors after one day	3576	3047	3165	3506
5.	Survivors after two days	101	84	88	96
6.	Survivors after three days	33	9	32	232

Table 4: Some results of various simulations of earthquake

Out of the assessment data presented in this table we can see that the different methods of simulation of an earthquake there are considerable differences between the variables analyzed as its own simulation data is the lowest that will grow up to the proposed simulation system grows. The results presented show that if you apply the formula for calculating Cresta simulate an earthquake about the same magnitude as the existing resources seems that resources that currently exist in an earthquake can not cope with the characteristics shown in this simulation, which requires maximum available resources and seriously questioning the need for external resources management application situation created by this type of earthquake.

Body inspection and hypothermia

The primary considerations ending inspection body. Inspect only those parts of the body that are considered absolutely necessary to save lives. A secondary consideration is made when it was thought to be likely to identify potential life-threatening injuries. Once medical treatment immediately allow imprisoned victim should be covered to avoid hypothermia

Hypothermia is a major factor threatening the victims injured in all scenarios. Hypothermia has both protective and hazardous effects. At a temperature of 32-33 ^{0} C (15) may limit neuronal damage after head injury, but it has a negative effect on both metabolic and hemostatic functions.

Oxygen consumption may increase activation of platelets and enzyme action is inhibited (11, 17, 31). The functionality of platelets and coagulation enzymes significantly reduces the body temperature below 34°C (33).

Hypothermia is a frequent event to traumatized victims and can occur despite the high temperatures of the environment. Incarceration is a major risk factor for hypothermia (12). Age, especially extremes, is another risk factor for the development of hypothermia. Once hypothermia occurred, it is difficult to correct. Efforts to prevent and treat hypothermia should be started as early as possible (23). Relative efficacy of different methods of reheating prespitalicească active phase of treatment, per os or iv are pending to establishment of their speed use.

Other damages

In 1906, many buildings in San Francisco affected by the earthquake were destroyed by fire. Fires are considered secondary events and may be caused by explosions triggered by gas pipelines and electric lines affected. Current incidence of burns in earthquake scenarios in the last two decades has been lower than expected. In the earthquake that struck Kobe in 1995, 504 deaths were considered related to fires (19).

Most victims were crushed or suffocated probably before being burned. Only 1.9% of hospitalized victims had burns and most were less affected by <20% of total body surface area. There was no correlation between the number of buildings burned and number of victims burned hospitalized.

Much more common is the vulnerability of victims entrapped to noise and dust. Dust can affect the victims. Victims should be given an eye and ear protection as quickly as possible (4). Open wounds must be cleaned and covered to prevent contamination of their future.

Antibiotic coverage with intravenous second-generation cephalosporins and administration of tetanus toxoid 0.5 ml im once administered must have received all other life-saving treatment

In this study, only hot roof victims treated showed an increase in body temperature. This increase was demonstrated in all such patients.

Usage of passive reflective coatings and warm intravenous fluids have not prevented the body temperature decreases.

Extrication

Ideally, the extrication initiation should follow a basic examination and resuscitation. However both victims and rescue teams remain exposed to the effects of an unstable environment which can endanger life. This includes the unstable rubble that may crumble at any time and cover both survivors and rescuers. It can also include fires and an atmosphere of methane whose content of 5-25% can lead to explosion. In such circumstances, removing the victim and the rescue team in immediate danger is the highest priority.

If the environment is stable, airway control, adequate ventilation and rehydration should be performed.

After adequate oxygen and fluid replacement primary plasma trapped victim can be executed carefully. Whenever possible, stabilize the spine and maintain the backbone of all the in-line position on a board must be made before Extrication.

Long bone fractures should be stabilized to control pain during descarcerării when the victim is not immediately life threatening.

Hyperkalemia is a cause of early death release the victims were under the debris. Once circulation is restored crushed limbs above, potassium is released from tissue necrosis in circulation. Identification and treatment of hyperkalemia should be a part of any treatment protocol during and immediately after extrication. Retrospective analysis of victims suffering from crushing injuries show that the serum potassium> 6.5 mEq / L is common immediately after extrication and is present in more than 22.7% of victims who experience a deterioration of renal function (29).

Elevated serum potassium levels are found especially in adult male victims with severe soft tissue injury (29, 30). (13). Hyperkalemia in children under the recently release the debris is rare, affecting relatively few of those who have renal failure (13).

Monitoring of serum potassium levels during descarcerării can be improvised by using a portable heart monitor. Considered to be a very sensitive method that a complete electrocardiogram, cardiac monitoring will allow comparison with the situation before descarcerării after Extrication. The first sample of serum potassium levels where T is the emergence of leadership chest high. This element is characteristic of mild to moderate hyperkalemia (<8 mmol / L), but bear to be seen in normal individuals without hyperkalaemia. Later due to increased atrial potassium complex disappears and the QRS complex widens with high T where. By widening QRS complex configuration is strange. At this stage must assume the presence of severe hyperkalemia may precede ventricular fibrillation or asistolia.

If hyperkalaemia is suspected, should be treated immediately and vigorously. If cardiac monitoring is the only way to monitor serum potassium levels, treatment should be considered when there are high T waves. As has been shown, 100-150 mEq of bicarbonate may be administered intravenously and 1 liter 4.3% dextrose in saline can be administered to non-diabetic peripheral.

Alkaliemia and glucose with insulin produced endogenously stimulate potassium re-entry into cells. This treatment may reduce serum potassium level of more than 2 mmol / L for several hours (34).

Another possible treatment of hyperkalemia is breathing inhaled administration, with beta-2 agonists such adrenoceptorilor such as Ventolin and salbutamol. (29). Serum potassium decreases to less than 0.5 mmol / L within 75-90 minutes after inhalation.

If atrial complexes disappear and QRS complex widens, hyperkaliemia is severe and must be treated immediately. In such cases appropriate treatment consists in 50 ml of intravenous dextrose, 50%, with 10 units of short acting insulin.

Although the infusion of calcium is considered to prevent cardiac toxicity secondary to hyperkalemia, it is recommended to delay the ECG occurring ectopiile (34) There is evidence that calcium administration is beneficial to a victim suffering from extensive damage due to hyperkalemia and muscle. Calcium rapidly infused is deposited in injured muscle tissue and calcium ions are considered a mediator of cellular injury (5). It is still unclear how much calcium remains infused into service to counter the cardiotoxicity of hyperkalemia.

Must also weigh the potential benefits of calcium from potential adverse effects on muscle tissue injured. Although victims are entrapped under the debris and have muscle injuries, changes in potassium levels can be extreme once you release the victims were. Those who propose taking calcium may argue that the expected occurrence of ventricular complexes before calcium administration may prove too late. If deemed necessary will be given 10-30 ml of 10% calcium gluconate by intravenous infusion within 1-5 minutes under a constant cardiac monitoring (34). Calcium almost immediately counteract the adverse effects of potassium on neuromuscular membranes. When calcium infusion is stopped, the serum calcium level decreases rapidly above (8).

Different ways to control pain include use of narcotics, ketamine and local anesthetics. Morphine is very effective in achieving pain control. It can be given to the needs of victims. În acest mediu morfina va fi administrată doar intravenos. In this environment will be given only intravenous morphine. Response to morphine administered intramuscularly is unpredictable especially in hypovolemic victims whose Intravascular volume was derived from the periphery to the essential organs. Once intravascular volume recovered a large quantity of morphine, administered repeatedly to achieve pain control may be rapidly absorbed into the systemic circulation leading to a depression of the central nervous system and breathing. Respiratory depression can be difficult to monitor in a small environment in which the victim is imprisoned. Intravenous morphine provides pain control for 1-2 hours. The average response to morphine is a major trend to hypotension which can sometimes be severe depletion volemică victims. An opioid antagonist naloxone, administered intravenously to counteract the hypotensive effects of morphine promptly.

Ketamine is a very effective analgesic. Ketamine provides deep sedation, analgesia and amnesia but one that maintains and preserves spontaneous breathing reflex degludiție. Similar levels of analgesia will require intubation and ventilation with several other classes of agents. Repeatedly administered intravenous doses of 0.2 mg / kg body weight to maintain analgesia.

Another option for pain control is to use local anesthetics. Their injection require previous experience. Anestezicele locale vor facilita extragerea membrelor încarcerate. Local anesthetics facilitate extraction of incarcerated members.

Evacuation

On January 17, 1995, in Kobe and its vicinity there was an earthquake with a Richter magnitude 7.2.

More than 400,000 homes and buildings were destroyed. Many roads and highways, bridges and railways were destroyed. Phone lines were either disconnected or overloaded.

Very few victims were transported to hospitals outside the disaster area on the first day after the earthquake. Most victims were transported to hospitals affected by the earthquake. Hospital mortality for those affected by the earthquake was significantly higher than those hospitalized in the hospitals affected, 8% vs. 3% respectively.

Hospitals in the area of disaster damage must be assumed and taken into account in medical evacuation plan (Schultz CH, Koenig KL, Noji EK: A medical disaster response to reduce immediate mortality after Earthquake year. N Engl J Med 1996; 334 (7): 438-444).

What to expect

Mobile medical team on site will meet the second wave of victims injured. The first wave will be the "wounded outpatients. This will include a large number of people who were injured by falling objects or light imprisoned in ruins and were quickly rescued by their families or by neighbors. Most of them will present contusion, laceration, fractures, mild head injury and / or soft tissue foreign bodies such as splinters of glass. Wound care, administration of tetanus toxoid, antibiotics and analgesics will probably be the most common treatment.

It seems that the term "wounded outpatients' is inappropriate and will be used accordingly the term" first wave of wounded. "

A small number of those injured will potentially dangerous damage to life such as stress syndrome, pneumothorax, and abdominal or pelvic lesions.

Another small number will be endangered by a series of situations which are not related to the earthquake itself, such as loss of important medications or acute coronary syndrome. Medical team was sent to the spot after a catastrophic earthquake must take consider these possibilities in its preparation.

The second wave of casualties includes those victims who were entrapped deep in built structures destroyed. These victims will release the normally within hours or days since the disaster. Home care for victims of the second wave is the complexity of their medical treatment and not necessarily their number, as opposed to victims of the first wave they will be rescued one by one.

Proper management and respect for the dignity of victims who died is another matter (2).

Identifying and determining cause of death in most disaster site will be made. Such information relating to a deceased victim must be thoroughly documented. The exact place where the body was found is one of the most important data necessary to identify the victim. Victims should have certain types of files attached with identification information. Whenever possible, transport the bodies to temporary storage facilities must be planned in time to avoid unnecessary clutter search and rescue operations (2*).*

Search and rescue team members are also the responsibility of the medical team (4,5).

This responsibility includes profilactic immunizations and medical treatment as appropriate in the circumstances. Rescue personnel search team should be monitored for adequate rest, hydration, calorie and signs of excessive stress. Workers in these teams especially those who are more exposed to the effects of disaster are at risk of symptomatic stress reactions (5).

Burn wounds, abrasions and other minor problem that can incapacity team workers to be treated. Rescue dogs are an integral part of these teams and some basal veterinary knowledge is a necessity (2).

Conclusions

We had presented in form of tables, our comments on specific pathology encountered in two events that We personally participated, 1977 Bucharest' earthquake (20) , Romania and 1999 Golguk',Turkey.

You can observe striking similarities in the specific pathology and could identify a specific pathology of entrapped victim in earthquake.

We sustain the necessity of a special medical education for intervensions in case of disaster, advanced training to help physicians in medical management of disasters.

The Faculty of Medicine and Dentistry of Titu Maiorescu University of Bucharest, introduced for the first time, in the academic year 2008, operating discipline of DISASTER MEDICINE in Bucharest' Medical School togher Oradea' University - Faculty of Medicine, the first in Romania.

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Authors Biographies

Prof. Dan MANASTIREANU, MD, PhD

After a fruitful military carreer ended with promotion to brigadier general, Professor has founded the first Romanian Universitary chair of Disaster Medicine at Oradea University, and than refounded this chair at Titu Maiorescu University in Bucharest, Romania. In the list of his achievements are the foundation of Military Ambulance Service at Central Clinical Military Hospital and the foundation alongside with Dr. N. Steiner of postgraduated medical treaning as competence study in Medical Management of Disasters. One of the last endeavour is the establishment of a Disaster Medicine multidisciplinary master training course at Titu Maiorescu University

Prof. Nicolae STEINER, MD, PhD

Folowing an military career in the last years dedicated to implementation of Distaster Medicine training in Romania he spend some years at NATO headquarters finishing its work as NATO International expert in Disaster Medicine and as chair of ad-hoc group of Critical Infrastructure Protection in Medical domain at NATO Joint Medical Committee. He strived toghether Professor Manastireanu to promote the postgraduated training as a competence study in Medical Management of Disasters and founded the Romanian National Centre for training in Medical Management of Disasters who had published over 90 books, handbooks and treaties. Now he is involved in establishment of a Disaster Medicine Master course at Titu Maiorescu Univesrsity together with Professor Manastireanu.

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HEALTH IMPLICATIONS OF FLOOD DISASTER MANAGEMENT IN SOUTH AFRICA

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E. coli, flood protection, public health implications, South Africa

Abstract

Disaster Management in South Africa is regulated by the Disaster Management Act No. 57/2002. Rapid growth of informal settlements has put a large portion of the South African population at risk from floods, since these settlements are often built below the flood line of nearby surface water resources. Such settlements lack formal sanitation infrastructure and subsistence farming is commonly practiced. For these reasons, leading to presence of human and animal faeces are often present on the banks of rivers and in the vicinity of surface water resources. Wastewater treatment plants often do not remove all the microbial contaminants before discharge of the final effluent into receiving surface water bodies. Ten percent of the South African population suffers from HIV/AIDS. In this context, health risks normally associated with floods, such as contamination of water resources from decomposing bodies; and presence of pathogens such as *Vibrio cholerae* and *Clostridium tetani* might not be the only relevant ones in South Africa. Additional risks could arise from flooding of sanitation infrastructure, banks of rivers where faecal material had been deposited; or the wastewater treatment plants which do not remove all the microbial contaminants during wastewater treatment. A literature review was conducted to identify relevant waterborne pathogens and the results showed that in addition to *E. coli* the surface waters should also be monitored for

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concentrations of *Salmonella spp.*, *Listeria spp.*, *Campylobacter jejuni* and *Klebsiella pneumoniae* during flood disasters. Some literature data has indicated that local and district municipalities suffer from limited microbial water quality monitoring capabilities. Further review was therefore conducted to see if there were any methods available which could be used by emergency relief workers on-site to assess the presence of the above listed pathogens during flood disasters in areas where laboratory facilities are lacking. Results are presented in this study.

Introduction

Disaster management in South Africa is governed by the Disaster Management Act No. 57/2002 (DMA, 2002). The Intergovernmental Committee on Disaster Management is constituted by the President of the Republic, and it is chaired by the Minister for Cooperative Governance and Traditional Affairs (DMA, 2002). Members of the committee include the Minister for Water and Environmental Affairs, Minister of Health, members of provincial administrations responsible for disaster management; and representatives of the South African Local Government Association (SALGA; DMA, 2002). This committee coordinates the activities of different spheres of government in terms of disaster management. The day-to-day disaster management is carried out by the National and Provincial Disaster Management Centres; and local/municipal disaster management committees (DMA, 2002).

The National Disaster Management Advisory Forum is convened and appointed by the Minister for Cooperative Governance and Traditional Affairs (DMA, 2002). Mandatory members include the Head of the National Disaster Management Centre and representatives of all relevant government departments, as well as participants from SALGA, the business community, chamber of mines, trade unions, the insurance industry, traditional leaders, medical practitioners, paramedics, hospital organisations, non-governmental and disaster relief organisations; scientists and relevant technical experts. This forum advises the Intergovernmental Committee on Disaster Management.

Microbial water quality deteriorates during floods (Nagels et al., 2002). Outbreaks of malaria, cholera, dengue and tetanus can occur in the disaster areas (WHO, 2006). The latter is caused by *Clostridium tetani* which is an anaerobic bacterium and its spores can be found in the soil. After floods soil particles can be carried into the surface water and when the human population comes into contact with such water and a disease-outbreak can occur (WHO, 2006). Therefore microbial water quality monitoring is a crucial tool of flood disaster and water resource management.

South Africa is divided into 19 Water Management Areas in the context of water resource management (WMAs; National Water Act – NWA, 1998; Murray et al., 2004). The National Microbial Monitoring Programme for surface water (NMMP) is run and managed by the national coordinator in the Department of Water Affairs (DWA; Murray et al., 2004). Regional coordinators manage the programme in each of the WMAs (Murray et al., 2007). Surface water samples are taken every 1 to 2 weeks at selected sampling sites and analysed for turbidity, pH and the concentration of *E. coli*. Results are then communicated to the Central Water Quality database (Murray et al., 2004; Murray et al., 2007).

Data reports are written every two months by the regional coordinator and sent to the national coordinator for distribution to the Ministry of Water and Environmental Affairs, the National Department of Health, relevant water resource authorities, and other stakeholders (Murray et al., 2004; Murray et al., 2007). There are a large number of tertiary catchments in South Africa and the budget of the NMMP is limited. Thus the main focus of the monitoring is on the severity of faecal contamination in areas where water resources are most prone to it (Murray et al., 2004). One of the drawbacks of the current sampling paradigm is that microbial water quality is not regularly assessed in up to 30 % of all water resources in South Africa (Rivett et al., 2009).

Rapid population growth and uneven distribution of economic opportunities has led to uncontrolled expansion of informal settlements in urban areas with limited or non-existent infrastructure. Subsistence agriculture is often the backbone of rural economic activity in South Africa. The rate of HIV/AIDS infections is high among the South African population (NDOH, 2008); and wastewater treatment often release final effluents with microbial quality which does not meet the regulatory requirements (Momba et al., 2006). All of these factors/activities often take place in the vicinity of surface water bodies.

It is therefore the aim of this article to identify pathogens which would be relevant in this context during flood events in South Africa; and amend the list of microbial parameters which should be included in the monitoring of surface microbial water quality in South Africa. The current status of staffing in the laboratory facilities was then assessed, and best monitoring strategies are proposed.

Theory and Method

Surface water quality will be influenced by the type and extent of agricultural activities and land uses in the vicinity of surface water bodies (Venter et al., 1998; Hubbard et al., 2004); and the location of the dwellings with respect to the flood line (Planact/CUBE, 2007). Additional factors to be taken into account include presence/absence, type and degree/regularity of maintenance of sanitation infrastructure in the settlements in close proximity to surface water bodies (Carden et al., 2007); as well as surface runoff in the form of sewage or greywater (Venter et al., 1998; Carden et al., 2007). Functionality of wastewater treatment plants in often microbiologically inferior (e.g. Momba et al., 2006) and the rate of HIV/AIDS infections in a given area is high (Obi and Bessong, 2002). During flooding pathogens can be released into the surface water resources from dysfunctional wastewater treatment modules; and sanitation infrastructure or faeces in the vicinity of water resources. All of the above mentioned factors can influence microbial water quality separately or in combination. A systematic review of relevant literature and government resources was conducted on the comparative significance of the individual factors. The following scientific databases were used: SCOPUS, ISI Web of Science, Google and Pubmed. Government documents from DWA and the National Department of Health were obtained from the public domain. Problems are identified and solutions proposed in the text below.

Results

Agricultural activities and land uses

Land uses have an impact on chemical composition of soils (Solomon and Lehman, 2000; Helfrich et al., 2006), physical properties of soils (e.g. Batey, 2009) and the presence of microbial contamination sources in the vicinity of surface water bodies (Effler et al., 2001; Muirhead et al., 2006). Increased soil compaction, i.e. decreased pore volume of soil, can be observed in the vicinity of surface water resources when these are crossed by agricultural animals during grazing and livestock watering. This happens as the animals trample on the soil surface and their hooves exert pressure on it. As a result, the surface horizons of the soil profile are compressed, leading to soil compaction (Betteridge et al., 1999; Broersma et al., 1999). The extent of these effects has been studied and documented in South Africa for sheep, and has been shown to decrease water infiltration rates into the soil profile (du Toit et al., 2009). This in turn results in increased surface runoff (Proffitt et al., 1995).

Defecation by agricultural animals occurs during grazing in the vicinity of surface water bodies mainly in shaded areas (Hubbard et al., 2004). If the intensity of the surface runoff increases due to trampling by these animals on the banks of water resources, there is an increased probability that their faeces will be transported into the surface water resources (McDowell, 2006). This can decrease microbial quality of surface water as demonstrated in the literature for cattle (Muirhead et al. 2005); sheep (McDowell, 2006) and goats (Ufnar et al., 2007). During flooding this could lead to outbreaks of waterborne diseases, which will be relevant in South Africa for provinces with significant agricultural production, i.e. the Eastern Cape, the Free State, KwaZulu Natal and Limpopo.

Sanitation infrastructure in urban and peri-urban settlements

In urban areas, surface runoff can occur in the form of greywater, sewage or stormwater. Discharge of untreated greywater and sewage into surface water bodies leads to microbial contamination (Mathee et al., 1999). This is caused by the presence of faecal matter in greywater (Eriksson et al., 2002) and pathogens in sewage (Stamper et al., 2008). In the informal and peri-urban settlements in South Africa, stormwater pipes generally discharge directly into the nearby streams (Barnes, 2003). Jagals et al. (1995) measured 4.4×10^6 colony-forming units (CFUs)/100 mL of faecal coliforms (FC) in stormwater runoff from an informal settlement near Bloemfontein, South Africa. Samples of stormwater discharged into the Plankenburg River in the Western Cape Province contained concentrations of *E. coli* of 2.44×10^9 CFUs/100 mL (Barnes, 2003). Effler et al. (2001) reported a significant increase in the number of diarrhoea cases caused by *E. coli* O157 with the onset of heavy rains in South Africa and Swaziland.

Paulse et al. (2009) found that concentrations of FC and *E. coli* in the Plankenburg River, near a peri-urban settlement with limited sanitation infrastructure, ranged from 10 to approximately 3.5×10^6 cells/100 mL. The FC concentration ranged from 1.7×10^2 CFUs/100 ml to 3.5×10^7 CFUs/100 mL, while concentrations of *E. coli* varied between 3.6×10^1 and 1.7×10^7 CFUs/100 mL in the Berg River, South Africa (Paulse et al., 2007). An informal settlement located on the banks of the Modder River, approximately 60 km west of Bloemfontein, contained from 0 to 8.4×10^5 CFUs/100 mL of FC (Jagals and Grabow, 1996). Similar observations were made for samples taken in the Jukskei River near Johannesburg. Background concentrations of *E. coli* were equal to 1.5×10^3 cells/100 ml upstream of the Alexandra informal settlement with limited infrastructure (de Wet et al., 2000). These increased to 3.7×10^5 cells/100 ml in the stretch of the river passing through the settlement, and remained elevated downstream of the settlement with concentrations reaching 1.3×10^5 cells/100 ml (de Wet et al., 2000). Flooding of these settlements will pose substantial risks to human health from poor microbial quality of surface water.

Wastewater treatment plants

Another potential source of microbial contamination of surface water comes from flooding wastewater treatment plants which discharge final effluents of inferior microbial water quality. In South Africa, concentrations of above 0 CFUs/mL of *Listeria spp.* were reported in the final effluent discharged into the Tyume River in the Eastern Cape (Odjadjare and Okoh, 2010). Similar observations were made for samples from the final treated effluents in the Buffalo City and the Nkokonbe Municipalities of the Eastern Cape where finite concentrations of *Salmonella spp.*, *Shigella spp.*, and *Vibrio cholerae* were detected (Momba et al., 2006). In the Mpumalanga province, Samie et al. (2009) reported the FC concentrations between 3×10^0 and 3.6×10^5 CFUs/100 ml, and 36 % of samples contained non-zero concentrations of *Vibrio spp.*; and 57 % of samples taken contained strains of *Campylobacter spp.* All these genera can be causative agents of waterborne diseases (Obi et al., 2003a,b). If they are detected in water samples during flood disasters then there is a strong public health concern. For example, infections due to *Listeria spp.* are rare, but public health risks are severe in the case of surface water contamination as the mortality rates vary between 20 and 50 % of the *Listeria*-infected patients (Odjadjare and Okoh, 2010). On the other hand, infections due to *Vibrio cholerae* and virulent strains of *Salmonella spp.* require prolonged treatment, which can increase the financial burden of relief operations and stretch the health authorities' resources thin during flood disasters (Mugero and Hoque, 2001).

Influence of HIV/AIDS infections

In South Africa, the rates of the HIV/AIDS infections are high in certain provinces like KwaZulu-Natal, Gauteng and the Eastern Cape (NDOH, 2008). Obi and Bessong (2002) found that 60 % of patients with chronic diarrhoea were HIV-positive in the Limpopo province and the causative agents of diarrhoea included *Campylobacter jejuni*, *Campylobacter coli*, *Plesiomonas shigelloides*, *Aeromonas species*, *Shigella spp.*, *Salmonella spp.*, *Escherichia coli*, *Yersinia enterocolitica* and *Vibrio cholerae*. Strains of these species have been shown to cause waterborne diseases (Abbott, 1997). In this province, a large part of the population lives in settlements where the sanitation infrastructure is underdeveloped or lacking completely (Obi et al. 2006). Therefore defecation by HIV/AIDS sufferers in the vicinity of surface water bodies, combined with surface runoff from the settlements, and settlement flooding, are likely to constitute a significant source of microbial contamination of surface water resources in the vicinity of settlements.

Coliform bacteria and their survival

E. coli and FC are members of the coliform group of microorganisms that are often excreted in the faeces of humans and animals. The majority of FC excreted in faeces of healthy humans and warm-blooded animals, such cattle and pigs is accounted for by *E. coli* (Medema et al., 2003), but other FC strains are present as well. One such example is *Klebsiella pneumoniae* which is excreted in faeces of 5 % of the adult human population (Degener et al., 1983) and in 80 % of dairy cow faeces (Munoz et al., 2006). Strains of *Klebsiella spp.* have been shown to survive in the environment in substantial concentrations for up to 30 days after contamination had occurred (Dowd and Pillay, 1997). They have also been demonstrated to remain virulent at temperatures as low as 12 ºC (Knittel et al., 1977). The chemical composition of soil and water, flow and atmospheric conditions on-site and the source of microbial contamination will control survival rates and concentrations of different coliform bacteria in the surface water resource (Howell et al., 1996; Jamieson et al., 2004; Foppen and Schijven, 2006).

Strains of *Klebsiella pneumoniae* are often isolated from plant surfaces and soils (Abbott, 1997). Examples of plant surfaces include tree bark and needles, mosses and fern leaves (Duncan and Razzell, 1972). The cells of *Klebsiella spp.* can be released from plant surfaces into soil by precipitation and then possibly carried into a water resource with soil particles during surface runoff (Butterworth and MacCartney, 1991). They can also be found in wastewaters from the paper industry (Caplenas et al., 1981). *Klebsiella pneumoniae* and other members of this genus have been shown to cause infections of the pulmonary tract and other human tissues (Abbott, 1997). Thus surface runoff from environmental sources and discharge of industry wastewaters into surface water bodies can contribute to the pathogen load of surface water during flood events and can be a source of *Klebsiella spp*. strains.

Discussion

Review of the potential sources and pathogens likely to be released into surface water resources during the floods indicates that the existing NMMP parameter suite should be widened to include *Vibrio cholerae*, *Listeria spp.*, *Campylobacter jejuni*, and *Klebsiella spp.* or *pneumoniae*; and possibly *Salmonella spp.* The number and frequency of the modified sampling programme will depend on the minimum information needed to make public health decisions and the financial considerations of the NMMP budget. Baseline data should be collected in areas most prone to flooding for all of these microbial parameters. The frequency for the regular monitoring should then be set based on the data for recent outbreaks of individual pathogens in a given province. One such example is cholera. Regular monitoring should be as frequent as financially and logistically possible in provinces of Mpumalanga and Gauteng (last outbreak took place in 1998; Dalsgaard et al. 2001) and Limpopo (outbreak in 2009; Stuijt, 2009). *Clostridium tetani* is not likely to be a significant flood-related pathogen in South Africa, as the Expanded Programme on Immunisation Schedule has all but eliminated the tetanus infections in the country (Johnston, 2010). This can be proven by number of tetanus related death in South Africa which ranged from 0 to 13.9 deaths per year in adults between 1999 and 2005 (HST, 2011); and from 6 to 10 per year in neonates between 1998 and 2006 (Ngcobo, 2008).

Historically, there has been a lack of accredited laboratories, skilled laboratory personnel and finances to perform regular microbial water quality testing in many part of South Africa (Monyai, 2004; Rivett et al., 2009; SANAS, 2011). After an exhaustive literature search, it was established that there are no rapid tests for the determination of *Vibrio cholerae*, *Listeria spp.*, *Campylobacter jejuni*, and *Klebsiella spp.* or *pneumoniae*. Therefore if there is a lack of access to an accredited laboratory the analyses should be performed by trained disaster relief personnel on-site using the Paqualab system (Pritchard et al., 2008). As there are no vaccines currently available against *Listeria spp.* and *Campylobacter spp.* performance of such analyses should be done after taking maximum biological hazmat precautions.

Conclusion

Results of this study indicate that the suite of parameters currently analysed for in the microbial water quality monitoring in surface water resources should be widened to include *Vibrio cholerae*, *Listeria spp.*, *Campylobacter jejuni*, and *Klebsiella spp.* or *pneumoniae*; and possibly *Salmonella spp.* This is the case in the context of health implications of flood disaster management in South Africa.

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How to scale up a disaster response project? An NGO perspective.

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Abstract poster: Every time a natural disaster strikes Romania, the most important question is how the reconstruction of the damaged houses will be done. Along with the Government, some NGOs take the responsibility to engage in the recovery process. No matter the size of the damage and economic loss, the response should be effective and adapted to the real needs of the affected people. Therefore, it is important to better identify the gaps on the ground and address those needs that can’t be covered by any state effort. With limited private resources, it is crucial to find the best ways to scale up the intervention in order to enable the affected people to rebuild their communities and livelihoods.

The case of Dorohoi reconstruction project developed by an NGO, Habitat for Humanity, in partnership with the Ministry of Regional Development and Tourism shows what the key factors of a successful intervention are. The focus is on competent authorities role, use of volunteers, fundraising and private companies taking part in, know how transfer from Habitat International, new technical solutions and innovation and moreover, the beneficiary families involvement. An NGO has the ability to recognize, analyze and to approach quickly a new context due to its flexible decision making and management system. Therefore, the project was designed to be complementary to the official state actions. As a resource centre, Habitat for Humanity tries to respond to local demand and need of hundreds of users with limited resources, who build their houses without or limited support.

Victims' management bureau within the county inspectorate for emergency situatons

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Abstract: Based of experience gained by EU's countries a UK and Spain following the terrorist attacks, and taking into consideration that Arges County is prone to major disaster, emergency county council's members along with members of the County Inspectorate for Emergency Situations Arges have started to study the main ideas to implement the concept at the county level. The paper introduce the main elements of the concept, existing particularities related to the concept at county level and a proposal of structure to be implemented at county level, underling advantages and disadvantages.

Voluntary Corp of Bucharest

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Abstract: Bucharest – one of the most exposed capital city around the world, experienced a devastating earthquake in 1977, and concentrating almost 7% of the Romanian population. Considering that the actual situation exceeds the existing possibilities for a good consequences management, the Bucharest City hall initiated a feasibility study regarding the setting up a voluntary corp direct subordinate to the city hall council.

The paper presents the principal tasks, the proposed structure, and how the municipality envisages using voluntaries for population education.

AUTOMATIC SETTLEMENT DYNAMIC MONITORING USING MULTITEMPORAL EARTH OBSERVATION IMAGES

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Keywords

Multi-temporal series, dynamic assessment, change detection.

Abstract

Changes that occur in urban areas can be caused by human activity or may be a result of natural phenomena such as earthquakes, climate change, or heavy rains. Thus, they can appear gradually over large periods of time that can extend over several years, or they can be sudden, in case of demolishment or unexpected events. In order to monitor, assess and understand the evolution in time of large human settlements it is necessary to use information available over large periods of time that captures all the intermediate transformations that take place. High resolution Earth Observation pairs of images with temporal baseline give precise information about changes that occur between two different time moments, while multi-temporal series of images can be used to map the gradual changes over long time periods (decades). This paper proposes a workflow that complements optical multi-temporal analysis with a Synthetic Aperture Radar change detection algorithm. By making use of an object interaction method which employs the histogram of forces we illustrate the dynamics of the urban structures. The time span of the multi-temporal series employed in our scenario – urban development in Bucharest - reaches 26 years, from 1984 to 2010. Images are acquired with Landsat 5 and 7, have 30 meters spatial resolution, and 6 spectral bands. The spectro-temporal signatures developed allow the classification of natural and human process dynamics and are extracted by means of the first two tasselled cap features and a multiclass SVM classification that was used to create land change maps. The complementary SAR change detection algorithm uses the conditional probability density function to provide accurate changes in high resolution TerraSAR-X data (1m) on the same test area, the city of Bucharest.

Introduction

Over the last years, Earth Observation (EO) applications have benefitted from the continuous development of remote sensing techniques. One of the most important activities in the remote sensing and EO community refers to detecting different types of changes suffered by the Earth's surface, landcover and urban settlements. In order to detect changes that occur on the surface one must make use of a series of remotely sensed images (aerial or satellite) with a relevant temporal baseline, depending on the type of change that needs to be observed. The analysis of the available data stacks aims at identifying the changes that can take place over urban areas caused by human activity or results of natural phenomena, such as earthquakes, landslides or climate change.

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The changes can be generally classified as short time changes that occur over the extent of only a few hours or days, such as the results of heavy rains, earthquakes, demolition of buildings or changes that take place gradually over large time intervals. The last category can includes events like urban development, climate induced changes or pollution effects.

Satellite image temporal series are effective instruments for settlement dynamic monitoring. Depending on the time interval corresponding to the acquisition of each image, both long and short term changes can be detected. One of the important aspects of a long temporal baseline analysis is that is offers the possibility to detect and classify structures/objects/landcover classes that exhibit similar behaviors in terms of their dynamics.

Moreover, the abundance of medium resolution satellite images enables the creation of long-term Satellite Image Time Series (SITS). SITS are multidimensional signals of high complexity, embedding spectral, spatial and temporal information. SITS analysis enables observation of complex spatio-temporal patterns that cannot be otherwise observed from a single scene. Developing algorithms for SITS analysis can be a challenging task, considering the complexity of the dataset, the irregular sampling in time domain and the possibility to improve the existing SITS by adding new data. Furthermore, the possibility of using data from multiple remote sensing platforms should be explored, enabling the creation of SITS with improved temporal resolution.

This paper proposes a methodology for the analysis of the transformations that occurred in the area of Bucharest, Romania. This approach consists in three complementary parts. Firstly, a method based on the histogram of forces [8], [9] measuring the amount of object interaction is employed for assessment of the urban settlement dynamics leading to the extraction of information about the surface and orientation of newly constructed areas. Secondly, a classification for the land use and land dynamics is performed using SITS in order to complete the built in area assessment considering also the town surroundings and the agricultural regions. Moreover, short time transformations have been analyzed using classical change detection [10] techniques between pair of Synthetic Aperture Radar (SAR) images acquired at different times. The use of SAR data as a complementary source of information, apart from high resolution optical time series is justified by the capabilities of SAR sensors which are independent of the weather an illumination conditions (e.g. clouds, rain, and night).

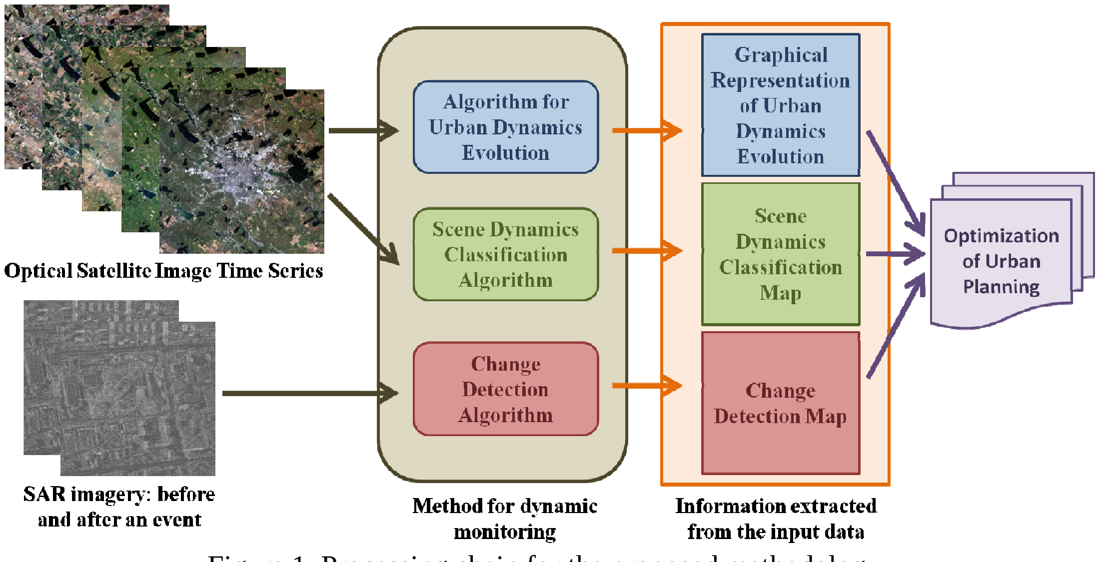


Figure 1. Processing chain for the proposed methodology

This approach has been proposed as a solution for monitoring high density urban areas and their predominant directions for development. The purpose of this application is an improvement of the living conditions in the newly built regions, by expanding the existing sewage system and infrastructure. Moreover, these studies can easily lead to the conclusion that new facilities are needed in the area, such as playgrounds, parks for residential neighborhoods and parking lots for industrial and financial sites.

The dynamic evolution of urban areas

In our scenario, we analyze the evolution of the city of Bucharest both spatially and temporally over a period of 15 years. The test was performed on five masks for the urban region corresponding to 1984, 1989, 1994, 2002 and 2007, which were provided by the Romanian Space Agency (Figure 2). The histogram of forces, which gives a measure of how much different objects “attract” each other [8], [9] is applied on each mask as a method for the quantitative analysis of the evolution of the urban area. The algorithm provides information about the positioning of the city at a given time, the preferred directions for development and also about the dimensions of the built-up area. The histogram of forces was computed between a reference point placed in the centre of Bucharest and the surrounding urban region.

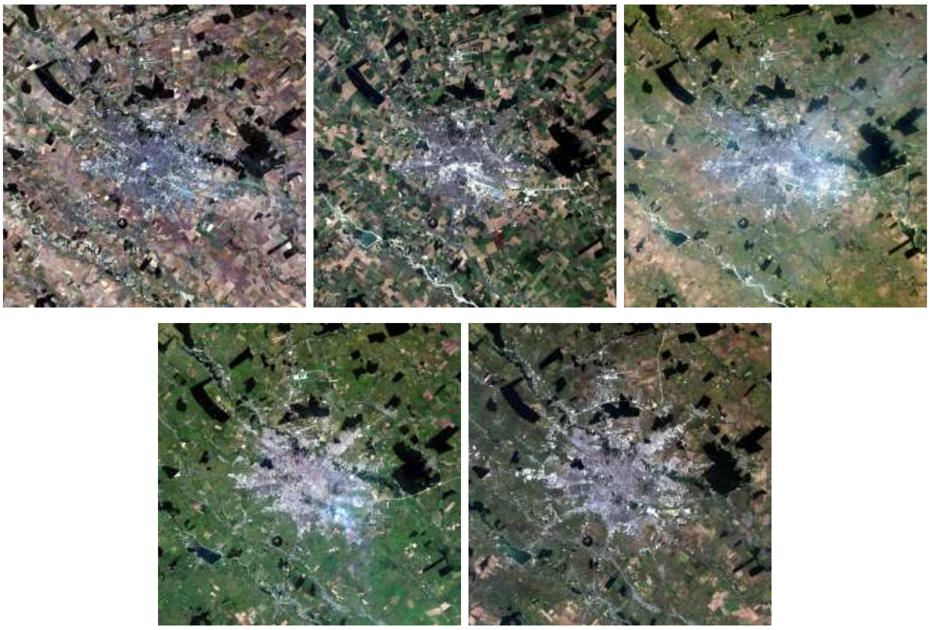
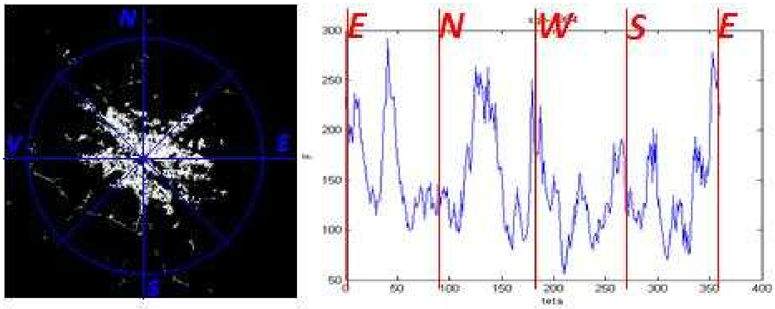


Figure 2. Landsat images for the area of Bucharest in 1984, 1989, 1994, 2002 and 2007

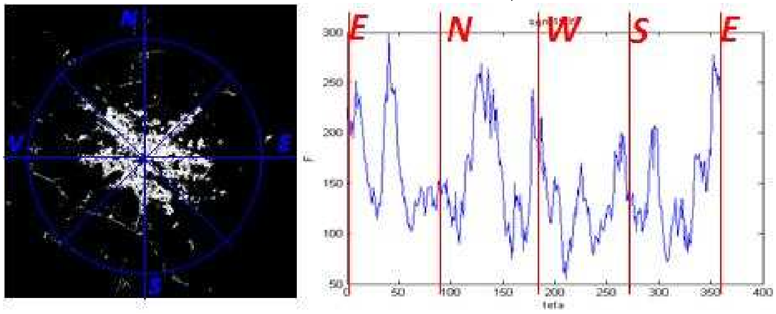
As we can distinguish in Figure 3, the south part of the city has constantly developed in every direction, while in the north side the evolution is made on specific directions. Considering that the five histograms were computed starting with the 0^{o} direction, we perform a two by two subtraction between them in order to analyse how the city evolved. Figure 3 presents the preferential directions for development and the quantity of building. There are four time periods for the urban area assessment: 1984-1989, 1989-1994, 1994-2002, 2002-2009, represented with four different colours.

Figure 3 shows that the southern part of the city (W-S-E) has suffered a circular growth, constantly spreading in each direction. On the other hand, the northern half of the considered region (W-N-E) follows a series of specific growth directions. An important example is the area in the NW region, at 130o spreading over 450 pixels (histogram of forces) x 30 m (resolution) = 13500 (13.5km) from the centre of the urban area.

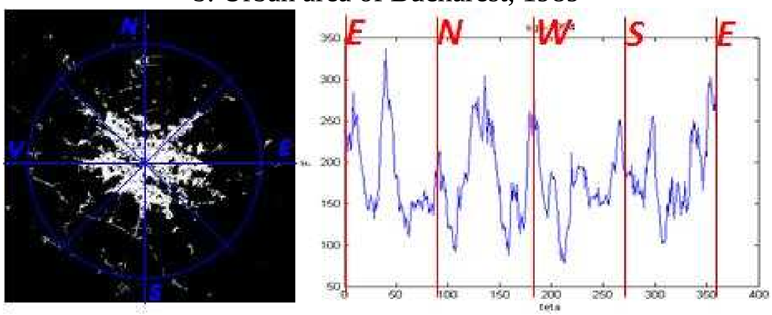
Given the fact that all 4 histograms were computed starting with the 0^{o} direction, we can analyze the evolution of the city by defining subtraction operations between histograms and establishing the direction in which the city has developed (Figure 4).



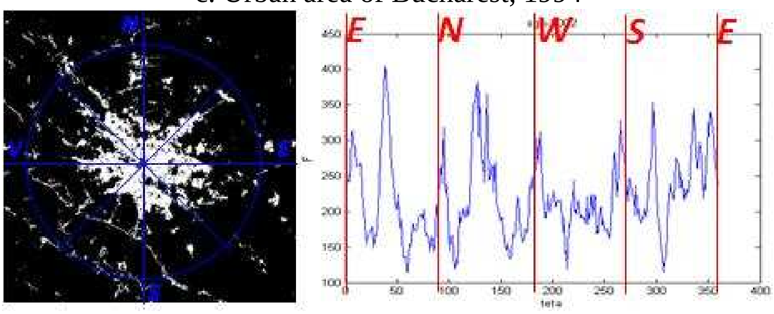
a. Urban area of Bucharest, 1984



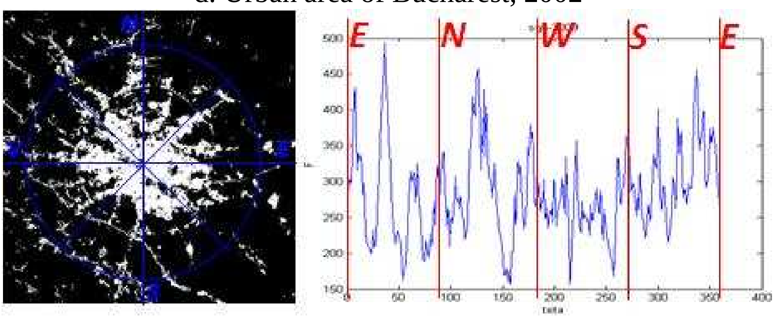
b. Urban area of Bucharest, 1989



c. Urban area of Bucharest, 1994



d. Urban area of Bucharest, 2002



e. Urban area of Bucharest, 2009

Figure 3. Masks for urban area of Bucharest. The histogram of forces computed for each mask of the urban region points out the development directions of the city.

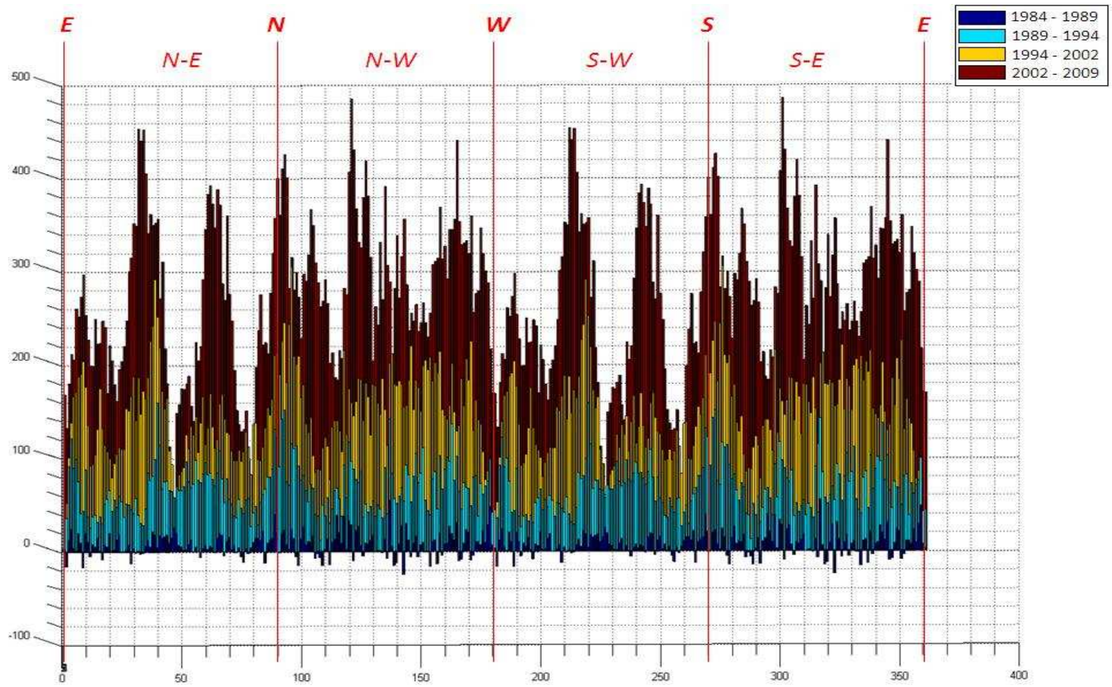


Figure 4. The development of Bucharest city between 1984 and 2009

Figure 4 presents the results of the analysis performed over four time intervals over urban areas: 1984-1989, 1989-1994, 1994-2002 and 2002-2009. The four colors represent the direction and amount of new buildings for the aforementioned intervals.

In the NE direction, we notice fewer construction sites at 50^o with a length of only 12 x 30 m=360 m, compared to the size of the urban area in 1984. One of the most proficient directions for building is in the NW-W area, between 160^o-180^o, on a length of 250 x 3 m=7500 m (7.5 km) and a surface of approximately 2500 ha, compared to the existing urban area from 1984.

Classification of scene dynamics from multi-temporal Landsat data

So far we have described our test scene in terms of its global dynamics. A next step is to go one level up and detect regions that exhibited similar development tendencies over a long period of time. For this task we will employ a SITS analysis method using spectral indices followed by a supervised direct multi-date classification. In the end, the regions with similar dynamic over the 15 years will be assigned the same label.

The method is developed for long-term monitoring of urban expansion from SITS covering an extended period of time. The method uses the Tasseled Cap Transformation [1] as a method to perform in one single step both multiplatform data fusion and feature reduction, followed by a supervised classification of the extracted features.

The use of the Tasseled Cap Transformation (TCT) brings several advantages: it is a fixed transformation that uses information from all the original spectral bands, and is dependent only on the remote sensing used and independent on the contents of the remotely observed scene. For this reason, adding new data to an existing SITS requires only the processing of the new data.

The Tasseled Cap Transformation can be expressed as:

$$\begin{bmatrix} brightness \\ greeness \\ wetness \\ haze \\ TC_5 \\ TC_6 \end{bmatrix} = W_{TC} \cdot \begin{bmatrix} DN_1 \\ DN_2 \\ DN_3 \\ DN_4 \\ DN_5 \\ DN_7 \end{bmatrix} + B \tag{1}$$

In the above formula $\boldsymbol{W}_{TC}$ is the weight matrix, DN_k is the digital number of each original spectral band and B is a bias vector.

For Landsat data, the coefficients in the weight matrix and bias vector for Landsat-4 TM were derived from DN numbers by Christ and Cicone in [1] and for Landsat-5 TM by Christ et al. in [2]. The coefficients for Landsat-7 ETM+ were determined by Huang et al. [3] based on at-sensor reflectance and are given in tables I - III.

In this paper we used only the first two tasseled cap components, the brightness and the greenness, as they explain the most of the variance of the satellite image time series [4]. All the extracted features were normalized to zero mean and unit variance.

TABLE I
TASSELED CAP COEFFICIENTS FOR LANDSAT-4 TM

	TM1	TM2	TM3	TM4	TM5	TM7	Bias
Brightness	0.3037	0.2973	0.4743	0.5585	0.5082	0.1863	-
Greenness	-0.2848	-0.2435	-0.5436	0.7243	0.0840	-0.1800	-

TABLE II
TASSELED CAP COEFFICIENTS FOR LANDSAT-5 TM

	TM1	TM2	TM3	TM4	TM5	TM7	Bias
Brightness	0.2909	0.2493	0.4806	0.5568	0.4438	0.1706	10.3695
Greenness	-0.2728	-0.2174	-0.5508	0.7221	0.0733	-0.1648	-0.7310

TABLE III
TASSELED CAP COEFFICIENTS FOR LANDSAT-7 ETM+

	ETM+1	ETM+2	ETM+3	ETM+4	ETM+5	ETM+7	Bias
Brightness	0.3561	0.3972	0.3904	0.6966	0.2286	0.1596	-
Greenness	-0.3344	-0.3544	-0.4556	0.6966	-0.0242	-0.2630	-

The classification of the extracted features is performed by a multiclass SVM classifier [5], the choice of the classifier being given by the fact that SVMs show no decrease in performance in a high-dimensional feature space.

The experiments described in this paper were performed on a SITS of 40 Landsat TM and ETM+ scenes, covering an area of 44.7 x 31 km, centered on Bucharest, the capital city of Romania. The remote sensing platform and the acquisition dates of the scenes in the SITS are given in table IV.

As a result of the classification we have obtained the land use and land dynamics map illustrated in Figure 5, with the confusion map displayed in table V. Ten classes of land use and land cover dynamics were considered: five different classes are allocated for the urban development: first class is for unchanged areas, the second class is for the changes in Bucharest city centre, third class describes urban expansion 1990-2000, forth class is for urban expansion 2000-2006, and the fifth class is for urban expansion 2006-2010.

TABLE IV

ACQUISITION DATES FOR BUCHAREST SITS

NR. CRT	DATE	SENSOR	NR. CRT	DATE	SENSOR
1	14/09/1984	TM	21	14/01/2001	ETM+
2	05/02/1985	TM	22	27/07/2001	ETM+
3	03/05/1985	TM	23	26/12/2001	ETM+
4	19/08/1986	TM	24	08/04/2002	ETM+
5	04/09/1986	TM	25	03/05/2002	ETM+
6	12/07/1987	TM	26	23/08/2002	ETM+
7	15/07/1988	TM	27	13/12/2002	ETM+
8	23/07/1989	TM	28	14/01/2003	ETM+
9	09/07/1989	TM	29	17/07/2003	TM
10	16/07/1991	TM	30	25/08/2003	TM
11	01/08/1991	TM	31	09/07/2010	TM
12	10/07/1992	TM	32	04/10/2006	TM
13	23/04/1993	TM	33	16/05/2007	TM
14	13/08/1993	TM	34	10/06/2007	TM
15	24/07/1994	TM	35	04/08/2007	TM
16	01/09/1994	TM	36	17/07/2009	TM
17	02/07/1995	TM	37	18/08/2009	TM
18	02/10/1999	ETM+	38	10/05/2010	TM
19	22/01/2000	ETM+	39	20/07/2010	TM
20	17/08/2000	ETM+	40	12/08/2010	TM

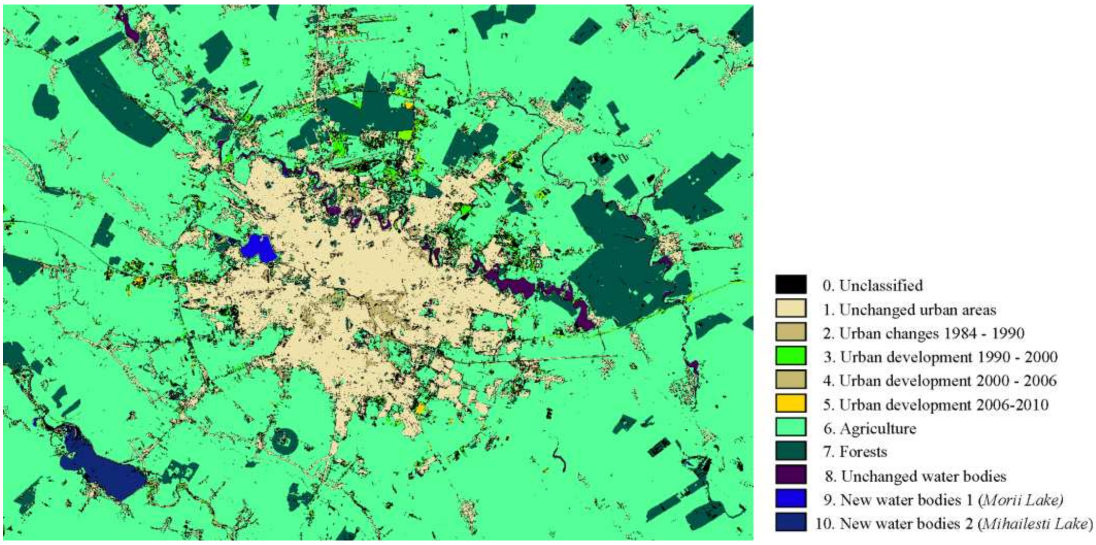


Figure 5. The classification for scene dynamics

TABLE V

CONFUSION MATRIX FOR CLASSES DEFINED IN FIG.1

	1	2	3	4	5	6	7	8	9	10
1	**89.87**	1.10	0.14	0.14	0.00	0.84	0.09	0.00	0.00	0.00
2	10.79	**56.65**	0.14	0.15	0.01	14.06	0.04	0.00	0.00	0.04
3	4.88	0.00	**53.66**	0.00	0.00	3.66	0.00	0.00	0.00	0.00
4	1.50	0.75	0.25	**48.50**	7.89	2.63	0.00	0.00	0.00	0.00
5	1.15	0.58	0.10	6.33	**16.68**	32.02	0.29	0.00	0.00	0.00
6	0.01	0.06	0.01	0.03	0.02	**99.20**	0.00	0.00	0.00	0.00
7	0.01	0.00	0.00	0.00	0.00	1.36	**96.89**	0.00	0.00	0.00
8	0.37	0.27	1.26	0.00	0.00	0.32	0.00	**89.90**	0.00	0.00
9	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**94.65**	0.93
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	**96.76**

Fragmentation of land parcels and crop rotation results in a very large number of temporal evolutions corresponding to agriculture. Due to the absence of reliable ground truth information for each type of agricultural use we preferred to assign all agricultural land use to a single class and to provide a large training set to cover as many of the temporal evolutions possible. One class was allocated to forests and other densely vegetated areas.

Water bodies were described by three evolution classes: one class is for unchanged water bodies, and one class for each of the two artificial lakes (*Morii* and *Mihailesti*).

A training set of 150 samples was defined using existing ground truth information and using Corine Land Cover (CLC) maps [6]. To validate the results we defined a test set of 150000 samples using CLC and Urban Atlas Maps [7].

SAR change detection component

Although optical sensors have been greatly exploited and different automatic change detection methodologies have been developed, the use of SAR sensors became more attractive due to their ability of monitoring geographical areas regularly, even if covered by clouds.The results of the previously described optical algorithm have been assessed using a series of TerraSAR images also covering the city of Bucharest. The images were acquired using Spotlight mode and have a resolution of 1m. The method used for SAR change detection is the Alparone algorithm, due to elimination of the preliminary de-speckling step, a novelty in SAR image processing. The rationale is that the negative of the logarithm of an amplitude level in one image conditional to the level of the same pixel in the other image conveys information on the amount of change occurred between the two passes [10].

The steps of the algorithm are as follows: first the local means at each pixel position is computed using a (2p+1) x (2p+1) window sliding over the images. The contribution of each pixel inside the sliding window is multiplied by normalized coefficients summing to (2p+1)2 and decaying toward the edges with Gaussian slope. The scatter-plot of the mediated images is partitioned into an LxL array of rectangular blocks, in order to get a 2D histogram h(i,j), where i matches the level of g2 and j the level of g1.The number of scatter-plots in each block is normalized to the overall number of points. The next step is to apply a Gaussian-shaped filter to the discrete normalized 2D histogram to get the discrete joint probability density function (PDF). The discrete conditional 2D-PDF can now be computed as:

$$p(i \mid j) = p(i,\, j) \,/\, p(j) = \frac{p(i,\, j)}{\sum_i p(i,\, j)} \tag{2}$$

We perform a scaling of each p(i,j) to its maximum along the column. This way, there is no change (the logarithm is zero) when p(i,j) attains this maximum. The rescaled conditional probability becomes:

$$q(i \mid j) = \frac{p(i, j)}{\max_i \, p(i, j)} = p(i \mid j) \frac{\sum_i p(i, j)}{\max_i \, p(i, j)} \tag{3}$$

Finally the conditional information of g2 to g1 at (m,n) is given by:

$$C(m, n) = -\log(q(\lfloor \bar{g}_2(m, n) \rfloor \mid \lfloor \bar{g}_1(m, n) \rfloor)) \tag{4}$$

(a) (b) (c)

Figure 6. TerraSAR-X images acquired in September (a) – October (b) 2008 and corresponding change detection map (c)

In the Figure 6 above an example of change detection map computed using the Alparone algorithm can be seen (c). We apply the method to two TerraSAR-X images acquired in September (a) and October (b) 2010. In the change map lighter tones represent changes, while darker areas are regions that stay the same. The results have been validated using ground truth data: the circled area was a shopping centre site under construction that suffered major changes during the considered time interval, when the parking area was built.

Conclusions

In this paper we presented a methodology consisting of three approaches for urban development, change monitoring and assessment. The methods provide complementary information about the test sites and allow for an in depth analysis and understanding of the evolution and extent of large urban areas. We have obtained a precise assessment of the new built-up areas in terms of position and extent. Moreover, the areas with similar dynamics over a period of 15 years have been identified. Finally, we have detected precise changes (given by urban development) that occurred in a fixed period of time.

To conclude, we can state that the results obtained in this paper can be used for the optimization of urban planning. The first part of the processing chain gives us an estimate about the newly built urban domains, the urban density and flow, as well as the development of infrastructure. Moreover, the second part provides a map for the classification of similarly developed areas over large periods of time. This allows for the assessment of the dynamics of interest areas, based on which decision makers can prioritize further development. Finally, the method used in the last part shows regions affected by major changes over short time intervals that require immediate response. In the example presented in Figure 6, the building of a commercial site implies a close monitoring of the traffic around it.

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INFRASCTRUCTURE MONITORING AND ASSESEMNT BASED ON HIGH RESOLUTION EARTH OBSERVATION IMAGES

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Keywords

Remote sensing images, risk assessment, rapid mapping

Abstract

In risk situations, both natural disasters and human conflicts, the most important effects affect areas that are of interest for human activities, such as residential areas and strategic infrastructure (bridges, power plants, highways, etc.). Decision support products, procedures and platforms have to be defined and implemented. The majority of the extent data analysis methods for decision support are currently based on visual analysis. Therefore, automatic data processing methods with real time response are required. These methods need to be adapted for High Resolution remote sensing data, to allow for the identification of affected man-made structures. This paper proposes a methodology for automatic processing of High Resolution Earth Observation images. The methodology is based on methods for rapid mapping, anomaly detection, object identification and interaction. We employ information theory measures such as the Rate Distortion and the Kullback-Leibler divergence for anomaly detection and Bayes theory for object detection, as well as the Latent Dirichlet Allocation for retrieving land cover categories and object interaction.

Introduction

In emergency situations that involve displaced persons and require humanitarian intervention for risk reduction, locations of refugee settlements have to be evaluated, in terms of water and food supply, safety level, and impact on the environment. The European Commission defined hazards as "*a dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage*". In order to asses the risk impact and to identify the appropriate risk mitigation measures, reliable real-time risk assessment and mapping tools have to be employed. Satellite imagery has proven to be a reliable source of information regarding the hazard impact, disaster prevention and solution planning. In most hazardous situations, gathering in-situ information from the affected sites is a hard task to accomplish, either because the necessary infrastructure has been affected or because the risk has not been eliminated. That is why remote sensed information becomes essential. Satellite imagery with meter and sub meter resolution offers the possibility to inspect hazardous areas in a safe, reliable and precise manner.

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This paper presents a processing chain for meter and sub-meter resolution optical satellite images, which makes use of information theory concepts and stochastic models, to produce Landcover maps and pin point the anomalies and changes that occur as a result of a risk event. The employed statistical measures are Kullback-Leibler (Faur at al, 2006) divergence for anomaly detection and Bayes theory for object detection, as well as the Latent Dirichlet Allocation (Blei,2003) for retrieving land cover categories and object interaction. The processing chain output results are exemplified on a real test scenario, the earthquake in Bam (Iran) in 2003. The event occurred in a country which suffers frequent earthquakes (figure 1), on December 26, during night time, and had 6.3 degrees magnitude Richter, which led not only to significant material damages (70% of the houses have been destroyed, as reported by the Iranian State Television) but also to enormous human losses (26 thousand dead and 30 thousand injured).

Figure 1. Proposed scenario. Earthquake in Bam, Iran in December 2003. Location and damages.

Theory and methods

The proposed methodology for automatic High Resolution Earth Observation optical images combines methods for rapid mapping, anomaly detection, object identification and interaction, as depicted in figure 2.

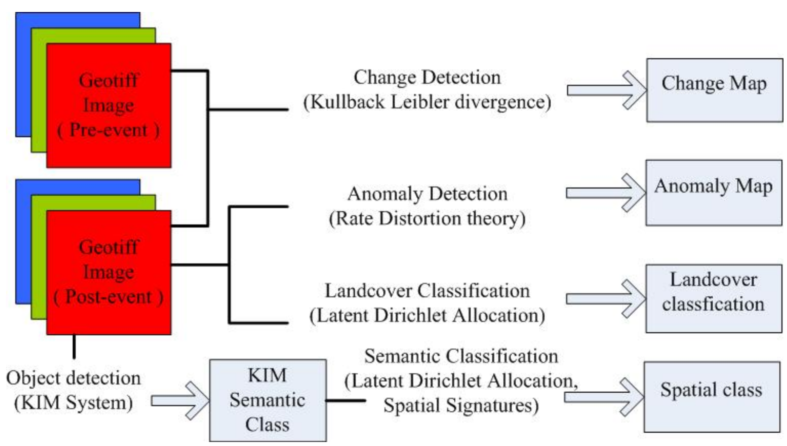


Figure 2. Processing chain

In order to asses the effects of a natural disaster or anthropic risk event pre- and postevent images of the interest scene were envisaged. Primitive features were obtained from the input data using probabilistic models and will further be introduced in the proposed applications.

The first generated product is a *change map* as a result of computing Kullback-Leibler divergence, an extension of Shannon's measure of information, between the pre- and post-event images. The divergence is a function of two probability densities (Eq.1) potentially characterizing a random variable (the pixels' grey levels).

$$KL(p,q) = \sum_i p(x_i) \log \frac{p(x_i)}{q(x_i)} \qquad \text{Eq.1}$$

The two images are simultaneously scanned with identical windows; for each step one computes the probability densities (the histograms) of the tiles and includes the results in the Kullback-Leibler formula (Eq 1). In the end, one can find out how much the images are alike If the probability densities in the two windows are similar, the Kullback-Leibler divergence has a small value. The result will be represented as a dark point in the map of changes (Figure 3). The lighter points signify the bigger changes occurred in the landscape. At different scales, the areas of changes are mostly the same. From the computational point of view it is better to choose larger sliding windows, also for smaller sliding windows size the changes are identified precisely and the change detection is more accurate.

Depending on the time lag between the acquisitions, change may be caused by the event or by other natural or man-made phenomena (different vegetation due to different seasons, urban development, etc.). Thus, it is important to distinguish between significant change and irrelevant change. This degree and type of change can be further assessed by determining the *scene anomalies.* Anomaly detection in Earth Observation images refers to the detection of irregularity in the scene that appears unlikely according to a probabilistic or physical model of the scene, for example ammunition elements in a scene which is dominated by vegetation and soil, or bare land in a dense urban area.

In the field of information theory, rate distortion theory is to code, as accurately and efficiently possible, the output of a source. Typically, the source output consists of a sequence of realizations of a continuous random variable. Representing or transmitting a real number with perfect accuracy requires storing an infinite number of bits, which is not feasible. Instead, a finite set of code words is chosen to approximate the numbers or source symbols as well as possible. One defines a distance function, *the distortion*, between a source symbol and its representation, to measure the “goodness” of the code. A typical criterion for a good code is that it should minimize the expected distortion for a draw from the underlying probability distribution of the source. Therefore, the central problem in rate distortion theory is to find the best possible distortion achievable with a given number of code words. In our approach, the number of classified image regions is equivalent to the number of code words. The mean of a region provide canonical representation of respective group members and the distortion function is mean-square error (mse) as follows: If *k* is the number of regions, *Si* area of the region *i*, *Xj* the 3-D vector corresponding to the pixel *j*, *Ci* the 3-D vector corresponding to the center of the region *i*, then the distortion is:

$$\text{mse} = \sum_{i=1}^{K} \sum_{j=1}^{Ni} \sqrt{\sum_{m=1}^{3} \left(X_{jm} - C_{im} \right)^2} \qquad \text{Eq.2}$$

where m is the number of clusters. After computing and plotting the rate-distortion function, we analyze the point at which the resulting distortion curve levels off, this point giving the optimal number of clusters, since past this point the drops are much smaller. The number of clusters is proportional to the image information content, so finding the number of clusters also gives us the possibility to rank the images according to their complexity.

The third processing step is to add *semantic meaning* to the obtained change and anomaly maps. This is obtained by performing Landcover classification over the post-event data. We extract the meaningful objects and define spatial relationships [Popescu et al.] between them. Considering the proposed scenario the primary interest is to relocate the displaced population. To accomplish this task we must determine the location of the damaged buildings, the areas with potential risk and the terrains which are suitable for refugee tent placement, water bodies and infrastructure. These areas are examples of meaningful objects in the scene.

To retrive the defined above categories from the images and to analyze object interactions LDA (Latent Dirichlet Algorithm) model was envisaged (Bratasanu et al, 2010). By employing this statistical model, adapted from the text domain (Blei, 2003), similar pixels that belong to the same information class are grouped together under a semantic label provided directly by the users. As a text document that contains many words can be regarded as belonging to a single topic of interest (e.g. politics, news, science), so too a region of the satellite image can contain multiple pixels that belong to a single class (e.g. Urban Areas). Grouping together pixels belonging to the same information class under the same high level semantic label leads to discovery of the semantic rules that bridge the processing layers, from primitive features with no semantic meaning to high-level human-centered maps of information.

If the previous approach described above mention a complete semantic labeling for all the regions inside the scene, regarded as single and independent objects, the last part of the proposed processing chain refers at an analysis of objects being a component of the environment. The KIM system, a powerful concept to explore image catalogues based on human-centered concepts (Datcu et al.,2003), allows the user to search in an archive by giving examples directly on the image. A graphical user interface enables a variety of mining tools, including semantic querying by image content or image example, interactive classification and learning of image content. During the training session, the user is able to define exactly the type of objects that he is interested about for further analysis. These objects acquire different meanings when put together, based on their relative position inside the scene.

Therefore, considering the user extracted objects from the image with the KIM system, we group them in configurations of two. For each configuration the spatial signature is computed as in [Vaduva et al. 2010]. Based on the spatial characteristics and the spectral features, visual words are defined in order to describe a vocabulary for image content description. Finally, a Latent Dirichlet Allocation (LDA) model is applied over this vocabulary. The image will be described as a mixture of proportions of some topics, each topic representing a semantic class. A semantic class contains similar groups of regions in the scene [Bratasanu et al, 2011]. This new attribute depicts the image content at the scene level.

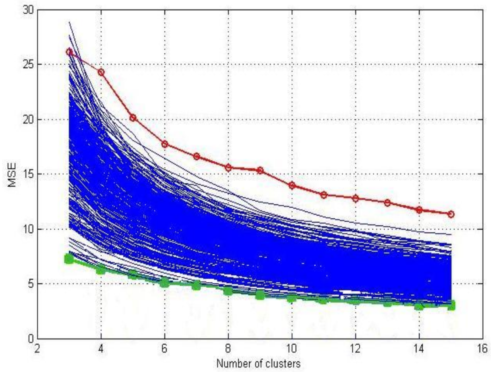
Results and discussions

The results of the first step of the processing chain are shown in figure 3, b. The image on the left depicts the analyzed post-event scene, containing damaged buildings, green areas, roads and refugee tents. The change map obtained using the Kullback-Leibler divergence is depicted on the right. The change map legend ranges from dark tones to very bright areas, coding the degree of change. Highest change is visible in the area where refugee tents have been placed.

The second step is to detect anomalies in the scene using Rate Distortion (RD) theory.The feature space is coded using K-means clustering algorithm, leading to a certain "compression" degree.


a


b



c

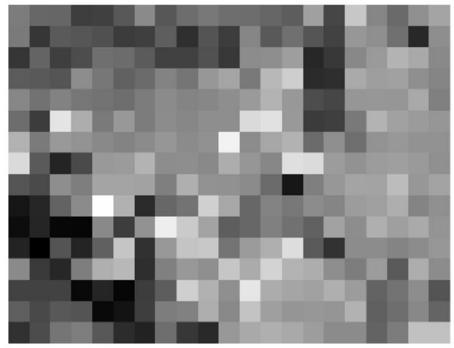

d

Figure 3. a) Original Quickbird image, post event, 2 m resolution, refugee tent visible tent in the lower left side of the image; b) change map, important changes are marked in white, dark tones represents areas with no change; c) MSE function d) anomaly map:lighter tones represent anomalies in the scene, damaged buildings.

Through compression, the processed signal is "distorted", rate distortion theory ensuring a balance between an acceptable distortion and a satisfactory compression rate. The more "complex" areas in the image can be characterized for a given number of regions by a greater MSE values (see figure 3 red curve) while the "simple" areas can be described, for the same number of regions, by a smaller MSE values (see figure 3 green curve). The results indicate that ranking of images based on rate distortion function corresponds to the ranking resulting after a simple manmade visual inspection. It is to see that really, the more complex region in the image can be characterized for a given error with a larger number N of clusters.

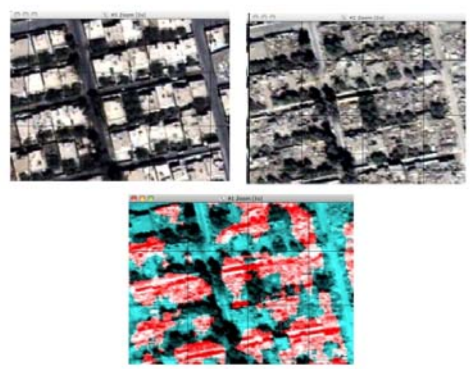


Figure 4 Classification of damaged buildings (left) and detail (right) of pre-, post-event building;damaged buildings color-coded in red.

Further, to extract land cover classes we employ the statistical generative probabilistic model for collections of discrete data Latent Dirichlet Allocation (LDA). Similar pixels that belong to the same information class are grouped together under a semantic label, provided directly by the users in a patch wise approach (Bratasanu et al,2010).

Figure 4 shows the results of the classification obtained using the hierarchical Bayesian model LDA. The image displays a document-level (image) representation of visual topic “damaged buildings”. Each topic was modeled as a probability distribution over a set of words in the vocabulary. A detailed view is given on the right side, where pre- and post-event views of an affected urban area are presented, and the identification of damaged buildings is marked in red.

To perform semantic classification, KIM assigns meaning to the primitive features through a learning phase. Using the samples images, the user marks interest areas by giving positive and negative examples, refining the definition of derived feature through an iterative process. Great structures of interest will appear in red on gray scale panel visualization of the scene (figure 5). Once this system training has been satisfactorily completed, the definition can be saved and used afterwards just by requesting images containing the derived features.

The classes of objects extracted in this manner represent the basic level of semantics regarding image content. Their meaning is locally pointed, ignoring the environment. In order to get a general meaning for global understanding of the scene, neighbouring has to be taken into account. Therefore, we groups these objects two by two and we compute for each group a spatial signature, as an attribute for describing the relative positioning of the two objects included. Given the fact that the considered scenario contains bare land, buildings and refugee tents (figure 5), the aim is to retrieve similar configurations of bare land and buildings, bare land and refugee tents, buildings and refugee tents in order to identify nearby risk free areas for installing new camps or to establish which buildings have access to a first aid point.

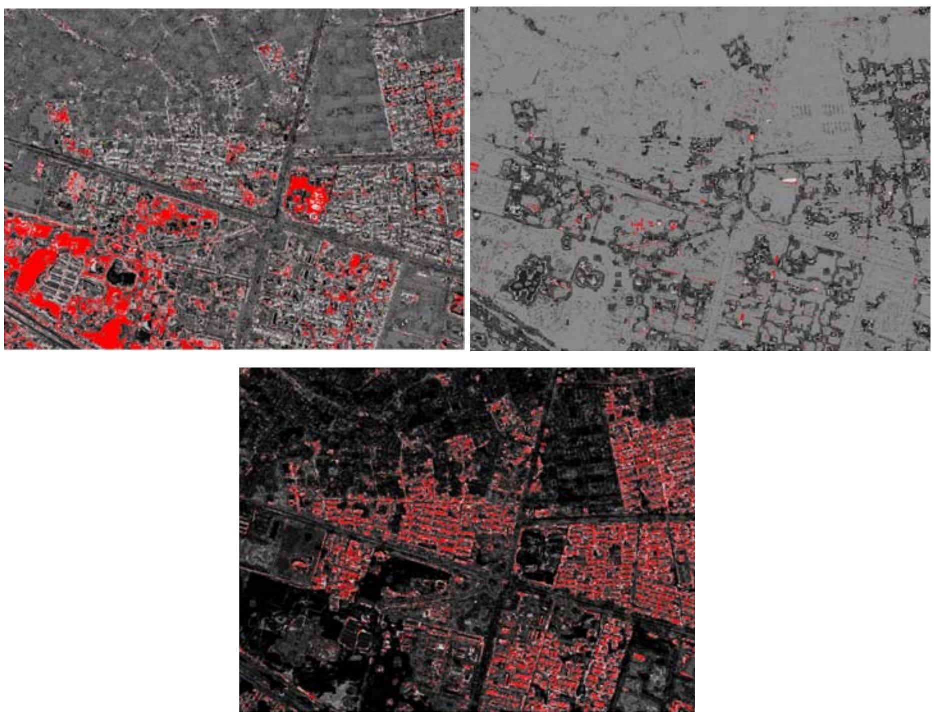


Figure 5. KIM semantic classes – bare land (upper, left side), refugee tents (upper, right side) and buildings (lower side)

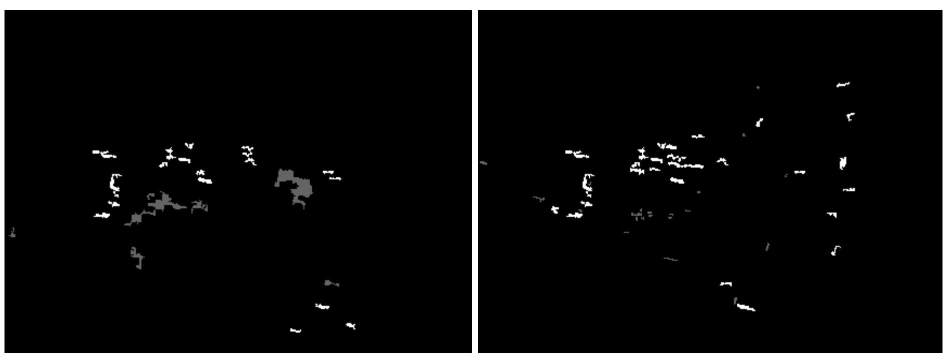


Figure 6. Two spatial semantic classes: groups of buildings + bare lands (in the left) and groups of buildings and refugee tents (in the right) characterized by a certain spatial positioning

Figure 6 shows two examples of obtained spatial semantic classes, containing configurations with similar spatial positioning, and the objects inside every configuration having the same spectral labels. For instance, one spatial semantic class is represented by all the groups of bare land and buildings having a certain positioning.

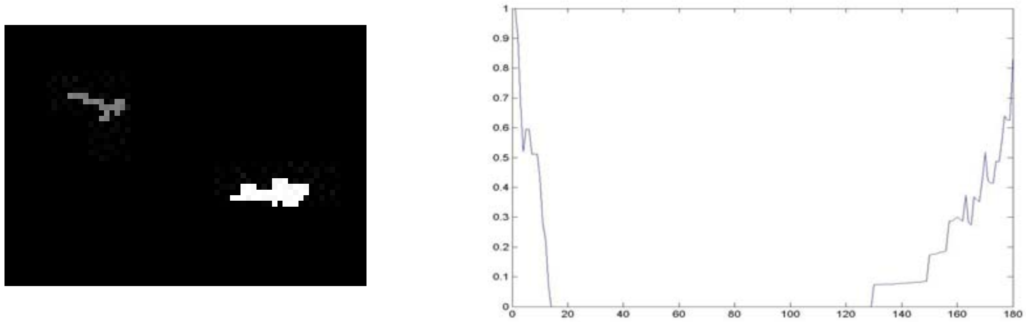


Figure 7. The pair of objects in the left side represents an example of the type of configurations included in the two spatial classes in figure 6. The corresponding spatial signature for the pair is depicted on the right.

The spatial signature characterizing the map results in figure 6 is represented in figure 7. The methodology was proposed for improving the existing capabilities to provide semantic classification of high resolution images required by the necessity to use reliable mapping tools in real time risk assessment situations.

Conclusions

We have presented and discussed a High Resolution Remote Sensing data processing chain for rapid mapping, anomaly detection, object identification and interaction, for decision support in risk and emergency situations. The methodology uses information theory measures such as the Rate Distortion and the Kullback-Leibler divergence for anomaly detection and Bayes theory for object detection, as well as the Latent Dirichlet Allocation for retrieving land cover categories and object interaction.

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DATA SHARING AND INTEGRATION INITIATIVES FOR CRISIS MANAGEMENT

WHAT ARE THE BENEFITS OF INSPIRE, GEOSS, SEIS AND CO.?

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INSPIRE, GMES, SEIS, environmental usage area, OGC, Sensor Web Enablement, SWE, crisis management

Abstract

EU-wide environmental initiatives such as GMES, INSPIRE, and SEIS are rapidly improving the capabilities of environmental information systems. At the same time, these initiatives influence the accompanying legal framework as well as the stakeholders' attitude in a direction that simplifies the use of environmental information in crisis management. The INSPIRE Directive forces all public authorities within the EU to exchange spatial data using well-defined data models and standardized service interfaces. GEOSS (Global Earth Observation System of Systems) and GMES (Global Monitoring for Environment and Security) explicitly address disaster reduction through coordination and integration of available information from both remote and terrestrial monitoring systems. Both initiatives are quite mature, with first (pre-)operational services scheduled to become available between 2011 and 2013. The Shared Environmental Information System (SEIS) builds on INSPIRE and GMES, with the intention of tying in better all existing data gathering and information flows related to EU environmental policies and legislation. Beyond and above this proclaimed goal, SEIS-related R&D for the first time explores the possibilities for active participation of the end users, e.g. by mean of Volunteered Geographic Information, distributed tagging of resources and geo-enabled social networking.

This paper gives an overview of the ongoing developments in the environmental sector from a perspective of risk and crisis management, with a special attention given to related European flagship FP6 and FP7 research projects, as well as to the operative services that already are, or soon will become available as a consequence of these developments.

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Introduction

Comprehensive environmental observations and models are a basis for successful crisis management. Thanks to the large efforts invested in initiatives such as "Infrastructure for Spatial Information in Europe" (INSPIRE) and "Global Monitoring for Environment and Security" (GMES), the capabilities of environmental information systems, and with them our understanding of the environment are rapidly improving through:

1. development of the architecture, services, data and meta-information models allowing seamless cross-organizational exchange of information;
2. development of web-enabled modeling and data fusion services capable of processing large amounts of heterogeneous data;
3. installation of an operative service infrastructure allowing easy access to aforementioned data and services.

The paper starts with an overview of the two main European initiatives aimed at establishing the European Spatial Infrastructure (GMES and INSPIRE). Both initiatives are just about reaching the operational stage at the moment. The INSPIRE road map foresees installation of the first operational services in 2011, and achieving of the full operational status by 2019. GMES is conceived as an "open end" activity, with current planning encompassing the period until 2020. First "pre-operational" GMES services are already online, and first fully operational GMES services are scheduled for 2014.

The paper continues with the discussion of the ongoing research activities originating from the environmental usage area, and with a description of the high potential for re-use in various stages of crisis management. In this section, we also present two upcoming FP7 Integrated Projects which intend to advance the standards and technology initially developed in environmental usage areas in cross-domain applications. Finally, we summarize the key advantages of the INSPIRE, GMES and SEIS initiatives from a crisis management point of view.

As a consequence of the European nature of INSPIRE, GMES, and SEIS, the paper mainly addresses risk management in Europe. However, the organizational and technical findings concerning the usability of environmental information systems, resources and standards in risk management will be equally valid elsewhere in the world.

INSPIRE

The INSPIRE initiative is based on the Directive 2007/2/EC of the European Parliament and Council **(INSPIRE, 2007)**, which entered into force as from May 15, 2007. INSPIRE aims at assuring that the spatial data infrastructures of the Member States are compatible and usable in a Community and trans-boundary context. Moreover, the Directive requires from all Member States to remove key obstacles to re-using Spatial Information "held by or on behalf of public authorities" by other public authorities. Some of the key INSPIRE requirements include:

1. development of common Implementing Rules (IR) for "Metadata", "Data Specifications", "Network Services", "Data and Service Sharing" and "Monitoring and Reporting";
2. installation of network services supporting the discovery, transformation, viewing and downloading of spatial data, as well as their usage in e-commerce services;
3. establishing of legal rules allowing public authorities to access spatial data required for their own work without ad hoc negotiations with the (public) authorities owning the data; and
4. a request to minimize monetary obstacles for re-using data, including the encouragement to provide part of the data and services free of charge.

The INSPIRE Directive addresses 34 spatial data themes, grouped in three “Annex” documents:

- **Annex I:** coordinate reference systems, geographical grid systems, geographical names, administrative units, addresses, cadastral parcels, transport networks, hydrography, and protected sites;
- **Annex II:** elevation, land cover, orthoimagery, geology
- **Annex III:** statistical units, buildings, soil, land use, human health and safety, utility and governmental services, environmental monitoring facilities, production and industrial facilities, agricultural and aquaculture facilities, population distribution and demography, area management/restriction/regulation zones & reporting units, natural risk zones, atmospheric conditions, meteorological geographical features, oceanographic geographical features, sea regions, bio-geographical regions, habitats and biotopes, species distribution, energy resources, mineral resources

The INSPIRE directive does not foresee the development of new observation systems or reports. However, *the possibility of easily discovering and using the data that was previously only available to a very limited number of stakeholders is precondition for cross-domain applications including those in the risk and crisis management domain.*

Consequently, the INSPIRE development mainly concentrated on legal issues first, followed by standardization of data models and service interfaces. Today, most of the Annex I and Annex II related regulations have been adopted by the member states. On a technical level, INSPIRE fully embraced the ISO 191** standards for meta-data, data, and services **(Craglia, 2010)**. It is important to keep in mind that the ISO 191** series corresponds to the „stable“ part of the Open Geospatial Consortium (OGC) standard suite. Relevant documents are available for download in the “Implementing rules” section of the INSPIRE web site **(INSPIRE, 2011)**, and the recently published “Good practice in data and service sharing” guidance document **(Eiselt, 2011)** provides several examples of INSPIRE-affine European and International framework agreements, technical systems and business practices.

First INSPIRE “discovery” (catalogue) and “view” (web maps) services are expected to reach an operational phase during 2011, and thus greatly improve the visibility of the INSPIRE-related resources. First “transformation” and “download” services are scheduled for late 2012, and the final implementation of all INSPIRE services is scheduled for May 2019 **(INSPIRE, 2010)**.

From a crisis management point of view, it is notable that such INSPIRE data concepts allow changes over time. These changes may be negligible in “elevation” or “geology” topics, and slow enough to be considered of only secondary importance in most applications for topics such as “transport networks” or “land cover”. As a consequence, the INSPIRE specifications currently specifically emphasize spatial data aspects, and tend to neglect the temporal aspect. Recently, a group of researchers suggested the adoption of the OGC SWE (Sensor Web Enablement) standards **(Botts et al., 2008)** as a way to handle time series of observations in INSPIRE **(Schleidt et al., 2010)**. Although this work primarily targeted the air-quality related part of the environmental monitoring facilities topic, the OGC SWE services and data encodings are known to work well with observations – i.e. being pieces of structured data containing at least a value, unit, temporal and spatial reference – from various sources and usage areas **(Havlik et al., 2011; Klopfer and Simonis, 2009)**, and may be adopted in the context of INSPIRE in the future.

GMES

The Global Monitoring for Environment and Security Programme **(GMES, 2010)** is the European Earth Observation program, and the main European contribution to the Global

Earth Observation System of Systems **(GEOSS, 2010)**. It aims at providing space based information for environmental and security related issues through an independent and operational European Earth Observation capacity **(GMES, 2011)**.

After many years of supporting R&D related activities to support its implementation, GMES became mature and is now heading for its operational phase. As from November 2010 the Regulation (EU) 911/2010 “on the European Earth Observation Programme (GMES) and its initial operations (2011 to 2013)” entered into force **(GMES, 2010)**. According to this regulation initial GMES operations will provide information supporting atmosphere monitoring, climate change monitoring, emergency management, land monitoring, marine monitoring, and security between 2011 and 2013. Fully operational services are envisaged from 2014 on.

Unlike INSPIRE, GMES is building its own space infrastructure, with special attention given to remote monitoring. As demonstrated for example through the SpaceAid framework of the “United Nations Platform for Space-based Information for Disaster Management and Emergency Response” (UN-SPIDER), a wide range of available satellite missions is regularly investigated for their use and tasked in the aftermath of a crisis event **(SPACEAID, 2011)**. The fleet of GMES Sentinel satellites developed by the European Space Agency (ESA) will therefore monitor the atmosphere, earth and marine surfaces at different wavelengths. In particular, the radar satellite Sentinel-1 and the high resolution optical Sentinel-2 are expected to significantly contribute to a worldwide capacity of satellite systems available for supporting disaster response. First Sentinel-1 and Sentinel-2 satellites are planned to launch in 2013 **(ESA, 2011)**. In addition to the space component, GMES foresees the “in situ” component and the “service” component, with in situ data being all kinds of data from sources other than space.

A recently published report **(EEA, 2011)** documents a variety of in situ datasets required for the operation of the GMES emergency response service. These comprise data commonly known from topographic maps (administrative boundaries, infrastructure, settlements, and others) as well as census information, weather forecasts, and many others. Much of the in-situ data required by GMES will be provided by EU member states through INSPIRE services. Additional data is expected from international networks and industry as well as from volunteers. Related activities are currently managed through the European Environment Agency (EEA). The coordination of both the space and the in situ component will facilitate data access to the service providers and will thus save valuable time in the aftermath of crisis events. Moreover, the data policies foresee a full and open access to data and derived service products. The open data access will also take into account existing commercial data **(GMES, 2010)**. This also promotes sharing of data and information products in accordance with INSPIRE and GEOSS principles **(GEO-VI, 2009; INSPIRE, 2010b)**. EEA’s current GISC project (“GMES In-Situ Coordination”) aims at documenting the in situ data needs, and at exploring stakeholders and networks to negotiate the provision of the required data for GMES which should lead to a long-term and sustainable framework for GMES services **(EEA, 2011)**.

The implementation of first pre-operational GMES services is ensured through R&D projects funded under the 7th Framework Programme (FP7) of the European Union such as geoland2 (land monitoring), MyOcean (marine environment monitoring), MACC (atmosphere monitoring), SAFER (emergency management) and G-MOSAIC (security). It is important to keep in mind that the GMES notion of service components goes beyond the simple discover - view - transform - download pattern envisaged by INSPIRE. Above mentioned projects are therefore expected to provide graphical user interface (GUI) and decision support functionality for the end users, rather than simply providing a set of services for later applications.

“Emergency response service” developed by SAFER is the pre-operative GMES service most relevant for crisis management **(SAFER, 2010)**. It is expected to provide:

- reference maps with up-to-date cartographic information about the location of a crisis within six hours after the event;
- assessment maps with information about the extent and impact of the crisis, giving an image about the damages; and
- thematic reference maps supporting disaster preparedness and mitigation actions.

The GMES emergency response service will be fully integrated into existing global and regional mechanisms supporting the application of space-based information for disaster management and emergency response, such as the International Charter Space and Major Disasters.

GMES plans go beyond its initial operations phase between 2011 and 2013. The current concept comprises the period until 2020. This allows a long-term and sustainable provision of data and services which is important for gaining trust in reliable services and for a successful customer relation.

ICT architecture and application developments beyond INSPIRE and GMES

With INSPIRE and GMES nearing the operational phase, research is moving towards *hybrid architectures for the observation web and cross-domain applications.*

SEIS, SISE, and beyond

The “Shared Environmental Information System” (SEIS, 2010), and the “Single Information Space in Europe for the Environment - SISE” (Hřebíček and Pillmann, 2009) are logical follow-ups of previous INSPIRE initiative. SEIS is a joint initiative of the European Commission and the European Environment Agency (EEA) and aims to establish an integrated and shared EU-wide environmental information system and thus make environmental information more readily available and easier to understand for policy makers and the public, while SISE essentially represents a research component thereof. The SEIS idea of data and services sharing across administrative and domain borders was first introduced in the course of the ORCHESTRA FP6 project, formalized in the Reference Model for the Orchestra Architecture RM-OA (Usländer, 2007), and later adopted for sensor service networks by the SANY FP6 project, resulting in Sensor Service Architecture (SensorSA) specifications (Usländer, 2009; Havlik et al., 2009). A summary of key RM-OA and SensorSA ideas is given in Table 1 below.

RM-OA features strict separation of functional description from technical implementation and self-description of resources as a way to improve interoperability in large heterogeneous service networks and “networks of networks”. Heavily disputed at first, the RM-OA has been accepted as an OGC “best practice” document, and its key premises have gradually been integrated in OGC standards. SANY has subsequently embraced and extended the RM-OA architecture with services, data encodings and interaction patterns inherent to sensor service networks and practically tested the idea of technology independent specifications with SOAP, OGC-style, and RESTful **(Mazzetti et al., 2009)** implementation of OGC SWE services which were developed and deployed in the SANY pilot applications. In addition, SensorSA introduced the notion of equal architectural treatment for request/reply (“pull”) and event driven (“push”) interaction patterns. Many of the SensorSA architectural ideas have been integrated in the next generation of the OGC Sensor Web Enablement (SWE 2.0) standards. A comprehensive overview of the SWE 2.0 functionality and development status has been recently published in MDPI Sensors **(Bröring et al., 2011)**.

Table 1: Some architectural premises of ORCHESTRA RM-OA and SANY SensorSA, and the level of acceptance in various communities

Architectural premises	Level of acceptance
RM-OA: Technology independent specifications + mapping to specific technology	Inherent to GEOSS "system of systems" approach. Implementations of various OGC services with W3C (SO AP), OGC-style, and RESTful bindings exist.
RM-OA: All resources (data, services) have to be self-descriptive	Need for rich meta-information on resources widely accepted in INSPIRE, GMES, SEIS. Follow-up development in the FP7 TaToo project: decentralized semantic tagging of third-party resources (Havlik and Schimak, 2010).
RM-OA: Data can be both information and meta-information depending on the usage	Difficult to achieve with OGC services, and consequently not used in the INSPIRE/GMES context; de-facto practiced in Semantic web/linked data applications. Follow-up development in the FP7 TaToo project: possibility to "tag the tag", thus providing additional meta-information on information that was initially contributed as meta-information (Schimak et al., 2010).
SensorSA: equal treatment for observations from sensors and models/data fusion services ("model as a sensor")	SANY sensor model indicating the fact that all observations originate from models is incorporated in OGC SWE specifications; CAFE/INSPIRE prototype by Schleidt et. al. (2010). Follow-up developments in SUDPLAN; extension to Volunteered Geographic Information (VGI) from people and ubiquitous sensors planned in the FP7 ENVIROFI project (Havlik et al., 2011).
SensorSA: equal treatment for request/reply ("pull") and event driven ("push") interaction patterns	Some elements of event driven architecture are already present in OGC SWE 1.0; strong emphasis on events in upcoming OGC SWE 2.0. Follow-up development planned in the FP7 CRISMA project (CRISMA, 2010).

FP7 "Climate Change" research

At the level of applications, the most interesting research is currently conducted under the umbrella of the FP7 "ICT for Sustainable Growth" **(EC, 2009)**, in the "ICT for Environmental services and Climate Change adaptation" topic. The following projects are developing the technology and prototype applications of high relevance to crisis management:

- **ENVISION** project (ENVIronmental Services Infrastructure with ONtologies; http://www.envision-project.eu/) develops Environmental Services Infrastructure that aims to *support non ICT-skilled users in the process of semantic discovery and adaptive chaining and composition of environmental services.*

- **NETMAR** project (open service NETwork for MARine environmental data; http://netmar.nersc.no/) aims to develop a prototype European Marine Information System *for searching, downloading and integrating satellite, in situ and model data from ocean and coastal areas*.
- **PESCADO** project (Personalized Environmental Services Configuration and Delivery Orchestration; http://www.pescado-project.eu/) develops an interconnected multipurpose *environmental user-oriented service for a federated community* of citizens, public services (such as tourist offices and environmental institutions), public administrations, and entrepreneurs active *in sectors sensitive to environmental conditions.*
- **SUDPLAN** project (Sustainable Urban Development Planner for Climate Change Adaptation; http://sudplan.eu) develops a *SensorSA/OGC SWE compliant Model Web implementation* as well as the *downscaling services for the climate change* domain applications.
- **TaToo** project (Tagging Tool based on a Semantic Discovery Framework; http://www.tatoo-fp7.eu/tatooweb/) explores the feasibility of distributed meta-information management and quality in an environmental context, as a way to overcome the meta-information gap.
- **UncertWeb** project (The Uncertainty Enabled Model Web; http://www.uncertweb.org) develops an uncertainty-enabled Model Web, which is a resource sharing system that supports handling uncertainty information from sensor observations and models error propagation.
- **UrbanFlood** project (http://urbanflood.eu/default.aspx) investigates the use of sensors within flood embankments to support an online early warning system, real time emergency management and routine asset management.

More information on the above mentioned projects can be found in the proceedings of the Envip 2010 workshop (Berre et al., 2010)

Upcoming cross-domain projects

The architectural ideas of ORCHESTRA and SANY, as well as the lessons learned in above mentioned projects will be further developed in two upcoming FP7 Integrated Projects relevant to crisis management:

- **ENVIROFI** stands for *"The Environmental Observation Web and its Service Applications within the Future Internet"*. This project, which started in April 2011 shall extend the SensorSA architecture in the direction of Volunteered Geographic Information (VGI) from people and ubiquitous sensors **(Zook et al., 2010; Maisonneuve et al., 2010)**. ENVIROFI intends to integrate environmental data and services as "environmental enablers" within the upcoming Future Internet architecture. A comprehensive overview of the research topics pertinent to ENVIROFI and their importance for the Future Internet development has been recently published in MDPI Sensors **(Havlik et al., 2011)**.

- **CRISMA** stands for *"Modeling crisis management for improved action and preparedness"*. At the time of writing this paper, CRISMA was still in the negotiation phase, and the project is expected to start in Q4 2010 or Q1 2011. CRISMA intends to explore the generic manner in which "observations" are defined within SANY Sensor Service architecture and OGC Sensor Web Enablement in dual purpose crisis management applications for both training/preparation and real world implementation. An additional architectural challenge will be the integration of agent-based simulations **(Bousquet and Page, 2004)** into SensorSA which is foreseen by the project plan **(EC, 2010)**.

ENVIROFI and CRISMA have a potential to further extend the impact of ORCHESTRA and SANY by establishing a close link between the Environmental Usage, Future Internet, and Crisis Management at the level of ICT architecture, standardization, and applications.

Conclusions

The Environmental Usage Area provides much of the information required for successful crisis management. This information includes environmental observations from institutional in-situ and EO sources, VGI from people ("human sensors") and ubiquitous low-cost sensors, as well as observations generated by various models (data fusion, now-casting, forecasting, indicators). Less known outside of the environmental ICT community are the recent advances in open standards for architecture, services and data models which occurred in cooperation of the environmental ICT researchers with the standardization working groups at OGC. This paper presents some of the key ICT developments relevant to crisis management originating from the environmental usage area.

With INSPIRE reaching the operative phase, many of hitherto inaccessible environmental data sources will soon become readily available on the web. INSPIRE data ranges from background information required for accurate situation awareness (e.g., geographic names, addresses) over information related to vulnerability and resilience (e.g., transport networks, land use, population distribution and demography, production and industrial capacities) to real time monitoring systems (e.g., environmental monitoring facilities). Many of the data sets can be used in more than one way: for instance, industrial sites can be seen as capacity, may be vulnerable to certain types of hazards, and may also present a hazard of their own.

GMES adds Earth Observations, additional in-situ data, and modeling to the INSPIRE core. One of the first pre-operative GMES services is the "emergency response service" **(SAFER, 2010)**. This service is expected to provide: (1) reference maps about the location of a crisis; (2) assessment maps with information about the extent and impact of the crisis; and (3) the thematic reference maps supporting disaster preparedness and mitigation actions. The information provided through these maps shall allow emergency response actors to react quickly and geographically focused and thus mitigate the disaster impact.

Finally, the SEIS initiative builds upon INSPIRE and GMES, with the main idea of further improving the re-usability of services across administrative and domain borders. A number of recent and upcoming research projects listed in the previous section all contribute to certain aspects of this overall goal. SEIS and its research associate SISE closely relate to the Future Internet initiative: acknowledging the changes in users' expectations with respect to environmental data and service provision and consumption patterns, SISE anticipates a *decentralized EU-wide system of systems where users can plug in their own use cases and leverage the third party services in a transparent way*. In this context, the FP7 SUDPLAN project already explores crisis-management relevant aspects of climate change, and the UrbanFlood project explores the technical possibilities of novel sensor systems in urban flood management.

At the level of distributed open standard based architecture and services, the pioneering work of the FP6 ORCHESTRA and SANY Integrated Projects, and the ongoing standardization work of the Open Geospatial Consortium provide a sound basis allowing planning, executing and exchanging the environmental observations from various sources. In particular, the SANY Sensor Service Architecture emphasizes a generic definition of "observations" within OGC Sensor Web Enablement, and imposes equal architectural treatment for observations directly taken from in-situ sensors, EO "products", historic observation repositories, models, and data fusion.

The work on architecture and applications development relevant to both environmental and crisis management applications continues in two upcoming Integration Projects: ENVIROFI and CRISMA. These two projects expect to establish and, where necessary, extend the OGC standards, which are heavily used throughout the environmental usage area in Future Internet and crisis management domains, and to provide RM-OA/SensorSA extensions allowing the use of the Future Internet infrastructure and services, as well as VGI in both environmental and crisis management applications.

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EMERGENCY MANAGEMENT IN VRANCEA (ROMANIA) EARTHQUAKES OF 1940 AND 1977: CASUALTY PATTERNS VS. SEARCH AND RESCUE NEEDS.

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Keywords

earthquake, casualty, search and rescue, Vrancea, Romania

Abstract

During the acute phase after a strong earthquake, emergency management is dependent on the extent of damage and the casualty patterns. In Romania, large magnitude ($M_w \geq 7.2$) Vrancea intermediate depth earthquakes ($h \geq 60$km), as those in 1940 and 1977, caused a large number of building collapses, the loss of many lives and many more injuries. In 1940, Bucharest shared 23.6% of the dead and injured relative to the total. In 1977, the casualties were concentrated in Bucharest, with 90.2% of the killed and 67.1% of the injured. Heavy rescue of victims trapped under the rubble of multi-storey buildings was a general need. This paper will present newly assembled data on building damage and associated casualties, conditional upon disaster management, attempting to explain the number, patterns, ratios and social impacts. These data and figures will provide an image of the disaster management at the time in particular related to the speed of extrication of victims from collapsed buildings and their hospitalisation.

Introduction

Recent earthquake disasters in the World have shown that progress in construction techniques and earthquake resistant design is the path to reduce casualties, with each new seismic event bringing new data, problems and lessons. In Romania, large magnitude ($M_w \geq 7.2$) Vrancea intermediate depth earthquakes ($h \geq 60$km), may affect simultaneously with intensities of VII to IX EMS, circa 50% of the territory, over 50% of population, among which circa 35% of the total population is exposed in urban localities. Table 1 contains a summary of what is known about the human casualties caused by Vrancea earthquakes in Romania during the XXth century, based on data gathered by the authors (Georgescu and Pomonis, 2010). It is obvious that the November 10, 1940 effects were different to those in March 4, 1977. Some probabilistic assessments warn about a major and highly destructive Vrancea earthquake that could occur in the future and in this respect, we may need to be better prepared to cope with possible casualties, using a proper emergency management.

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Table 1 Human casualties in Romania due to significant Vrancea earthquakes (various sources)

				Total Casualties		of which in Bucharest	
Event	Occur. Time (Local)	M_W	Depth (km)	Deaths	Injuries	Deaths	Injuries
1990.05.30	12:40	7.0-7.1	91	9	296	2	unknown
1986.08.31	00:28	7.1-7.3	133	8	317	0	some
1977.03.04	21:22	7.5	109	1,578	11,321	1,424	7,598
1940.11.10	03:39	7.6-7.7	150	593	1,271	140	300

Note: the seismological data of table 1 are those used in URBAN-INCERC database and may differ of any recent revisions by other authors.

Thesis

The casualty trends presented in Table 1 are contrary to the actual progress in earthquake protection that was achieved gradually in Romania and needs a careful analysis. In this respect we evaluate the chain that relates causes, i.e. earthquake patterns and building resistance, to effects, i.e. damage / collapse patterns and casualties, their location and specifics, researching as much as possible the search and rescue operations after each event. Availability of data on building damage is quite satisfactory for both events but data on casualties are quite scarce and overlooked. In terms of present-day emergency management, the concepts and activities that are presently under this term did not exist in 1940 and were only implicit in the management of the crisis in 1977. Each event occurred in a different socio-political type of regime and the response was different. In 1940 casualty data were not exhaustively collected, as WW II was on-going and Romania had just been occupied by German troops, while in 1977 because of the specific policies of the regime of the time released information was also somewhat limited. Thus, the recovery of data on casualty and post-disaster operations was our primary goal and has been presented in recent papers (Georgescu and Pomonis, 2008 and 2010).

As this historic research process is long-term and gradual, the present paper will introduce and correlate newly assembled data on building damage and associated casualties, conditional upon disaster management, attempting to explain the number and patterns, ratios and social impacts in Romania. All data and figures will provide also an image about the disaster management at the time.

Sources of information

Because at the time of the 1940 earthquake's occurrence, World War II had just started in Europe and German troops were already occupying Romania, reporting on its effects has been limited in the local and international press. After the war the political changes that took place in Romania meant that the flow of information on such matters continued to be restricted until the 1990's. As a result valuable information was to certain extent lost and knowledge about the damage and casualties incomplete and sometimes contradictory. For the 1977 earthquake, physical damage reports existed, but casualty data were condensed in official press releases and details barely available.

In order to recover data that will shed light in the events that took place in 1940 and 1977, the authors searched press archives, memories of survivors, data and imagery bases, contemporary papers and reports. In the internationally accepted earthquake catalogues the fatalities of the 1940 event are given as 1,000 and those injured as thousands (Utsu, 2002; USGS Earthquakes with 1,000 or More Deaths since 1900 at http://earthquake.usgs.gov/regional/world/world_deaths.php). Our research suggests that the loss of life and injuries were not so extensive and the figures shown in Table 1 we believe give a more accurate picture of the human casualties of the 1940 event (for more details refer to: Georgescu and Pomonis, 2010).

Human casualty effects of the 1977 event in Bucharest and the rest of Romania are almost identical in all international publications; Table 1 gives the data of BSSA (1978), which we checked against local contemporary reports and find to be reliable and consistent with a report by the World Bank (1978) and with our analysis of life loss potential from the collapse of buildings in Bucharest.

It is also worth to remark that the 1986 and 1990 events caused limited casualties, due to smaller magnitude (1990), deeper focus (1986) or other reasons. According to Steiner and Manastireanu (1996), the August 1986 event caused 8 deaths and 317 injured in Romania; BSSA reported some damage as intensity VIII and VII (BSSA, 1987). The May 1990 earthquake caused 8 or 9 deaths in Romania of which 2 in Bucharest in the district of Colentina, when the heavy plasterboard of a large 11-storey apartment block collapsed along the expansion joint, due to pounding between the two sections; these two people were trying to evacuate a ground floor shop. Adevarul Newspaper, (May 31, 1990) reported 8 deaths, 75 seriously injured and 221 lightly injured for Romania (Pomonis *et al.*, EEFIT, 1990), consistent with Steiner and Manastireanu (1996) giving 9 deaths and 296 injured. All four events have in addition caused casualties in Bulgaria and Moldova Republic (analysed in Georgescu and Pomonis, 2010).

The November 10, 1940 earthquake

This is the greatest earthquake since 1802 in the Vrancea region, preceded by another earthquake that struck on October 22, 1940 ($M_{G\text{-}R} = 6.1$). Seismological data are as follows:

- magnitude $M_{G\text{-}R} = 7.4$ (converted at present as $M_w = 7.6\text{-}7.7$); epicenter coordinates were determined at 45.8 N; 26.6 E, in Vrancea area, Demetrescu (1941);
- the focal depth was assessed as 140-150 km, a value which is until now under debate and re-evaluation; Demetrescu (1941) gave 100–200 km;
- epicentral intensity was assessed as 10 MCS by Demetrescu (1941), or 10 MM (Tillotson, 1940). Isoseismal map of Demetrescu showed an area with intensities of VII$^+$ to IX MCS near the Vrancea region, surrounded by large areas of intensity VIII to VII and VI, Bucharest being in IX MCS. The revised map of Radu *et al.* (1990) put IX MSK North of Focsani City, with large areas of VIII and VII MSK, with Bucharest in VIII MSK.

Damage was heavier in counties and towns near the epicentral area, as: Panciu, Focsani, Galați, Barlad, Brăila, Buzau, Valeni, upon the buildings made of masonry, adobe, wattle and daub and timber; the damage was widespread in all Moldova region, especially towards Iasi. The earthquake affected seriously the Moldova and Bessarabia regions which presently lie within Romania and Moldova Republic. It caused significant damage in Bucharest, where the 12-storey Carlton block, the tallest reinforced concrete building in the city, collapsed entirely. Reported casualties were based on less rigourous evidence, however on the second day official reports gave 267 killed and 476 injured all over the country until the evening of November 10 (Universul Newspaper, Nov 12). Tillotson (1940) gave many details of the effects of the earthquake around the country and estimated the casualties at 400 killed and 800 severely injured in Romania, with more than 150 killed in Bucharest where 30 or more were still trapped under the debris of Carlton and more than one thousand badly damaged houses had to be evacuated.

Time Magazine (1940) said that about 98 bodies were extricated from under Carlton debris, while there were 357 killed and thousands injured in all the country.

In 1982, the published memoirs of the vice-premier of Romania at the time of the event, indicated 593 killed and 1,271 injured in all the country, and in Bucharest 140 killed from the 226 occupants of Carlton block, with another 300 injured in the city (Sima, 1982). Information on casualties in Sima's book refers to some 21 towns and counties. According to this, Bucharest shared 23.6% of the dead and injured relative to the total, mainly due to the collapse of the Carlton high-rise apartment building.

Fig. 1 Carlton Block before collapse (left) and immediately after collapse (right)
(Photo: postcard and Ministry of Propaganda files, 1940)

Concerning the collapse of Carlton block, the recovered photos allowed authors to assess that the loss of volume was very high (>0.70). This collapse was the first urban search and rescue case in the history of Romania, with time-consuming operations and technical difficulties caused by heavy rain and fire during the operations. The lethality of the Carlton collapse is assessed as 62% based on figures by Sima (1982).

Fig. 2 Carlton Block site during debris removal (Photo Iosif Bergman, 1940)

Search and rescue operations in Bucharest, at Carlton Block, were started by authorities and neighbours, Firemen, Romanian Army and Police, some paramilitary squads, as well as soldiers of the German Army. Some persons were entrapped in the basement. First attempts to save lives with bare hands were less successful, and there was an attempt to dig a tunnel to reach the basement, but the lack of experience lead to a cut of water pipe, a short circuit and a fire to the fuel stored there. Thus, water and fire hampered seriously the rescue operations. Eventually, a crane was installed and concrete debris removed.

The rest of the country's casualties were mostly in masonry buildings. Near the epicenter, the city of Focsani and the town of Panciu were heavily damaged and many lives were lost there.

In the region of Muntenia, the cities of Galati and Ploiesti were ~~also~~ seriously affected. As the most tragic example, the rural town of Panciu in the epicentral area, had apparently only a handful of buildings standing among a total of 371 (Wikipedia article about Panciu in Romanian language). However, the number of casualties in Panciu is uncertain (22 to 62 deaths, 54 to 300 injured have been referred in various sources). Based on our research so far we lean towards the higher figures, as of Radulescu (1941). In the rural towns, removal of low-rise masonry houses debris was a less difficult task, and recovery of entrapped, injured and corpses was easier.

The 1940 event killed approximately 78 people and caused an unknown number of injuries in Moldova (mostly in the city of Chisinau; Alcaz, 2006) and 15 injuries in Bulgaria (Tillotson, 1940). Based on collected figures of fatalities from many sources and for various locations, we propose a total for the event at 690 of which less than 620 were in Romania. More details about the geographic distribution of the casualties are given in Georgescu and Pomonis (2010).

The March 4, 1977 earthquake

The main seismological data are as follows (Balan et al, 1982):

- magnitude M_{G-R} = 7.2 ; depth 109 km; coordinates of the main shock: 45.34 North; 26.30 East;
- epicentral intensity was assessed at I_0 = VIII MSK for a reduced area at Carpathian Mt. curvature, surrounded by large areas of intensity VII MSK towards S-E and N-E; with Bucharest, Iasi and Zimnicea being islands of intensity VIII within the intensity zone VII.

These data were successively revised and at present the NIEP Romanian Earthquake Catalogue ROMPLUS (2010) give coordinates 45.77 N and 26.66 E, depth 94 km, M_w 7.4 (as Utsu (2002) and USGS). Seismological data of Table 1 are those used in URBAN-INCERC database and may differ.

Concerning the socio-economic impact, according to Georgescu and Pomonis (2008), earthquake losses were accounted and available in the initial official communiqués, local technical books, papers and some reports of international teams (Berg *et al*., 1977; Fattal *et al*., 1977; JICA, 1977 etc). Casualties were reported in 1977, in rounded figures, as 1,570 deaths, 11,300 injured (with 90% of the victims in Bucharest) and 35,000 homeless families. Official damage data referred to some 2 billion US$ losses, 32,900 collapsed or heavily damaged dwellings, tens of thousands of damaged properties etc.

In 1977, the casualties were concentrated in Bucharest, with 90.2% of the killed and 67.1% of the injured (see Table 1), resulting mainly due to the collapse of 19 high-rise apartment buildings (of 7 to 14 storeys) that were constructed in the 1920-1940 period as reinforced concrete (RC) frames designed only for gravity loads. Most of these had been damaged by the 1940 event but had not been strengthened properly (World Bank, 1978). In addition about 150 buildings of this category were seriously damaged and many were subsequently demolished. In addition 2 low-code high-rise reinforced concrete shear wall structure apartment block buildings built in 1962 and 1974 collapsed partially (Block 30 and Block OD16) as did 4 non-residential buildings (incl. a 4-storey hotel, two government buildings and a faculty building of the University of Bucharest).

The number of people killed and rescued in each of the collapsed buildings is not known, but some data were collected by the authors mainly from survivors' memories and press reports. Some of them fit to loss of volume and casualties ratio in the international literature (e.g. Pomonis et al., 2011; Pomonis et al., 1991). In total 28 buildings collapsed, 23 of which were situated in the city centre and mostly on street corners. We identified the collapse patterns by collecting photos and processed casualty and rescue data for some of the 28 collapsed buildings. Loss of volume ratio was in the range of 0.15 to 0.85.

Causes of deaths and injuries were the crushing under concrete or under members or parts of buildings and falling of non-structural members. Search and rescue needs were extensive as 23 of these buildings were heavily occupied residential structures with 15 to 89 apartments and extrication of the trapped was very difficult. Fire occurred after collapse in several cases. In Table 2 we summarize the information we have collected so far for each of the collapsed buildings in Bucharest.

Table 2. Buildings that collapsed in Bucharest during the March 4, 1977 earthquake, in correlation with emergency management issues (partial data from unofficial sources)

BUILDING NAME AND ADDRESS	YEAR BUILT	STRUCTURE, NO. OF FLOORS AND COLLAPSE TYPE	CASUALTIES DATA
Bloc Casata, Bd. Magheru 26	1937	RC Fr/ 11/partial	
Bloc Lido, Str. An. Simu 6 (Franklin 11)	1905	RC Fr/8/partial	
Bloc Scala, Bd. Balcescu 36	1937	RC Fr/ 11/total	108 corpses pulled out by March 6; 8 rescued (1 woman working in the basement kitchen that survived under a metal desk; 1 woman under a door frame; 1 man around 80+ hrs later)
Bloc Wilson, Bd. Balcescu 25	1940	RC Fr/11/partial	3 rescued circa 13 hrs. later (cuting steel, opening a hole)
Bloc Dunarea, Bd. Balcescu 3-5	1940	RC Fr/ 9/partial	
Bloc Continental, Colonadelor 3	1935	RC Fr/11/ total	300 deaths said by Poetess Ana Blandiana on March 4, 2010 *; a girl of 6.5 yrs old rescued around 61-72 hrs later, mother alive, 2 brothers killed; lawyer rescued 110 hrs later; 19 yr old boy rescued in basement 251 hrs later
Str. Bibliotecii 6	1939	RC Fr/ 11/total	* Casualties may have been accounted together for these 2 neighboring buildings
Bloc Nestor, Calea Victoriei 63-69	1937	RC Fr/9/partial	4 rescued from basement? after 45 hrs
Str. Pictor Grigorescu 2	Ca. 1930	RC Fr/9/partial	
Pasaj Comedia		URM/6/total	
Academiei 5 Ministry Offices	1936	RC Fr/10/partial	
Bloc Belvedere, Str. Brezoianu 7	1938	RC Fr/ 14/total	Fire followed; 4 rescued (by March 7) 2 were women
Hotel Victoria, Str. Lipscani	Before 1900	URM/4/partial	
Str. Poenaru Bordea 18	Ca. 1930	RC Fr/8/partial	
Str. Poenaru Bordea 20	Ca. 1930	RC Fr/8/total	
Str. Apolodor 31		RC Fr/9/partial	
Str. Scoalei 2	1937	RC Fr/8/partial	
Str. Alex. Sahia 58 (J.L. Calderon)	1935	RC Fr/9/total	Woman rescued 197 hrs later
Str. Galati 33 (Vas. Lascar)	1936	RC Fr/7/partial	
Str. Popa Rusu 11	1932	URM/3/ total	
Str. Alex. Sahia 1-3 (J.L. Calderon)	1938	RC F/10/ total	Fire followed; 25 killed & 4 rescued (by March 7)
Str. Tudor Arghezi 1	1938	RC Fr/9/ total	A student rescued after 62 hours, a 22 yrs. woman that was at 7-th floor rescued after 127 hours, found at basement level
Str. Hristo Botev 10	Ca. 1930	RC Fr/10/ total	107 dead recovered, testimony of Gh. Florescu, 2011
Str. Lipscani 102	1927	URM/ 6/total	
Calea Mosilor 132	1937	RC Fr/ 11/total	
Bloc 30, Soseaua Stefan cel Mare 33	1962	RC SW/10/partial	16 tenants dead and 1 visitor; 1 person dead outside (survivor s testimony, 2009)
Bloc OD 16, Bd. Pacii 7	1974	RC SW/11/total	3 rescued injured immediately; 26 corpses were recovered by noon of March 5
Comp. Center, Str. Garii de Nord	1968	RC SW + Fr/3/total	
Fac.Chemistry, Splaiul Independentei 87	<1940	URM/5/partial	Damaged by bombing in WW2 (1944) and rebuilt; fire followed in 1977

Notes:
RC-reinforced concrete; Fr- Frames; URM-Unreinforced Masonry; SW-Shear Walls;

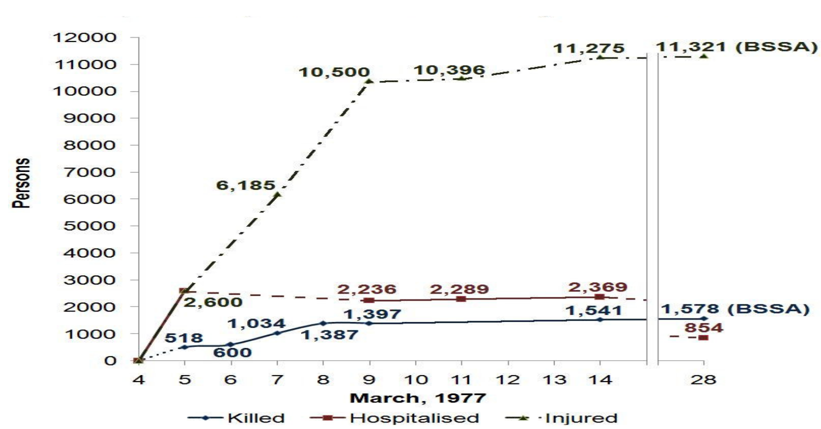
Firemen, Civil Defence, Army, Police, Emergency Medicine specialized teams, miners, volunteers and heavy equipment were deployed to each collapse site. Attorney-prosecutors and forensic medicine doctors were named to assist the recovery and preliminary identification of bodies. According to Udor and Eftene (2007), the Bucharest Firemen Command led the search and rescue operations in the night of March 4, 1977 at 16 collapse sites, each with a General as a head of operations, with 87 officers, 205 military masters and under-officers, 867 soldiers and 111 machines; this work allowed to rescue 110 persons, evacuate an additional 806 and extinguish 71 fires. As a result of intensive work, the emergency state was ceased on March 10, 1977 in the country, but in Bucharest it continued for many more days (e.g. Boulevard Magheru, the main traffic artery in the city centre was closed for more than a week). The Fire Service operations in Bucharest lasted for 30 days (Udor and Eftene, 2007). Pancake collapse pattern was common for the pre-1940 structures, while shear-wall failure and soft-storey were causes for the collapse of the three low-code buildings that had lower levels of volume loss (Fig. 3).

Figure. 3 Full collapse and extreme loss of volume in case of pre-1940 RC structure, Continental Bldg., 1977 (left) and collapse of OD 16 Block Section, 1977 (right).

We estimate that high lethality (>50%) occurred in the main Bucharest collapse sites as the collapse pattern was quite extreme in most of the residential blocks, and chances of survival would have been diminished by the relatively low temperatures during the first and critical night. The information given by Udor and Eftene (2007) also suggests that the lethality in the 16 search and rescue operation sites where most of the 1,424 that died in Bucharest were actually situated was high, as only 110 people were rescued from the rubble.

The number of killed, injured and hospitalised after March 4, 1977 Vrancea earthquake was preliminarily recovered, mostly from press sources, checked for final values with BSSA data, and given in Figure 4.

Figure 4. The number of killed, injured and hospitalised after March 4, 1977 Vrancea earthquake



These data are influenced by the number and patterns of Bucharest casualties, with victims under concrete debris and they are not necessarily simultaneously valid, per each day, as it was a continuous flow of entries and exits from hospitals. To certain extent, the figures provide also an image about the speed of extrication as well as about the ratios between killed and injured. The pattern of injuries was reported by Steiner and Manastireanu (1996) for 6,980 patients, and some 49.7% were treated for surgical and orthopaedic wounds. More details about the geographic distribution of the casualties including those outside Romania during the 1977 earthquake are given in Georgescu and Pomonis (2010).

The 1977 event killed 120 people (Tzenov and Botev, 2009) and injured around 165 in Bulgaria (in the town of Svishtov on the southern shores of the Danube river), most of them caused by the collapse of 4 buildings. It also caused some injuries in Yugoslavia.

Findings and discussion

In terms of preparedness for future Vrancea earthquakes the data recovered and interpreted about human casualties and search and rescue operations after the 1940 and 1977 earthquakes, were primarily related to the collapse of pre-1940 high-rise buildings, especially in Bucharest. Other pre-1977 low-code buildings, with soft-story weaknesses and low-ductility are also a threat and may collapse causing further casualties (though these have a much lower collapse probability). The stock of low-rise and mid-rise old masonry buildings is still numerous in rural Romania and smaller towns in Vrancea, Muntenia and Moldova regions, but their casualty potential is not as great, though it can be a burden for health assistance. The 1940, 1977 and 1986 events took place at night; this circumstance may explain casualty patterns, especially in the case of 1940 and 1977 disasters.

Ratios of injured to killed in overall casualties was close to 2 in 1940 and over 7 in 1977, but for 1940 the number of reported injured may be incomplete. In 1978 a new earthquake code was introduced and subsequently upgraded in 1992 and 2006, significantly reducing the probability of collapse. Structural alterations and aging is an additional concern. Some towns and counties located at large distances from the Vrancea source zone suffered heavy damage and casualties in both 1940 and 1977, but in 1977 the cumulative damage effects, especially in pre-war high-rise structures, partly explains the concentration of damage and casualties in Bucharest. Trans-boundary damage and casualties happened in all four earthquakes, in Moldova, Bulgaria and Yugoslavia.

Concerning the learning from past to prepare for future events, the possible impacts when a next Big-One will strike can be evaluated in terms of management. We are concerned that there remain at least 100 and perhaps as many as 250 collapse candidate buildings in the city of Bucharest and some other cities of south-eastern and north-eastern Romania, some of which have been damaged by the 1940, 1977, 1986 and 1990 earthquakes. Buildings in this category have been registered and signposted by the authorities in Bucharest and other cities but only about 10-15 have been strengthened so far. Many of these are high occupancy buildings and can be candidates to heavy damage and possibly a cause of risk to life. Search and rescue in case of pancake collapse is a difficult task and will require extremely rapid mobilization, heavy equipment in many locations.

For emergency management, the following measures are of greatest importance and will have the greatest mitigation potential:

- strengthening that prevents cumulative damage and collapse, weak-story or overturning, source of heavy casualties, high rates of deaths and injuries; publicly-funded subsidies incl. interim relocation housing for the strengthening or demolition and replacement of buildings that have already been signposted as “high-risk” structures;
- prevent wall and roof collapse in rural weak masonry buildings, where collar beam does not exist;
- training for search and rescue in specific collapse patterns, using advanced instruments for victims detection and equipment for speedy extrication.

The recent disasters from Haiti and Chile (2010) and Christchurch, New Zealand (2011) have again most vividly reminded us the difficulty of intervention in reinforced concrete collapse sites and the reduced chance of finding survivors, after the first 24 hours.

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NEED FOR REGIONAL HARMONIZATION OF VRANCEA SEISMIC HAZARD

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Abstract

The Vrancea subcrustal source, located where the Carpathians Mountains Arch bends, at about 130km epicentral distance from Bucharest, is a source of repeated seismic activity, which affects more than 2/3 of the territory of Romania and an important part of the territories of Republic of Moldova, Bulgaria and Ukraine. Based on the catalogue of Vrancea earthquakes during last millennium, and earthquake records from the March 4, 1977 (moment magnitude $M_W \cong 7.5$, depth $h=109\ km$), Aug 30, 1986 ($M_W=7.2,\ h=133km$) and May 30, 1990 ($M_W=7.0,\ h=91km$) obtained in Romania, Bulgaria and Republic of Moldova, the paper presents the background of the seismic hazard map of Romania and design spectra in new seismic design code P100-1/2006 following Eurocode 8 format. Need for harmonization of national seismic hazard maps from Romania, Republic of Moldova and Bulgaria is emphasized.

Keywords: Vrancea, seismic hazard, Romania, spectra

Vrancea earthquakes catalogues

The catalogues of earthquakes occurred on the territory of Romania were compiled by Radu (1970, 1974, 1980 and 1994 manuscripts published Lungu et al., 1997) and Constantinescu and Marza (1980, 1995). In 1997 Romplus – a version of Constantinescu and Marza catalogue was presented at "First International Seminar on Vrancea earthquakes" and is updated daily on the web site (www.infp.ro) by National Institute of Earth Physics, INFP, Magurele. The most complete Vrancea historical catalogue is Radu Catalogue, even the significant events are also included in Constantinescu and Marza Catalogue. The magnitude in the Radu catalogue is the Gutenberg-Richter magnitude, M.

From the existing catalogues, one may note: during the time interval 984-1900, one event/century with epicentral intensity $I_0 \geq 9.0$ and during the period 1901-2000, two events per century with intensity $I_0 \geq 9.0$ (or magnitude $M \geq 7.2$).

The most powerful Vrancea earthquake is generally accepted to be the 26th of October 1802 event ($M_{G\text{-}R} \geq 7.5$). It was felt on a surface over 2 000 000 km^2 (Popescu, 1941). Strong earthquakes followed on 26th of Nov 1829 and on 23rd of Jan 1838 (maximum seismic intensity 8 ÷ 9).

The Vrancea earthquake with the highest magnitude recorded during 20th century is the Nov 10th, 1940 event ($M_{G\text{-}R}=7.4$).

The most destructive Vrancea earthquake during 20th century was the March 4, 1977 ($M_{G\text{-}R}=7.2$, moment magnitude $M_w=7.5$) earthquake. On this occasion was obtained the first strong ground motion in Romania (on SMAC B Japanese instrument in Eastern Bucharest).

In Figure 1 is presented the Romania seismicity map and seismic regions based on Radulian (2000) proposal.

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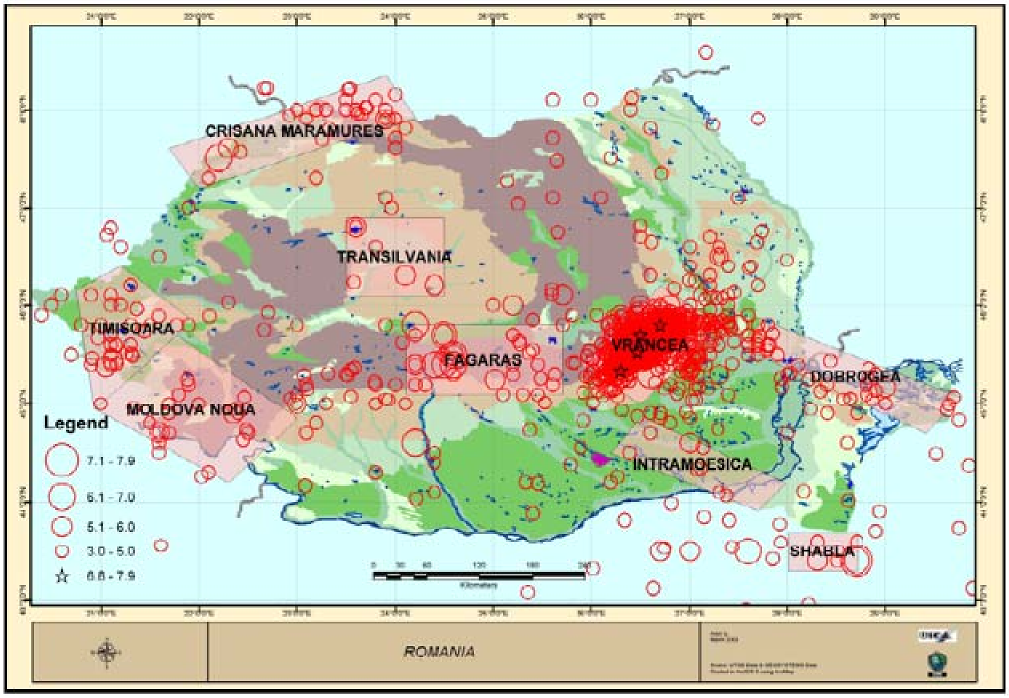

Figure 1. Romania: Location of the epicenters from 984 to 2003 and seismic regions according to Radulian

Vrancea destructive earthquakes in 19th and 20th centuries

<u>1802 and 1838 earthquakes</u>

The 26 Oct 1802 (M_S = *7.4 – 7.7*) earthquake is considered to be the strongest Vrancea subcrustal event; there are no precise information on causalities but some information on damages. The earthquake was felt in Ukraine, Russia, Poland, Bulgaria and Turkey. The event was felt on a total estimated area of more than 2 millions square kilometers.

Table 1. Radu's historical catalogue of major Vrancea subcrustal earthquake, $I_0 \geq 9$ (Radu manuscripts, 1994, published in Lungu *et al*., 1997, 1), 2), 3)

No.	Date		Max MSK Intensity, I_o		Magnitude M_{G-R}		M_s	Radu's source
			Radu	Others	Radu	Others		
1	1196	Feb 13	(8) 8-9	9/CM	(6.7) 7.2	7.0/KS	7.3/CM	RT, R
2	1230	May 10	(8-9) 9+	8.5/CM	(6.9) 7.4	7.1/KS	7.1/CM	RT, R, N
3	1446	Oct 10	8	8.5/CM, 8-9RT	6.7	7.3/KS	7.3/CM	RT, R
4	1471	Aug 29	(8) 9	9/CM, 8-9 KS	(6.9) 7.4	7.1/KS	7.3/CM	RT, R
5	1516	Nov 8	9	9/CM, 8/KS	7.2		6.8/KS	RT, R
6	1620	Nov 8	(8-9) 9	9/CM, 8/KS	(6.9) 7.2	6.5/KS	7.3/CM	RT
7	1679	Ian29?/Aug 9	(8) 6	9/CM	(6.7) 5.5	6.8/KS	7.3/CM	RT
8	1681	Aug 18	9	8/CM	(6.7) 7.4	6.8/KS	6.8/CM	RT
9	1738	May 31/ Jun 11	(8-9) 9	9.5/CM	(6.9) 7.4	7.0/KS	7.5/CM	RT, R
10	1802	Oct 26	9	10/CM	7.5	7.4/KS	7.7/CM	R
11	1838	Jan 23	8	9/CM	6.7	6.9/KS	7.3/CM	R

1) Source abbreviations: R - Radu, C., 1971, 1974 catalogues; RT - Radu, C., Torro, E., 1986 catalogue; N - Nikonov catalogues; CM - Constantinescu and Marza, 1980 catalogue; KS - Kondorskaya N. V., Shebalin N.V., 1977 catalogue; 2) Focus depth h is considered as intermediate depth: $60 \leq h \leq 170$km; 3) The intensity in parenthesis indicates the previous estimations made by Radu (1980).

The 23 Jan 1838 (M_S = *6.9 – 7.3*) earthquake was felt on an extended area in Europe: Ukraine, Poland, Bulgaria, up to Constantinople and to NE of Italy.

1940 earthquake

"The November 10, 1940 earthquake put damages all around Romania and throw the people in mourning", Comptes Rendus des Séances de l'Académie des Sciences de Roumanie, 1941, Fig.2. The earthquake was felt on about 2 millions square kilometers: from East (Odessa, Cracovia, Moscow were the estimated intensity was V-VI) to north up to Leningrad, to West up to Tissa river and in South in Yugoslavia and all Bulgaria up to Istanbul.

In Bucharest the most significant damage from the Nov. 10, 1940 earthquake ($M_{G\text{-}R}$ = 7.4) was the complete collapse of Carlton building (Fig. 3), the highest RC building (47m, 12 storeys) in Romania at that moment.

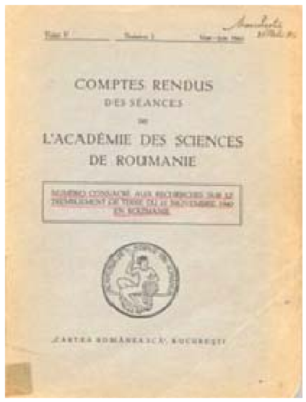

Figure 2. Comptes Rendus des Séances de l'Academie des Sciences de Roumanie, 1941

Figure 3. Carlton building in Bucharest, collapsed during 1940 earthquake

After 1940 earthquake were identified two zones of maximum intensity in Romania: one is in the area of Panciu and Focsani (epicentral area) and the second one in Romanian Plain, from Campina to Bucharest. In those areas the seismic intensity was over VIII on Mercalli-Sieberg scale, and close to IX in Campina, Focsani, Tecuci, Beresti, and about X in Panciu.

Table 2. 20th century strong Vrancea earthquakes, $M_{G\text{-}R}$ *or* $M_s \geq 6.0$ (Lungu & Aldea, 2000)

No.	Date	Lat. N°	Long. E°	Focus depth *h* km			Magnitude[3)]			
							M_s	M_w	$M_{G\text{-}R}$	M_w
				Radu	Marza	infp.ro	Marza	infp.ro	Radu	[1)]
1	*1903* Sep 13	45.7	26.6	*≥60*	70	70	5.7	6.3	*6.3*	6.6
2	*1904* Feb 6	45.7	26.6	*≥60*	75	75	6.3	6.6	*5.7*	-
3	*1908* Oct 6	45.7	26.5	*150*	125	125	6.8	7.1	*6.8*	7.1
4	*1912* Mai 25	45.7	27.2	*80*	90	90	6.4	6.7	*6.0*	6.3
5	*1934* Mar 29	45.8	26.5	*90*	90	90	6.3	6.6	*6.3*	6.6
6	*1939* Sep 5	45.9	26.7	*115*	120	120	6.1	6.2	*5.3*	-
7	*1940* Oct 22	45.8	26.4	*122*	125	125	6.2	6.5	*6.5*	6.8
8	*1940* Nov 10	45.8	26.7	*133*[2)]	135[2)]	150	7.4	7.7	*7.4*	7.7
9	*1945* Sep 7	45.9	26.5	*75*	80	80	6.5	6.8	*6.5*	6.8
10	*1945* Dec 9	45.7	26.8	*80*	80	80	6.2	6.5	*6.0*	6.3
11	*1948* Mai 29	45.8	26.5	*140*	130	130	6.0	6.3	*5.8*	-
12	*1977* Mar 4	45.34	26.30	*109*	-	94	7.2	7.4	*7.2*	7.5
13	*1986* Aug 30	45.53	26.47	*133*	-	131	-	7.1	*7.0*	7.3
14	*1990* Mai 30	45.82	26.90	*91*	-	91	-	6.9	*6.7*	7.0
15	*1990* Mai 31	45.83	26.89	*79*	-	87	-	6.4	*6.1*	6.4

Notes: 1) $M_w \cong M_{G\text{-}R} + 0.3$ for $6.0 \leq M_{G\text{-}R} \leq 7.4$ (Lungu, 1999)
2) In present the value accepted for focus depth for Nov.10, 1940 event is *h*=140km
3) Magnitudes: $M_{G\text{-}R}$ - Gutenberg-Richter Magnitude, M_S – surface waves magnitude, M_W - moment magnitude.

No realistic estimation of the number of deaths was reported. Some authors indicated the following numbers: >1000 (Beles, Ifrim, 1962; Coburn & Spence 1992), 980 (EM-DAT: The

OFDA /CRED International Disaster Database.

1977 earthquake

The March 4, 1977 ($M_{G\text{-}R}$ = 7.2) was the most destructive earthquake in the history of Romania. International experts dispatched in Romania in the aftermath of the earthquake reported as follows.

"The unusual nature of the ground motion and the extent and distribution of the structural damage have important bearing on earthquake engineering efforts in the United States." Jennings & Blume, NRC&EERI, Washington.

"It mostly affected the densely populated and rapidly developing centres of Craiova, Pitesti, Zimnicea, Bucharest, Ploiesti, Focsani, Barlad" Ambraseys, N.N., 1977..

The 1977 earthquake killed 1,578 people (1,424 in Bucharest) and injured 11,221 people (7,598 in Bucharest). According to the World Bank (Report 16.P-2240-RO, 1978) the total losses in Romania worth 2.05 billion (1977) USD.

Vrancea source: seismic records and attenuation relationship

The first strong ground motion recorded in Romania was obtained in Eastern Bucharest, at seismic station of INCERC on a Japanese SMAC - B instrument during 1977 event. The ground motion was digitized and analysed by Building Research Institute, Ministry of Construction, Japan, (1978).

The unusual 1977 record, characterized by a long predominant period of ground vibration, $T_p \cong 1.6s$, has been used for calibrating design response spectra in Romanian seismic codes during the period 1977-1992 when almost 40% of Bucharest buildings stock has been built. A significant ground motion database of more than 80 records was collected during the 1986 and 1990 earthquakes.

The peak ground acceleration recorded in Romania during the last 3 strongest Vrancea events in Romania are interpolated in Fig.4 and shows the NE-SW directivity of the subcrustal Vrancea source, as it has been firstly observed by Montessus de Ballore, 1906.

The database of Vrancea strong ground motions contains records from 47 free-field stations in Romania distributed on networks and events. The "free field" accelerograms were obtained at the ground level or the basement of 1 - 2 storey buildings. The distribution of the recorded accelerograms is given in Table 3. Based on the very important conclusions from 1977, 1986 and 1990 earthquakes, the seismic instrumentation of Bucharest has been recently extended and improved by various national and international efforts. Presently Romania has more than 100 digital K2 & ETNA Kinematrics instruments, about half in Bucharest, distributed in three seismic networks: INCERC, INFP and NCSRR (National Center for Seismic Risk Reduction).

Table 3. Distribution of the free field accelerograms used in the attenuation analysis

Seismic network	Romania			Rep Moldova	Bulgaria	Total
Earthquake	*INCERC*	*INFP*	*GEOTEC*[1)]	*IGG*[2)]		
March 4, 1977	1	-	-	-	-	1
Aug. 30, 1986	24	8	3	2	-	37
May 30, 1990	23	10	2	2	5	42
Total	48	18	5	4	5	80

1)GEOTEC, Institute for Geotechnical and Geophysical Studies, Bucharest

2)IGG, Institute of Geophysics and Geology, Moldavian Academy of Science, Chisinau

The distributions of maximum *PGA* with epicentral distance and corresponding earthquake magnitudes are presented in Figure 5.

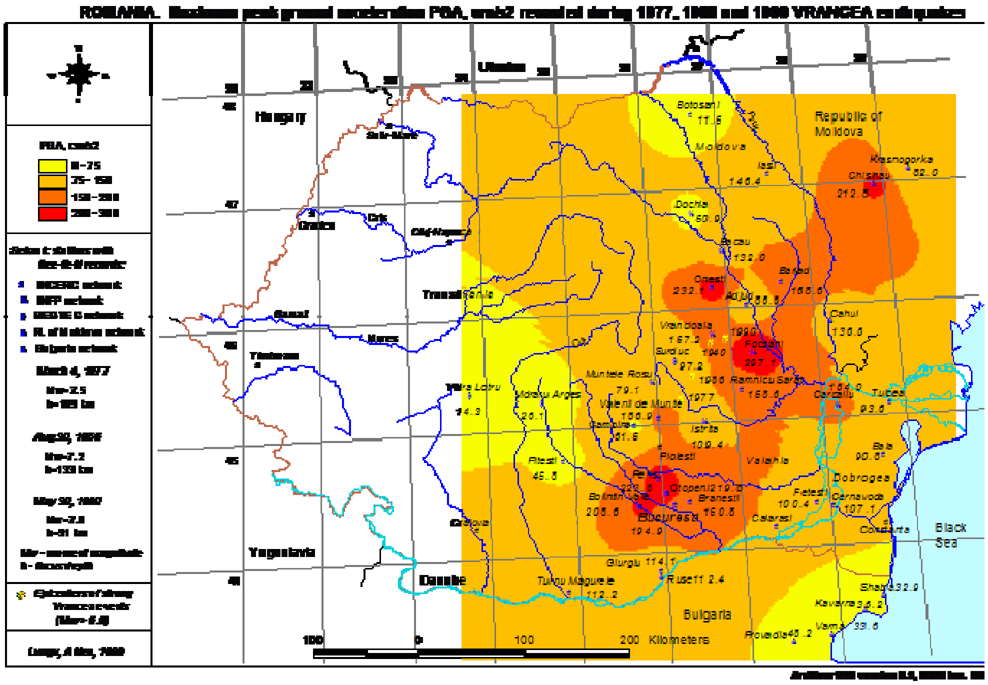

Figure 4. Maximum recorded peak ground acceleration during the last Vrancea strong events

The maximum of the two horizontal components of the ground motions was considered for *PGA* attenuation. The following attenuation model was selected :

$$ln\ PGA = c_0 + c_1 M_w + c_2 \ln R + c_3 R + c_4 h + \varepsilon \qquad (1)$$

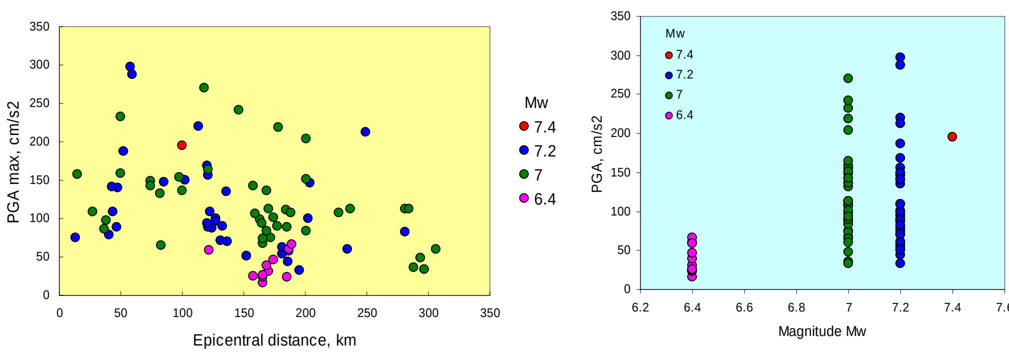

Figure 5. Distribution of *PGA* with epicentral distance and magnitude for Vrancea source

where: *PGA* is peak ground acceleration at the site, M_w- moment magnitude, *R* - hypocentral distance to the site $R = \sqrt{h^2 + \Delta^2}$, *h* - focal depth, c_0, c_1, c_2, c_3, c_4 - data dependent coefficients and ε - random variable with zero mean and standard deviation $\sigma_\varepsilon = \sigma_{ln\,PGA}$. The coefficients obtained from the regression are as follows [Lungu, Demetriu *et al.*, 1999]: c_0 = 3.098, c_1 = 1.053, c_2= -1.000, c_3=-0.0005, c_4=-0.006, σ_{lnPGA} =0.502.

Magnitude recurrence

The classical recurrence relationship was modified into the truncated Gutenberg-Richter relationship that for Vrancea source gives [Elnashai & Lungu, 1995]:

$$n(\geq M_w) = e^{8.654-1.687M_w} \frac{1-e^{-1.687(8.1-M_w)}}{1-e^{-1.687(8.1-6.3)}} \qquad (2)$$

In *Eq.(2),* the threshold lower magnitude is $M_w=6.3$, the maximum credible magnitude is $M_{w,max}=8.1$, and $\alpha = 3.76\ ln10 = 8.654$, $\beta = 0.73\ ln10 = 1.687$, Figure 6.

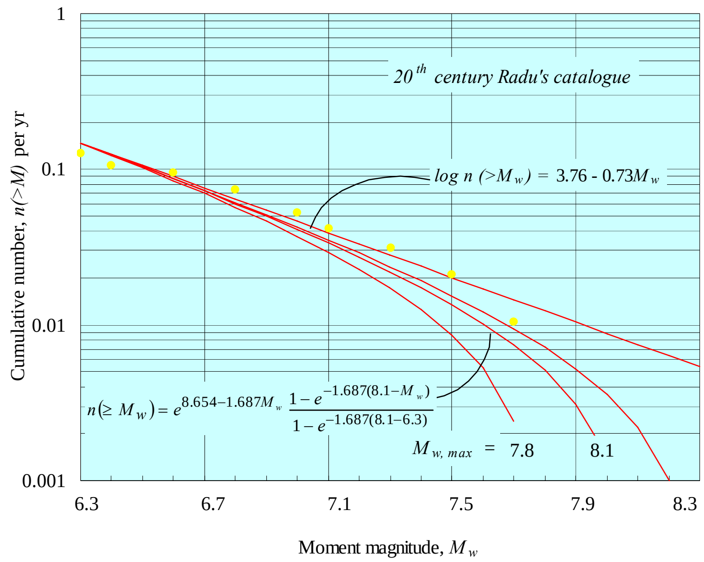

Figure 6. Magnitude recurrence relation for Vrancea subcrustal source ($M_w \geq 6.3$)

The relationship between the magnitude of a potentially destructive Vrancea earthquake ($M_w \geq 6.3$) and the corresponding focal depth shows that higher the magnitude, deeper the focus [Lungu et al., 1997]:

$$ln\ h = -\ 0.866 + 2.846\ lnM_w - 0.18\ P \quad (3)$$

where P is a binary variable: $P=0$ for the mean relationship and $P=1.0$ for mean minus one standard deviation relationship.

Seismic macrozonation and codes for earthquake resistance of structures in Romania

The first seismic zonation of Romania was done after the 1940 Vrancea earthquake. The 1941 zonation map contains two areas: one seismic area (Moldova, Valachia and Brasov area) and a second one considered as being not seismic (the remaining part of Romania). A.Cismigiu and E.Titaru wrote the first modern Romanian code for seismic design of buildings in 1954, but the first official regulation appeared only in 1963.

In Figure 7 is illustrated the present seismic zonation of Romania, Bulgaria, Ukraine and Republic of Moldova. The general pattern of the map (which is based on deterministic macroseismic observations) as well as the content of the table describing the conversion of seismic intensity into ground acceleration is self-explanatory. They clearly suggest the need for harmonization of seismic macrozonation maps and prove the need for a joint zonation of the seismic hazard in the influence area of the Vrancea source.

Table 4 presents the evolution of the seismic zonation and seismic design codes for buildings in Romania during the last 50 years. The P100-1/2006 Code for earthquake-resistant design of buildings - Part 1 (244p), was approved by Ministry of Transportation and Constructions order No.1711/19.09.2006 and it was enforced on Jan 1, 2007.

After the 1977 event, ductility rules for RC structures were imported into Romanian codes from American Concrete Institute ACI code of practice. Ductility rules were improved and enlarged in 1990/1992. The P100-1/2006 code follows ductility and provisions according to the EUROCODE 8 requirements. The evolution of normalised acceleration response spectra in the listed codes is indicated in Fig. 8.

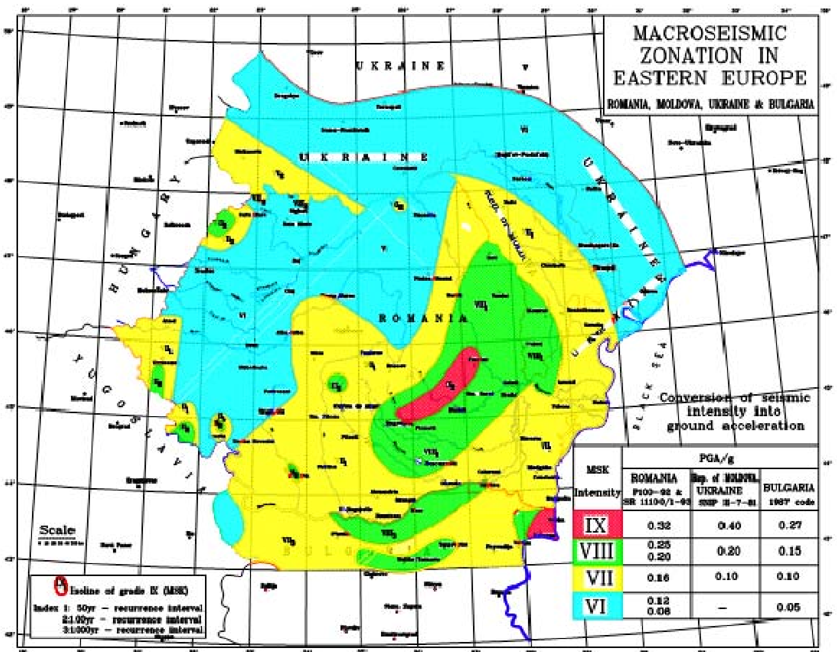

Figure 7. Macroseismic zonation for Vrancea source

Table 4. Classification of codes for design of earthquake resistant buildings and of standards for seismic zonation of Romania (1940-2008)

Period		Code for earthquake resistant buildings	Seismic zonation standard
Pre-code, before 1963	Prior to the 1940 earthquake and Prior to the 1963 code	*P.I. - 1941* *I - 1945*	*P.I. – 1941* *I – 1945* *STAS 2923 - 52*
Low-code, 1963-1977	Inspired by the Russian seismic practice	*P 13 - 63* *P 13 - 70*	*STAS 2923 - 63*
Moderate-code, 1977–1990	After the great 1977 earthquake	*P 100 - 78* *P 100 - 81*	*STAS 11100/1 - 77*
Moderate-code to High-code, after 1990	After the 1986 and the 1990 earthquakes	*P 100 - 90* *P 100 - 92*	*STAS 11100/1 - 91* *SR 11100/1 - 93*
High code, after 2006	Inspired by Eurocode 8	*P100 –1/2006*	*In P100 –1/2006 code*

New Romanian seismic design code P100-1/2006

Based on the results of probabilistic seismic hazard assessment from Vrancea source and taking into account the macroseismic fields from the crustal seismic sources in Romania, in Fig. 9 is presented the seismic hazard map from P100-1/2006 earthquake resistant design code, enforced from January 1st, 2007. The map presents the design ground acceleration (*PGA*) for a seismic event with mean recurrence interval *MRI*=100 years. The *MRI*=100 yr represents a transition *MRI* towards the *MRI*=475years recommended by Eurocode 8 & ASCE7. Certainly the next version of *P100* code (under work), will introduce 475yr-*PGA* for design in Romania. For Bucharest, the *PGA* having 475 yr recurrence interval is about 0.32g.

In the P100-1/2006, the ground conditions are characterized by the control period of response spectra T_C. The T_C macrozonation in the P100-1/2006, Figure 10, is based on processed ground motion from 1977, 1986 and 1990 events records. The studies made on the complete database of strong motion accelerograms of Romania [Lungu et.al., 2000] showed that the control period of response spectra T_C is reliable indicator for characterizing the frequency content of ground motions.

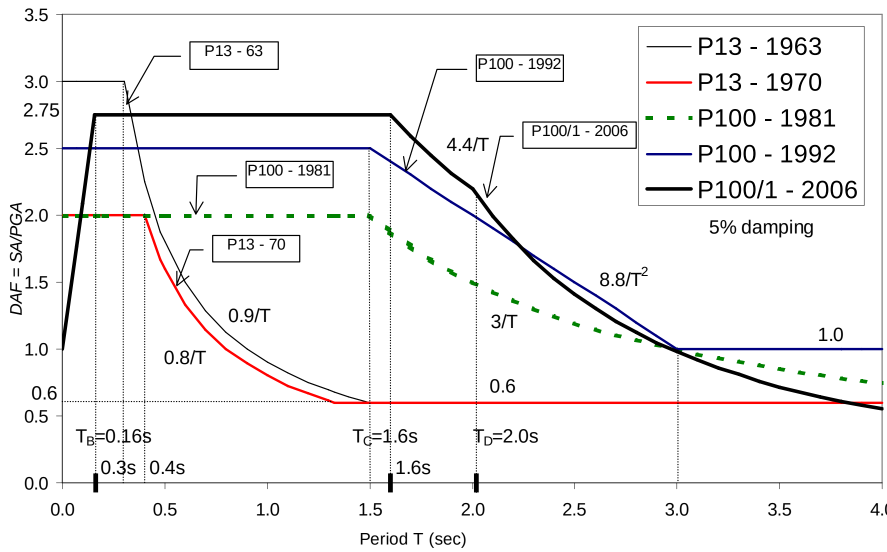

Figure 8. Normalized acceleration elastic response spectra in Bucharest, 1963 – 2000

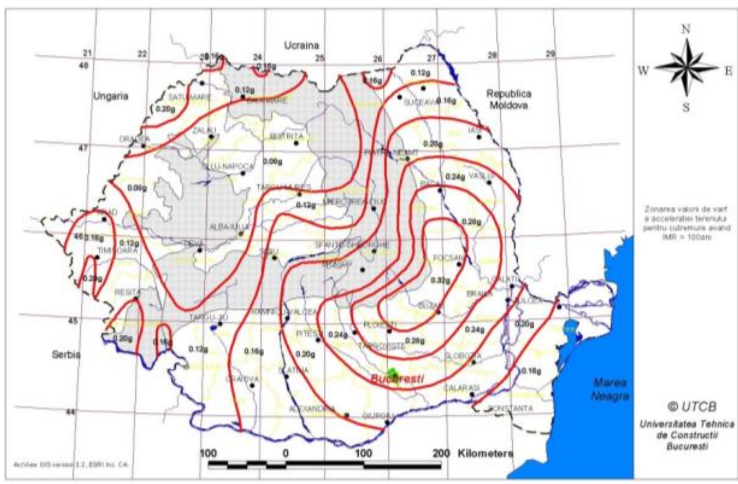

Figure 9. P100–1/2006 design ground acceleration a_g, for a seismic event with *MRI*=100 yr.

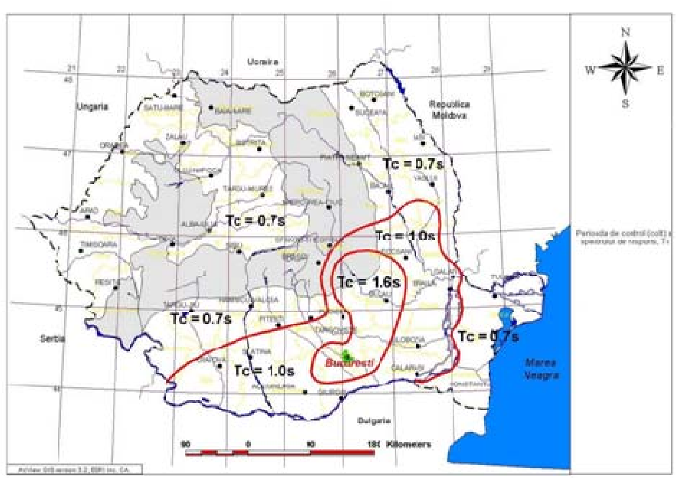

Figure 10. Zonation of the Romanian territory in terms of control period (corner period) T_C of the response spectrum

For each T_C area zones in Figure 10, a normalised acceleration elastic response spectrum is recommended (EC8 format), Fig. 11.

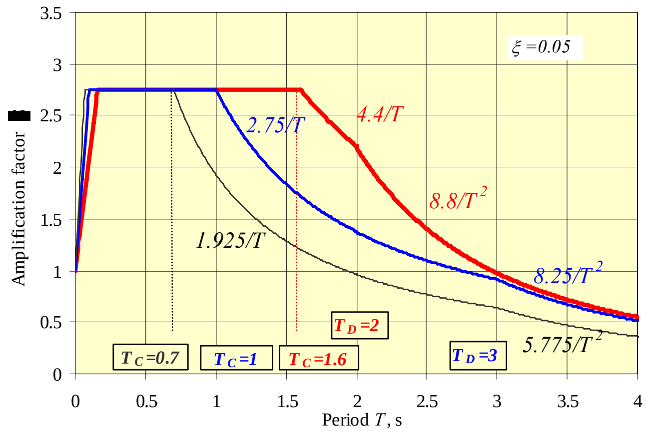

Figure 11. P100-1/2006 - Normalized acceleration response spectra for horizontal ground motion

A direct characterization/classification of ground conditions based on soil data (soil profile and shear velocities profile) is not yet possible due to the lack of soil data correlated with recorded strong ground motions. The few cases where such information exists (i.e., soil data and earthquake records) showed that imported criteria and corresponding design spectra from other countries are not valid in the area under the influence of Vrancea source [Lungu et al., 2002, Aldea, 2002]. In Annex A, P100-1/2006 recommends site-specific soil investigation for buildings belonging to class 1 of importance-exposure, and introduce a $\overline{V_{S,30}}$ site classification (as in EC8).

Using recent PS logging results the average shear wave velocities in the top 30 meters of soil, are presented in Fig. 12 for Bucharest.

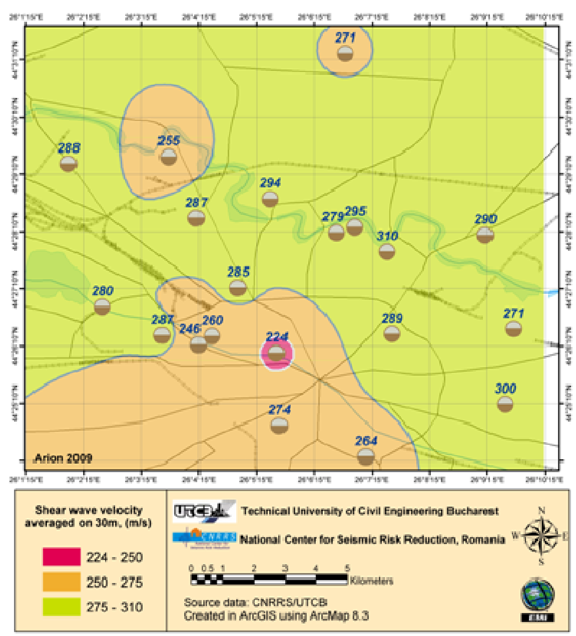

Figure 11. Bucharest. Microzonation map for shear wave velocity (m/s) averaged on 30m

Conclusions

The P100-1/2006 code was developed at Technical University of Civil Engineering, Bucharest in 2004 for the Ministry of Transports, Constructions and Tourism, it has been published in the Oficial

Gazette of Romania no. 462/2005, and it was enforced from Jan 1st, 2007. The present version of the code uses a transition definition of seismic action with *MRI=100years* instead of *MRI=475years* (as required by EUROCODE 8) and, due to the lack of ground data, it includes design spectra for regions characterized by different control (corner) period of response spectra T_C.
There is a clear need for harmonization of seismic macrozonation maps and prove the need for a joint zonation of the seismic hazard in the influence area of the Vrancea source.

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Biography

Dr. Alexandru Aldea is associate professor of structural reliability and risk analysis at Technical University of Civil Engineering in Bucharest. He got his Ph.D. in Civil Engineering (seismic hazard) in 2002 from the same University. From 2002 to 2010 he was the head of the National Center for Seismic Risk Reduction seismic network.

MASSIVE GLOBAL DAMAGE ASSESSMENT PROGRAM AND ONGOING RECONSTRUCTION STRATEGY IN HAITI IN THE AFTERMATH OF THE 2010 EARTHQUAKE

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Keywords

2010 Haiti Earthquake, damage assessment, database, damage classification, reconstruction

Abstract

The January 2010 Haiti Earthquake resulted in over 230,000 deaths, affected 3,000,000 people, caused the collapse or damage of over 200,000 structures. The Haitian Ministry of Public Works, Transport, and Communications—in coordination with the United Nations Office of Project Services, Pan American Development Foundation, World Bank, and U.S. Agency for International Development—undertook an unprecedented earthquake damage assessment project. The project has three major strategic goals: (1) rapid damage assessment; (2) reconstruction database development; and (3) upgrading technical capabilities of Haitian engineers. A modified ATC-20 technical platform, accounting for Haitian buildings, was developed. Personal digital assistant–based data collection techniques and quality-control quality assurance programs were implemented. Approximately 250 Haitian engineers were trained to conduct the surveys. Of over 360,000 structures assessed, 54%, 26%, and 20% were classified as safe (green-tagged), limited entry (yellow-tagged), and unsafe to enter (red-tagged), respectively. This database was next used to develop repair assessment of yellow-tagged structures using and to prepare a reparability/reconstruction/demolition assessment of red-tagged structures. This program could be extended as a platform for seismic damage evaluation and reconstruction strategies to other parts of the world.

Introduction

The 2010 Haiti Earthquake affected the lives of more than 3 million people. This paper presents the work performed by The Haitian Ministry of Public Works, Transport, and Communications (MTPTC) with assistance from international organizations, to assess the safety and reparability of the affected building inventory in Port-au-Prince and the affected communities.

In light of the enormity of the damage caused by the earthquake, the MTPTC developed the Bureau d'Évaluation Technique des Bâtiments (BETB), charged with the task of assessing damage to all buildings in the earthquake-affected areas, developing a criterion for repair and reconstruction, and providing quality control during reconstruction. With funding provided by

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the World Bank (WB), and U.S. Agency for International Development (USAID), field logistics provided by United Nations Office of Project Services (UNOPS), and The Pan American Development Foundation (PADF), and technical expertise provided by the authors, (Miyamoto International) (MI); the BETB embarked on an ambitious program to organize and train a cadre of approximately 250 Haitian national engineers to perform rapid evaluation of all affected buildings using the internationally accepted ATC-20 (ATC 2005) and FEMA 310 (FEMA 1998) methodology.

The authors led an intense four-day classroom session on the fundamentals of earthquake engineering and assessment for more than 600 applicants. Course work was followed by a written examination, from which approximately 250 candidates were selected as evaluators. Among these, 10 of the most qualified were selected as division leaders. Each division consisted of a division leader, four team leaders, and eight to ten evaluators, all taken from the ranks of the 250 trainees.

2010 Haiti Earthquake

The magnitude 7.0 Haiti Earthquake occurred at 1653 local time on Tuesday, 12 January 2010, with an epicenter located approximately 25 km west-southwest of the densely populated capital city of Port-au-Prince. This event caused shaking of Modified Mercalli Intensity (MMI) X in the city; see Figure 1 (USGS 2010). In the two weeks following the main event, at least 52 aftershocks in the magnitude range of 4.2 to 5.9 on the Richter scale were recorded.

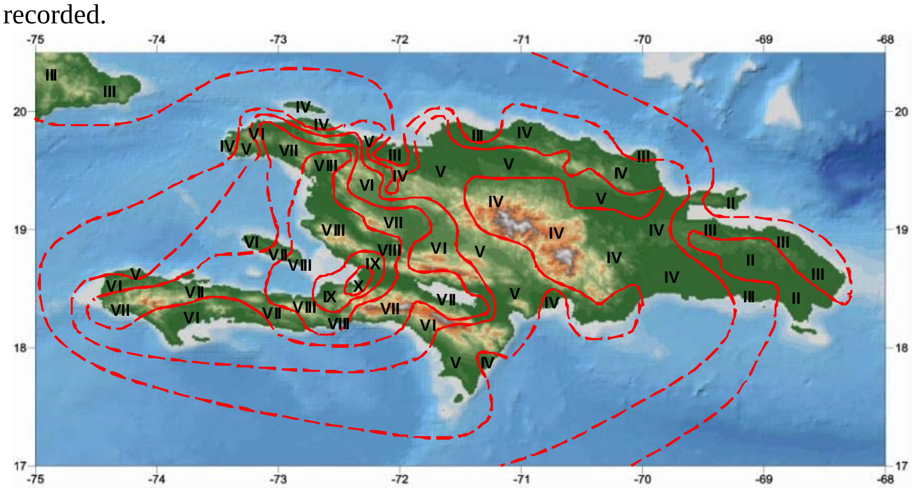

Figure 1. MMI Shaking In Haiti (USGS 2010)

The earthquake caused major damage to Port-au-Prince and the surrounding cities around the region. More than 200,000 structures had suffered damaged or had collapsed, including many essential buildings, most notable, the Presidential Palace, National Assembly Building, Port-au-Prince Cathedral, and the main Port-au-Prince jail. The headquarters of the United Nations Stabilization Mission in Haiti (MINUSTAH) also collapsed, killing many workers, including the mission's chief.

The Haitian government reported that more than 230,000 people died, 300,000 were injured, and 1.3 million were made homeless by the earthquake. Six months after the earthquake, more than 1.3 million people still lived in temporary camps many of which offer only minimal services and protection from natural hazards such as hurricanes, floods, and landslides

Primary Causes of Observed Damage

This earthquake caused devastation that was significantly disproportional to its magnitude. If any resemblance of an international seismic design and construction had been implemented in

Haiti, much of the life and economic loss could have been avoided. Observed factors that exacerbating this tragedy were the following:

- In Haiti, design and construction practices did considered earthquake forces. In addition, many engineers and contractors had neither education nor experience in any form of earthquake-resistant design methodology.
- Haiti lacked a seismic code.
- The past decade has seen rapid growth of low-income neighbourhoods because of migration into the city from outlying areas. In these neighbourhoods, unsafe housing had been built using substandard construction materials and practices.

The majority of the structures in Haiti are of a specific building type that is very susceptible to seismic damage. This building type used a variation of confined masonry construction comprising weak hollow concrete blocks (HCBs) with lightly reinforced and nonductile beams and columns. Minimal foundation design consideration was observed.

Damage assessment

Methodology

The evaluation method chosen for the damage assessment program was the ATC-20 (ATC 2005) Rapid Assessment Form; modifications were made to adapt the form to Haitian conditions and to provide more useful information to the MTPTC. This methodology, which was first developed in California in the 1980s, has been used successfully for evaluation after many major earthquakes in the United States, such as after the Loma Prieta earthquake of 1989 and the Northridge earthquake of 1994. The Rapid Assessment Form allows evaluators to characterize buildings in one of three ways: “Inspected” (also known as “green-tagged”), meaning that the building is structurally acceptable and may be occupied full-time; “Restricted Entry” (or “yellow-tagged”), meaning that the building should not be occupied for extended periods and that parts of the building might be considered off-limits; or “Unsafe” (or “red-tagged”), meaning that the building cannot be safely inhabited. The form was modified to provide evaluators with a checklist of Earthquake Vulnerability Factors per FEMA 310 (FEMA 1998), which has allowed evaluators to list the features of each structure that would make it more prone to earthquake damage.

One important consideration that was stressed to the evaluators is that while the three-color evaluation system provides an understanding of the hazard associated with a building at the time of the evaluation, it does not state whether a building must be demolished. Some buildings given “Unsafe” ratings are considered repairable, but the nature of the damage has rendered them hazardous to occupy until repairs can be completed. In the same way, the “Inspected” rating does not guarantee that a building will not be seriously damaged in the event of future earthquakes. If another major event of equal or greater magnitude were to take place along a section of the fault closer to the city, damage would in all likelihood be much more widespread. In general, the nature of local design and construction in Haiti is such that nearly all buildings can be considered seismically hazardous.

One key feature of the process has been the use of Personal Digital Assistant (PDA)s with Global Positioning System (GPS) capability to aid in performing the evaluations. The PDAs are preloaded with the modified ATC-20 Damage Assessment Form, and evaluators fill out the forms electronically during the course of each assessment. At the end of the day, all information from the more than 150 PDAs is uploaded on to a main server. Because some of the street layout of Port-au-Prince is unmapped and many residences have no addresses, the GPS coordinates of each structure have been used as the primary means of identification. The use of GPS has also proved to be an invaluable tool in developing overall damage maps and a reconstruction strategic plan.

Evaluations have been performed systematically, with each division given the responsibility to evaluate all the structures in a given zone each day. Zones are determined by MTPTC using aerial maps, which are updated daily to show the status (green, yellow, red) of each evaluated structure. As each zone is completed, new ones are assigned.

As the program evolved, and as additional funding became available through USAID and PADF, the original 10 teams were expanded to 17. With all 17 teams working at capacity, it was possible to assess more than 3,000 structures daily. The initial target of 100,000 structures evaluated was met on 31 May 2010, and by 15 June 2010, 132,662 buildings had been assessed.

<u>Typical Building Properties</u>

Although the buildings observed have displayed a wide variety of sizes, virtually all were constructed using a similar structural system: a cast-in-place concrete gravity frame with unreinforced HCB infill panels acting as incidental infill shear walls.

In such structures, the concrete floor and roof slabs are supported by lightly reinforced concrete columns, sometimes as small as 150 mm on one side. Floor and roof framing consists in some cases of a grid of concrete joists framing between the beams; voids between the joists are formed using HCBs as stay-in-place forms. Exterior wall cladding and interior partition walls universally consisted of HCBs joined with cement mortar. These infill wall panels effectively served as the seismic-force-resisting system; however, there has typically been no evidence of any system intentionally designed for that purpose. Buildings typically have lacked a seismic load path; in other words, they do not appear to have a system by which inertial forces generated in one portion of the structure could be transferred to other parts of the structure and then to the ground. In seismic zones, this load path commonly comprises diaphragms, collector elements such as chord and drag reinforcing, special vertical reinforcing at shear wall corners, and doweling between the walls and surrounding elements. None of these were observed in the vast majority of buildings.

Concrete gravity frames have displayed numerous design and construction practices that would be considered defective by international standards, particularly in seismic zones. Figure 2 through Figure 5 show some of the common seismic deficiencies.

Figure 2. Beam With Exposed Reinforcement.

Figure 3. Poor Concrete Consolidation in Column

Figure 4. Overhanging Upper Floor

Figure 5. Poor Workmanship in Unreinforced HCB Wall

Observed Deficiencies of Reinforced Concrete Members

The design deficiencies include the following:

- Use of smooth reinforcing bars. Typically these were sized at 6 mm diameter.
- Lack of column confinement reinforcing. Where confinement ties were observed, the ties were loosely spaced and were of the wire variety.
- Inadequate lap splices and rebar development.

The construction defects consist of the following:

- Segregation, voids, and rock pockets evident in finished concrete, particularly in columns and at construction joints
- Exposed rebar, poor aggregate shape and grading
- Poorly located construction joints, and paper and other debris left in joints; formwork embedded in finished concrete
- Out-of-plumb columns.

Observed Deficiencies of Masonry Construction

Typical Haitian masonry construction had numerous defects, including irregular coursing, missing or inadequate vertical mortar joints, inadequate horizontal joints, poor material quality, and extensive use of broken block. These conditions have been commonly found in nearly all buildings, regardless of age, size, or number of stories. These design and construction practices led to a combination of heavy buildings with little lateral strength and essentially no post-yielding capacity, and were key factors in the vast majority of failures observed.

Building damage survey and analysis

By 15 June 2010, 130,000 buildings have been assessed. The damage from this population sample is presented in this paper. Data from the complete population sample of 410,000-surveyed building is currently being analyzed and the results will be presented at a later date.

Summary data

Table 1 summarizes the number and the median (50th percentile) damage estimate for the population sample. As indicated in the table, the median damage estimate for buildings in all assessment categories was in the 1% to 10% damage range. Forty-eight percent is building stock that is undamaged and safe to use. Twenty-eight percent has moderate damage and most likely can be repaired. These numbers are significant, because they indicate that 76% of buildings affected by the earthquake can be immediately occupied or repaired with relative ease.

The majority of damaged and collapsed buildings are localized in the low-lying districts west of the airport, which includes downtown Port-au-Prince, Nazon, Turgeau, Canape Vert, Carrefour, and the lower portion of Delmas. By contrast, more southerly and easterly regions, in particular Juvenat and Pétionville, suffered much lighter damage. The difference in damage levels is mainly a result of soft-soil amplification. Softer soil is found in many of the highly-damage areas.

Table 1. Summary Data For Damage Assessment.

Category	Green- tagged	Yellow- tagged	Red- tagged
Number of structures	62,000	36,000	32,000
Percentage	48%	28%	24%
Median damage estimate	0–1%	1–30%	60–100%

<u>Damage classification</u>

By far, the most common damage observed among the buildings evaluated has been cracking or collapse of the HCB walls, which is a natural consequence of both the lack of reinforcing and poor material quality, (see Table 2). Among the buildings evaluated, moderate or serious wall cracking was cited in nearly 56,000 cases. Wall collapse was noted in slightly more than 40,000 cases. Cracking was observed to be most widespread in the lower levels of multi-storey buildings, where shear forces were the highest. The next most common damage mode was either cracking or crushing failure of concrete columns. Soft-story conditions were observed to be a major contributor to column bending and shear failures.

Table 2. Damage Types Found In Greater Port-au-Prince Area.

Damage Classification	Moderate	Serious
Column cracking or spalling	15,468	15,762
Slab, beam, joist cracking or spalling	12,360	11,715
Ground movement or cracking	12,124	6,204
Exterior, interior wall collapse	20,952	19,536
Exterior, interior wall cracking	30,207	25,711
Parapet, canopy, deck, stair damage	10,479	10,281

<u>Damage by building occupancy</u>

Overall damage did not vary significantly between building occupancies, but some trends can be seen from the data. The vast majority of buildings evaluated, nearly 95%, were residential structures. These structures varied widely in quality of construction, and ranged from large, engineered mansions to improvised shacks. Table 3 presents the distribution of damage for various building occupancies. Examination of data in this table shows the following:

- Commercial/industrial, healthcare, and civic buildings, which are often larger engineered structures, had better performance overall, with 52% to 57% of these building types being green-tagged, as opposed to 48% for single-family housing.
- The performance of essential facilities such as hospitals and public-safety facilities was not adequate. In healthcare, for example, the damage rate corresponds to a loss of healthcare capacity of approximately 44% immediately after the earthquake, a time when this capacity is needed most.
- The best overall performance (as measured by the largest percentage of green-tagged buildings) was experienced not by essential facilities (such as hospitals and police and fire stations), but by commercial/industrial facilities.

- One alarming finding was that one of the worst performance among occupancy types was experienced by schools with only 44% of the structures being green tagged.

Table 3. Damage Classification For Various Occupancy Types.

Building Occupancy	Green-tagged	Yellow-tagged	Red-tagged
Single-family residential buildings	48%	27%	25%
Multifamily residential buildings	45%	32%	23%
Schools	44%	34%	22%
Healthcare buildings	56%	25%	19%
Civic/public-safety facilities	52%	30%	18%
Commercial/industrial facilities	57%	24%	19%
Other	51%	32%	17%

Damage by number of stories

In general, among the structures evaluated, building performance (as measured by the percentage of red-tagged structures in each group) was progressively worse as building height increased, and tall buildings were much more prone to severe damage. Of the buildings that were four stories or more in height, 44% were red-tagged; versus 24% for one-story buildings. In other words, the potential for catastrophic failure or collapse is almost twice as high for four-story or taller buildings than for one-story buildings.

Table 4. Damage Classification For Various Number Of Stories.

Building Occupancy	Green-tagged	Yellow-tagged	Red-tagged
One	49%	27%	24%
Two	46%	29%	25%
Three	36%	29%	35%
Four and more	30%	26%	44%

Yellow-tagged building repair

A significant number of buildings with HCB and masonry construction have suffered HCB cracking damage. The preferred repair method is placing of horizontal and vertical reinforcement in the HCB walls, and using superior concrete mortar mix and masonry blocks. This is one of the procedures discussed in ASTM (1993). This method was selected as the primary approach for the repairing of failed HCB due to good earthquake performance, economic benefits, and the presence of locally available labor and material for implementation. To demonstrate its efficacy, a sample zone has been selected and is undergoing reconstruction before the effort is extended to broader areas of the country.

The assessment of data shows that approximately 27% are classified as yellow-tagged. These structures must be repaired expediently using safe earthquake engineering techniques to help reduce the number of people living in temporary camps.

Unfortunately, there is ample evidence of reconstruction and repair of these collapsed or damaged structures using pre-earthquake, unsafe methods. Such an approach would place the lives of the citizens of Haiti at risk again in the event of another large earthquake. Therefore, it is imperative to use an improved and safe repair and reconstruction plan that focuses on techniques, quality-control quality assurance (QC-QA), and an approval and review mechanism to reduce future life-safety risk. The proposed plan comprises the following components:

- Develop cost-effective and simple repair methodologies for typical residential buildings. The platform uses the existing research undertaken at leading technical research institutes that focus on these and similar types of construction as described previously.

- Develop guidelines and programs to communicate and train contractors and communities to repair and reconstruct residential structures. A simple illustrated guideline and training program was developed based on the information listed above. This guideline and training program has been developed for community implementation.
- Develop a repair assessment method and construction inspection plan. PDA-based repair assessment and QA was developed.
- Develop community-based reconstruction strategic plans based on the damage assessment database. The damage assessment database and the field knowledge developed during the assessment will be used to create a reconstruction strategic plan for each community. This plan will include possible total reconstruction areas, utilities requirements, and the cost of reconstruction and repair.
- Develop and implement a project communications program for the repair guidelines. A mass media, strategic public communications campaign will be initiated using the available modes of communication (including radio and community meetings) to inform the public about the reconstruction plan and promote the use of improved repair and reconstruction methods.

Red-tagged building reconstruction

The non-collapsed structures will be assessed in detail to confirm their red-tagged status and reparability. If the red-tagged structures are evaluated as feasible for repair, a repair assessment program will be conducted on the structure. If the red-tagged status and condition as infeasible for repair are confirmed, then the following data is recorded:

- Classification of demolition. The demolition will be classified into one of the four groups listed in the following section and information will be recorded to document the reasoning behind the qualification.
- Means and method of demolition. Given the classification of the demolition, on-site recommendations will be recorded on the means of demolition and the type of equipment and personnel that would be required for a removal.
- Quality of site access. The quality of access to the site will be determined; for example, what type of construction and demolition equipment can be brought to the site, if any, and whether the site allows for debris-hauling equipment. In addition, it will be determined whether the site would allow access for implementing the demolition requirements listed in the next section.
- Estimation of debris volume. An estimate of the volume of debris that would be generated after the demotion is completed will be identified.
- Means and methods of debris removal. Given the volume and type of debris, on-site recommendations will be recorded on the type of debris removal and equipment needed to achieve such a task.
- Identification of T shelter requirements. Given the size of the site and the number of tenants that the building had, an estimate will be made of the size and number of temporary shelters and housing that would be required until a new replacement structure had been erected.
- Identification of natural- and geohazard conditions. An estimate of flood hazards and geohazards at the site will also be made. This estimate involves documenting any unusual site conditions, including flooding potential; noting any peculiarities about the site that have amplified the response; and noting other hazards such as slope stability and proximity to fault. This data will then help engineers in the next phase of the reconstruction effort

<u>Classification of demolition</u>

During the detailed red-tagged structure evaluation, the engineers will also assess and document the means by which the building could be demolished. Four categories will be used:

- None or Minor. These buildings collapsed completely, essentially turning into rubble. No or only minor demolition or structural removal is required. The only task remaining is the debris removal and cleaning of the site.
- Simple. These buildings are typically one story tall and still have some small parts still standing. However, the remaining portions can be dismantled and removed by hand crews using simple hand tools. No engineering technical support is needed because the remaining structure does not present a life-safety hazard to the crew removing it.
- Medium. These structures are typically two to three stories tall and have experienced partial collapse at some levels. They require engineering expertise to safely remove the remaining portions of the units.
- Complex. These groups of buildings are typically tall and have experienced collapse of floors at intermediate levels. The buildings are still standing. The removal of these buildings should be undertaken by construction and demolition specialists who have the experience, technical support, and heavy equipment required to remove the buildings safely and incrementally.

Quality Management

Ten engineering divisions (150 national engineers) are to be deployed as part of the repair assessment program and another 10 engineering divisions should be deployed for a red-tagged structure assessment program to conduct detailed engineering assessment of 200,000 damaged structures for reconstruction within a reasonable time frame. The repair assessment program was initiated in Delmas 32 in August 2010.

The QC program will support yellow- and red-tagged structure assessment and reconstruction programs. The QC-QA program includes:

- QC of yellow- and red-tagged structure assessment programs. A construction-quality monitoring platform has been developed and a PDA-based monitoring tool is being implemented for yellow-tagged structure repair and reconstruction. This tool should also be used to provide a construction QA process. A similar tool will be developed for new construction.

These programs are critical activities for reconstruction. The authors have found that many Haitian engineers are more than capable of being trained in and implementing these yellow- and red-tagged structure programs with a proper QA program. This QC-QA program is also an integral part of the capacity development program in Haiti. Trained and experienced engineers from damage assessment, yellow-tagged structure assessment, and red-tagged structure assessment programs should be brought over to the QC-QA programs

Conclusions

The 2010 Haiti Earthquake once again revealed the vulnerability of unreinforced masonry and nonductile concrete construction to earthquake damage. The problem was more severe in Haiti due to the countries unpreparedness for a major earthquake. To address the special circumstances and damage assessment in Haiti, an international and national partnership was formed, and it focused on inspection and reconstruction. This effort showed that:

- An innovative assessment approach that relies on the expertise of international engineers to train national engineers in using state-of-the-art technology—such as ATC-20 and FEMA 310 protocols, PDAs, and GPS—is effective for rapid assessment and data collection.

- Such an event provides a unique opportunity to collect field data and to develop fragility functions for various building types, occupancies, and construction.
- Using a rapid assessment program as a database for reconstruction is an effective methodology. The methodology developed in Haiti can be implemented in other parts of the world as an effective damage assessment and reconstruction method.

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Kit Miyamoto: President and CEO of Miyamoto International. Dr. Miyamoto is a registered structural engineer in many states in the US and has been in charge of seismic design and retrofit of a significant number of buildings. Dr Miyamoto has been in Haiti for a significant part of last year, developing the assessment and reconstruction plans.

Amir Gilani: Senior Associates at Miyamoto International. Dr. Gilani is a registered structural engineer in California and extensive experience in seismic analysis and retrofit of structures. Dr Gilani has recently returned from New Zealand conducting initial survey of damage following the 2011 Christchurch Earthquake.

A SYSTEM FOR INTERDISCIPLINARY ASSESSMENT OF EARTHQUAKE EFFECTS ON BUILT ENVIRONMENT IN ROMANIA

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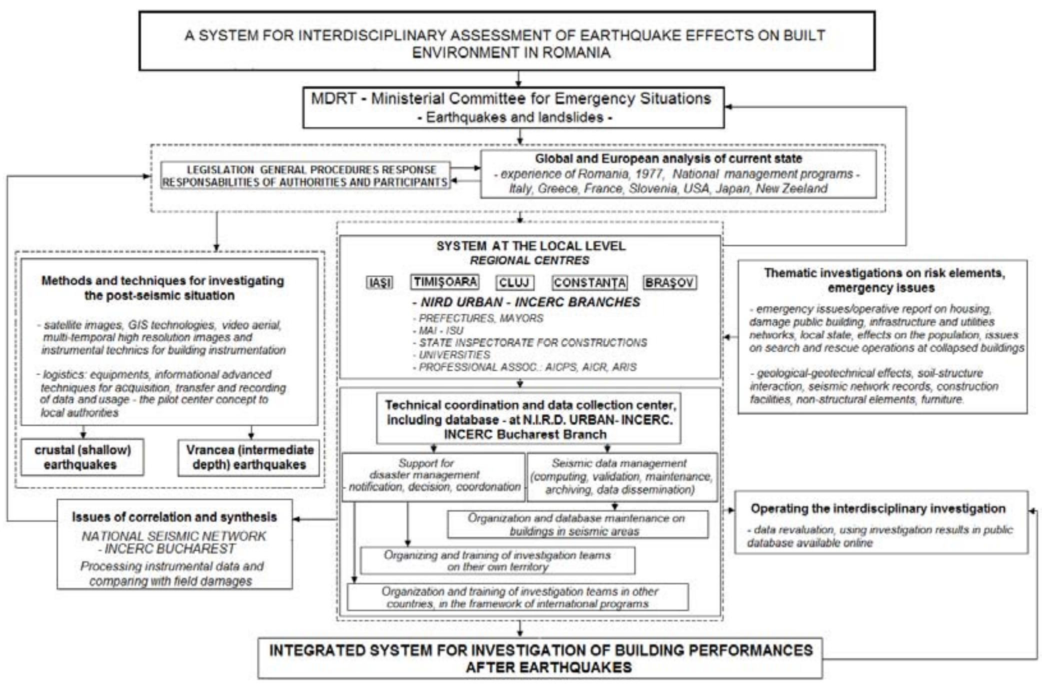
MDRT-Ministry of Regional Development and Tourism, Bucharest, Romania[2]

Since the seismic setting of Romania requires a special preparedness, especially for the impact of Vrancea earthquakes, the paper presents a research project of URBAN-INCERC, financed by MDRT, to create and operate a system for interdisciplinary assessment of earthquake effects, upon buildings, infrastructure networks and environment. The system is managed by the National Institute URBAN-INCERC, and has a central unit in INCERC Bucharest Branch, other five regional centers in Romania, including URBAN-INCERC Branches in Iasi, Cluj and Timisoara, while construction inspectorates and universities are associated partners.



The system will use advanced IT, will serve the ministerial emergency committee for earthquake emergencies under MDRT coordination, and will collect the necessary data, to provide lessons in engineering and disaster management regulations, as a knowledge base for future research and regulations.

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Integrating Applied Emergency Management into the Academic Environment

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Abstract

The field of Emergency Management is in a period of dramatic knowledge expansion. Practitioners from diverse public and private organizations and all levels of government are enjoying increased visibility and resources in combating a string of media enriched disaster events. A growing number of scholars and practitioners from multiple originating disciplines are bringing together an ever-increasing body of written work to support the recognition of Emergency Management as a profession and as a field for academic inquiry. This development in the United States has been propelled by the expansion of emergency management issues across disciplines, the establishment of a large number of academic programs across the country, and increasing visibility of disaster and its consequences, including the most recent emphasis on terrorism and homeland security.

Within the developing field, given the existing academic curricula, what are some of the core knowledge components of Emergency Management and what is the relative emphasis placed on each of the identified components. And within theses areas of emphasis, to what extent does the curricula content create intersection between originating disciplines and institutions of emergency management practice, or more plainly stated, between academics and practitioners.

Introduction

The field of Emergency Management is in a period of dramatic knowledge expansion. Practitioners from diverse public and private organizations and all levels of government are enjoying increased visibility and resources in combating a string of media enriched disaster events. A growing number of scholars and practitioners from multiple originating disciplines are bringing together an ever-increasing body of written work to support the recognition of Emergency Management as a profession and as a field for academic inquiry. This development in the United States has been propelled by the expansion of emergency management issues across disciplines, the establishment of a large number of academic programs across the country, and increasing visibility of disaster and its consequences, including the most recent emphasis on terrorism and homeland security.

Background

Several elements have expanded the debate surrounding emergency management professionalization

- the increase in the number of academic degree programs for emergency management, both undergraduate and graduate
- specialized training initiatives emphasizing leadership and management competencies
- increased interest in program accreditation, certification, professional standards, and performance measurement
- increased diversity within the profession, with more disciplines or specialized groups participating
- increased participation by the business sector
- more professionals seeking emergency management as a first career choice (Hecker, Kushma, McKay, Shaw, Buikema, Woodworth, & Fletcher, 1998).

There has also been an increase in the general public's acceptance of Emergency Management in recent years as it has transformed its emphasis from population protection in the Civil Defense era (during the two world wars and the ensuing Cold War) to an all hazards approach. Emergency management continues as an evolving field with its roots in civil defense, its present in addressing all forms of hazards management, and its future at a crossroad between sustainable community development (Winslow, 2001) and homeland security. Through this varied path, emergency managers have acquired an arguably definable body of knowledge and a skill set that many believe constitutes a profession. Though as a scholarly field of study emergency management is in its adolescence, it does retain some of the characteristics of an academic discipline which we will address later.

Emergency Management as a field of study, sub-discipline, or discipline, has been furthered by the exponential growth of Emergency Management academic programs in the last 10 years. The field of study includes the understanding of natural and technological hazards; cultural and human influences and impacts; and the relationship between the threats from hazards and the constructed or built environment. Therefore, the growth extends across disciplines in such diverse fields as public administration, sociology, engineering, social work, urban and regional planning, meteorology, geology, geography, business, psychology, and others.

Research Problem

Emergency Management as both a field of practice and as an emerging academic program has an obligation to reflect on itself and analyze its origins, present course, and future directions. Through self investigation it should examine the internal and external forces that shape and define the field and the "profession." The growth of a field into a profession is a complex process that includes meeting the expectations of other professions. Definitions or criteria of a profession vary across fields, however, most established criteria include a definable body of organized knowledge and values (Greenwood, 1957; Hatch, 1988; Lee, 1995). It follows that the development of Emergency Management must involve considerable attention to the field's underlying or supporting systematic ontological knowledge base and its underlying axiological values or beliefs. We define here, ontology – what is knowledge vs. axiology – what values go into it.

The knowledge and values within Emergency Management arguably originate from four sources: 1) the existing body of cross disciplined Emergency Management related research; 2) principles of Emergency Management as expressed by the practitioner community; 3) public and private sector training content; and 4) Emergency Management related academic curricula. While all bear an equal responsibility for their impact on the knowledge base and values of the field or sub-discipline of Emergency Management, the latter are the focus of this study. The youngest of the four sources, curricula at higher education institutions, helps set the tone not only for future practitioners and educators, but also for future research directions.

Very few would argue against the premise that higher education plays a crucial role in the attainment of a profession. Academics generate, evaluate, organize, and transfer knowledge (Hecker, et al., 1998). They provide students the information required for the creation of a new generation of Emergency Management professionals. For that generation of professionals to be effective, however, requires an understanding on the part of the academic community of what core knowledge and values are needed by the practitioner community and how academic programs and curricula development should meet that need. This study, therefore, is concerned with the following two questions: 1) based on existing academic curricula, what are some of the core knowledge components of Emergency Management and what is the relative emphasis placed on each of the identified components; and 2) how and to what extent does the curricula content create intersection between originating disciplines and institutions of emergency management practice, or more plainly stated, between academics and practitioners.

Study Rationale and Scope

Like most applied interdisciplinary fields, Emergency Management has no single, overarching theoretical base (Thomas & Mileti, 2003). It pulls from a wide variety of disciplines and an even wider range of theoretical underpinnings that address an almost unlimited number of problems and issues that arise from disasters and the hazards that cause them. Central to this study is the identification and examination of core knowledge subjects and values currently being taught in 254 Emergency Management related courses in 86 institutions of higher learning.

Outline of Process

Waugh (2000, p. ix) writes that “Emergency Management is one of those fields that grows the more one gets to know it”. By its very nature, Emergency Management is an applied field of study, oriented toward practice. But as McCurdy noted (1986), “No science can exist on applications alone. Someone must do the descriptive work upon which the applications are based.” As mentioned before, Emergency Management has been shaped by, and contributes to, a myriad of other disciplines, creating an eclectic base of knowledge. It relies on the contributing disciplines or fields of study of sociology, public administration, political science, business, economics, engineering, psychology, anthropology, geology, ecology, geography, meteorology, environmental science, criminal justice, fire science, urban and regional planning, and public health. And although it evolves through them, it also contributes to them, and consists, in and of itself, as more that the sum of the parts.

The field of Emergency Management has grown too complex and dynamic to be divided up into autonomous and fragmented fields of knowledge. A major problem is the lack of clear categories to compartmentalize the literature within. For example, an earlier survey of the Emergency Management literature (Dilling, 2002) revealed that there is no one established method for organizing the literature. Predominant methods include “system level” organization, i.e., individual, group, organization, community, society, international (Miletti, Drabek, & Haas, 1975a); by function, i.e., planning, warning, evacuation, etc. (Mileti, 1975) (Drabek, 1986); by phase, Preparedness, Response, Recovery, Mitigation (Drabek, 1986), (Miletti, Drabek, & Haas, 1975b); (Tierney, Lindell, & Perry, 2001). Are any of these the best approach? Are there additional boundaries that can be established? Identifying core knowledge and values that transcend disciplines is one step in formulating a future model for more effectively ordering the literature.

The Need for Synthesis

Apart from the need of ensuring that academic curricula is correctly defining the core knowledge and value base needed to establish Emergency Management as a profession, there are additional reasons to capsulate the information contained in existing academic curricula. Voices from disparate fields of the social science and social professions have asserted that efforts to accumulate new knowledge should be accompanied by a concerted effort to organize and cumulate existing knowledge (Rothman & Thomas, 1994, p. 134; Guetzkow, 1978). Glass, McGaw, and Smith (1981) argue that rather than “sink to confusion….the rubble ought to be sifted and culled for whatever consistency there is in it” (p. 134). They see this activity as a “genuinely important scholarly endeavor” (Glass, McGaw, & Smith, 1981, p. 134).

The accumulation of new knowledge should be accompanied by a concerted effort to organize existing knowledge (Rothman, Damron-Rodriquez, & Shenassa, 1994). Guestzkow (1978), a political scientist, calls for a time of consolidation. Scholars from other fields have traditionally “sifted” and aggregated this data from a traditional literature review. The flexible integrative qualitative process of the time honored literature review helps organize massive and disorderly research (Rothman & Thomas, 1994). Completing this among all contributing disciplines would be a monumental task. Therefore, this study, rather than “culling” literature, sifted through hundreds of Emergency Management higher education syllabi to “group similar elements or dimensions and visualize connections among distinct languages, concepts, and findings from diverse disciplines and contexts" (Rothman, 1980, p. 74). What Posner and Strike (1982) would call inductive interpretation, is used to arrange the individual parts or dimensions into consistent and satisfying patterns (Gibson, 1964). The diversity of contributing disciplines to Emergency Management courses underlines the need for creativity in analysis.

Developing a search methodology that cuts across multiple knowledge fields is strongly recommended by many scholars (Rothman, Damron-Rodriquez, & Shenassa, 1994; Glass, McGaw, & Smith, 1981; Light & Pillemer, 1994). This is particularly important when synthesizing the Emergency Management related syllabi identified for this study since they have emerged from so many different disciplinary approaches. Although disciplinary differences make knowledge integration more difficult (Rothman, et al., 1994), this makes the incorporation of multiple bodies of knowledge, here interdisciplinary syllabi, more important in order to reduce or negate disciplinary bias.

Identifying Specific Data Sources

This study encompassed two different sets of data, each containing a number of subsets. In the end, they may or may not bear close resemblance to one another. The first set of data, the primary data used for this study, was taken from syllabi collected by the Federal Emergency Management Agency's (FEMA) Higher Education Program. These data were categorized, coded, and analyzed to answer the first of our questions: based on existing academic curricula, what are some of the core knowledge components of Emergency Management and what is the relative emphasis placed on each of the identified components. Although there are 196 higher education institutions (as of November, 2007) with some level of Emergency Management programs identified by FEMA's Higher Education Project, (see Table 1) not all have provided syllabi of their courses to FEMA. The number of course syllabi provided from each institution ranged from one to nineteen. The number of syllabi submitted may differ from the total number of courses taught at each institution.

These syllabi were solicited by the Higher Education Project office. This is done annually to encourage emergency management programs to learn from one another. Reminders are sometimes sent to programs to encourage greater participation rates. However, since the submission is actively solicited, but not manadatory, some professors have provided syllabi and others have not. During the time of retrieval of the syllabi, 63 percent of the identified institutions had submitted one or more syllabi. Therefore, the data sample is arguably representative, though not inclusive of all institutions.

The institutions do represent a variety of disciplines and types of educational institutions however, increasing the richness of the data. For this study 296 syllabi were downloaded from the Higher Education site. They were sorted into the following categories by level of education: Associate Level, Undergraduate Level, Graduate Level, Stand Alone Certificates, and Unknown (for which it could not be determined by looking at the syllabus what level of study was represented). The breakouts by syllabi and institutions represented may be seen in Table 2.

Table 1 Emergency Management Higher Education Institutions

Level of Education	Number of institutions*
Associate Level	36
Bachelor Level	46
Masters level	49
Doctoral Level	8
Stand Alone or Certificate	57
	196

*from FEMA Higher Ed web site – retrieved on Nov. 29, 2007
http://www.training.fema.gov/EMIWeb/edu/collegelist/

Table 2- Syllabi Data Set by Category

Level of Education	Number of Syllabi	Institutions Represented
Associate	48	11
Undergraduate	116	42
Graduate	57	25
Certificale	33	8
Unknown Level	42	38
	296	124
Unknown Level Discarded	-42	-38
Total for study	254	86*

Note*: although there were a total of 104 institutions represented in the data, some were represented in more than one category, therefore these numbers represent differing institutions by category.

The data to support this analysis were taken from the results of two studies. The first are the results of a survey of practicing emergency managers in major U.S. cities, conducted in the fall of 2004 by two Oklahoma State University professors, Dr. William Parle and Dr. Anthony Brown (Parle & Brown, 2006). The purpose of their study was to determine the types of technical and theoretical knowledge that emergency managers at the local level of government considered to be most important in their professional work. First, respondents were asked to assess the importance of a list of job skills that were necessary to be an effective emergency manager. Then, respondents were asked to complete the same assessment process for a list of general knowledge areas related to emergency management (Parle & Brown, 2006). The survey was mailed to those individuals responsible for the emergency management function in the nation's 150 largest cities. Parle & Brown (2006) appropriately selected emergency managers in large municipalities on the assumption that they would have extensive experience in the field of emergency management to attain those positions. They had a response rate of 46.6%, representing 70 cities in 40 states. The cities responding ranged in population size from 141,674 to 8,008,278 (Parle & Brown, 2006, p. 2).

This data was broken down into domains and dimensions as earlier described so that their findings could be cross referenced and intersected to the findings from the analysis of the syllabi. The objective of this analysis was to determine if those subjects and emphasis areas currently being taught by higher education institutions coincide with the areas identified as most important by leading practitioners in emergency management, or between academics and practitioners. This points to an important limitation of this study. These domains and dimensions arising out of both the Parle and Brown study and that of the Thomas and Mileti study mentioned are used to define the definitional framework used to analyze the syllabi of courses taught in the field. In other words, the definitional framework was pre-defined and was not used to identify other possible dimensions that exist within the syllabi. The methodology used in this study might have prevented the emergence of other important dimensions from the syllabi that might not have been captured from the practitioners and subject matter experts in those two studies. Nevertheless, using the definitional frameword provided by the practitioners was deemed to be an important perspective for identifying key dimensions of the curricula without investigator bias.

The second set of data are results of a focus group of fifty-five recognized Emergency Management leaders who were convened by the Natural Hazard Center at the University of Colorado at Boulder and the University of Colorado at Denver in partnership with the FEMA Higher Education Project with support from the National Science Foundation (NSF). The working groups, representing both the practitioner community and various academic disciplines (Thomas & Mileti, 2003), set out to determine the core knowledge, skills, and abilities needed by tomorrow's emergency managers. During three days in October of 2003 the group worked on identifying 1) core skills; 2) core knowledge areas; 3) undergraduate curricula; 4) graduate curricula; and, 5) certificates, all germane to this study. They also considered issues and strategies related to 6) research and technology needs; 7) balancing research, theory, and practice; and, 8) continuing education (Thomas & Mileti, 2003, p. 3). Although significant to the emerging field of Emergency Management, these three areas of the resultant report were not considered in my analysis. These sections of the study are narrative and less specific in nature and not as conducive to the type of word frequency analysis and data comparisons planned here. However, the subjects and areas of emphasis identified in the first five areas mentioned above were compared to the results of the syllabi analysis to contribute to my findings. This set of data, though helpful in validating trends borne out by the Parle and Brown results, was not analyzed to the degree used with the Parle and Brown data. This is due to two limitations of the data: one, the focus group was not solely practitioners but a mixed group of subject matter experts from practice, academia, and the private sector. This makes it less compelling as a means to mark the intersection of academia and practice. Second the data was not organized in the same manner as that in the Parle and Brown study, missing the overarching domains which helped clarify the underlying dimensions or subject areas.

Parle & Brown Dictionaries

In the Parle & Brown (2004) survey participants were asked to rank the areas (domains, further defined by accompanying subordinate dimensions) on a scale of one (1) being the most important to (5) being the least important. They were asked to rank both what Parle & Brown described as applied skills and professional competencies and another group of subject areas defined as general knowledge or academic background areas (p. 7). The results of the survey, again as described earlier, of the 150 largest emergency management offices in the United States (with a response rate of 46.6%), are provided below.

Applied skills and competencies. The items are ranked in order of importance from highest to lowest based upon the mean score of respondents (Parle & Brown, p 12).

1.47 Planning for Emergencies and Disasters
1.47 Monitoring and Evaluating Preparedness
1.56 Responding to Disasters
1.86 Recovery from Disasters
1.90 Community Risk Assessment
2.00 Natural Hazards: Causes and Mitigation
2.11 Technological Hazards: Causes and Mitigation
2.16 Terrorism and Civil Hazards: Causes and Mitigation
2.43 Technology Applications in Emergency Management
2.73 Legal Basis of Emergency and Environmental Management

General Knowledge Areas. The items are ranked in order of importance from highest to lowest based upon the mean score of respondents. The disciplines in parentheses are ones they felt were most closely associated with the knowledge areas (Parle & Brown, 2004, p 16).

2.36 Governmental Budgeting and Financial Management (Public Administration)
2.55 Management Theory and Practice (Management and Public Administration)
2.83 Social and Psychological Impacts of Disasters (Sociology and Psychology)
2.87 Intergovernmental Relations (Political Science)
2.90 State and Local Government (Political Science)
2.97 Policy Analysis and Program Evaluation (Economics and Public Administration)
3.16 Urban Planning in the U.S. (Geography)
3.45 Evolution of Disaster Policy in the U.S. (History)
3.75 Probability and Statistics (Mathematics and Statistics)
3.80 Engineering for Non-Engineers (Engineering)

For our frequency analysis, both applied and general subjects were included in an MAXDictio dictionary, and these were then applied to all four levels or categories of syllabi. In some cases, not all areas (domains), or their accompanying subjects (dimensions) appeared in the syllabi. If no frequency counts were registered, the domains do not appear in that category of the MAXDictio runs.

Narrative Summary of Methodology and Findings

This study was organized by using Systematic Research Synthesis or SRS (Rothman, Damron-Rodriquez, & Shenassa, 1994). It helped us follow a systematic process in determining the steps we needed to follow to meet our end goal. In doing so we followed the general step-by-step approach repeated below:

Defining the problem/goal

This study sought to determine the degree of alignment between the perceptions of academics and practitioners in the field. To that end we answered two research questions: 1) based on existing academic curricula, what are the core knowledge components of Emergency Management, and what is the relative emphasis placed on each component; and 2) how and to what extent do the curricular contents create intersection between originating disciplines and institutions of emergency management practice, or more plainly stated, between academics and practitioners.

Identifying general knowledge areas relevant to the problem/goal

For the relatively young field or sub-field of Emergency Management we deemed it important to distinguish individual ontologies and epistemologies that academics bring to the academic Emergency Management literature and relate them to what practitioners value. We explained the rationale behind this study in terms of two overarching theoretical frameworks: systems theory and the sociological theory of professions. These theories helped 1) explain the connectedness of the subsequent cross discipline data analysis and 2) provided a rationale for the investigation itself.

Identifying specific data sources

Two data sources were used in this study: 1) a focus group study of academics and practitioners tasked with determining the core elements that should be present in emergency management higher education programs in a paper summarized by Thomas and Mileti (2003); and 2) a survey of emergency management directors for the 150 most populous jurisdictions in the United States in a paper summarized by Parle and Brown (2005). The survey participants were asked to identify the most important skills, competencies, and general knowledge that should be covered in higher education programs in emergency management to prepare future emergency managers for practice. These two studies serve to define the definitional framework used to analyze the syllabi of courses taught in the field. This pre-defined framework prevented the identification of other possible dimensions that might exist within the syllabi. Nevertheless, using the definitional frameword provided by the practitioners was deemed to be an important perspective for identifying key dimensions of the curricula without investigator bias. The method used here has, however, identified several important dimensions that are being taught.

Determining appropriate descriptors for the search

The data sources mentioned above provided the base data (later to form the dictionaries in MAXQDA Dictio) and represented the practitioner view of what was needed to be taught. Now we needed the data descriptors representing the academic view to search and compare for congruence. This was accomplished by downloading two hundred and fifty-four (254) syllabi from one hundred and ninety-six (196) different institutions to reflect what was being taught in emergency management programs across the United States. The contents of the syllabi were then used to search for dimensions (terms or subjects) and domains (major theme areas) that matched those identified by the practitioners as important.

Establishing procedures for codifying assessing, and managing information

The syllabi were divided into four categories -- associate, stand alone certificate, undergraduate, and graduate -- related to the level of education they represented. They were scrubbed of all unrelated sections, i.e., grading, honor code, etc. They were then segregated by originating disciplines, i.e., public administration, sociology, etc.

MAXQDA Dictio was used to manage the content analysis of the data by determining word frequency counts and percentages based on dictionaries created by transferring the contents of the two data sources, Thomas and Mileti (2003) and Parle and Brown (2005), into the software. Using the software, the syllabi were run against the dictionaries to determine symmetry between the practitioner and academic perspectives.

Establishing procedures for developing consensus findings

Each of the two research questions were examined, respectively. For the first question regarding knowledge areas identified as important by practitioners and academics, the frequency count results were examined to ascertain the congruence between the two perspectives. For question two involving the relatedness of originating disciplines to the practitioner field, the frequency counts were compared and analyzed by discipline to the practitioner data.

Conclusions: Generalization of findings to the field of Emergency Management

This study sought to determine the degree of alignment between the perceptions of academics and practitioners in the field. To that end we answered two research questions: 1) based on existing academic curricula, what are the core knowledge components of Emergency Management, and what is the relative emphasis placed on each component; and, 2) how and to what extent do the curricular contents create intersection between originating disciplines and institutions of emergency management practice, or more plainly stated, between academics and practitioners.

It can be argued that the substantive aim of this study was met and the two research questions answered. There were two major findings:

1. There are identifiable core components and there is powerful congruence between academics and practitioners about what should be taught in dedicated emergency management courses regardless of discipline.
2. That although practitioners have identified the need for multidisciplinary education for emergency management, multi-disciplinary perspectives are largely absent from the dedicated emergency management courses, irrespective of the disciplinary orientation of the hosting departments.

The stress on the first finding is the word “core”. There was very strong symmetry on core competencies or what the Parle and Brown study defined as “applied skills and competencies”. There was substantial agreement among practitioners and academics about major topics areas and subjects in this arena. Congruence regarding broad topics between what practitioners say need to be taught and what academics are doing extends beyond disciplinary boundaries. As relates to the sociology of professions, that would indicate emerging maturity or maturation in the field as a profession. A sound profession has agreement regarding its theoretical underpinnings (Greenwood (1957). Professional education is in line with professional (clinical) need. In employing the framework of the theory of the sociology of professions to guide the direction of this analysis, we may have taken one closer step to agreeing that Emergency Management is indeed a profession. If there is agreement in core knowledge components, a field can gain societal recognition. Defining parameters of knowledge is critically important in the making of a profession. Public Administration, as a field or discipline, has experienced difficulties doing this due to the many broad areas of knowledge it encompasses. Emergency Management, given this part of the analysis, may have a somewhat easier time defining itself, at least as it relates to “core” skills and competencies.

There was not however, symmetry on the more general knowledge areas, which, though not ranked as important as applied skills and competencies by the practitioners, were deemed important to be covered. On this cautionary note, for example, of about 40 specific undergraduate level subject areas identified in the Thomas & Mileti study, only about a dozen received appreciable mention in the syllabi. This suggests that the dedicated emergency management specific courses may be neglecting important knowledge areas. This points to the need for cross-disciplinary study since the topics identified do cross disciplinary boundaries.

Our findings concluded with the finding relative to general knowledge areas. The result of the analysis was that these general knowledge areas, e.g., financial management, management theory, intergovernmental relations, policy analysis, etc., are not being taught in dedicated emergency management courses. These general knowledge areas are also being missed in certificate or stand alone programs. If we look at the results of the Parle and Brown practitioner survey and the Thomas and Mileti focus group study, it seems evident that specialized courses in themselves are not enough to prepare a student to be an effective emergency management professional. More rounded educational preparation may be required.

It would seem that the professionals surveyed by Parle and Brown are really calling for more interdisciplinary studies. Practitioners are calling for multi-disciplinary education, more than is being provided in dedicated emergency management courses. Again, it can be assumed that students enrolled in other disciplines that have courses or specializations in emergency management are receiving the more general knowledge areas in their broader program of study. This holds true across disciplines. For example, public administration may provide some of the general knowledge areas, but no single field of study, including public administration, provides all the general topics that are needed to prepare a well-rounded emergency management professional. Dedicated certificate or emergency management degree programs, therefore, should be ensuring these broader subject areas are integrated within the more applied subject areas they are addressing.

It would follow that the academic field of emergency management is strengthened by the very nature of its interdisciplinary character. Diversity is advantageous rather than fragmenting for this discipline. For undergraduate or graduate degrees, students should be, not just allowed, but encouraged or required, to take courses in other departments. That of course runs contrary to the funding and budgeting policies of many universities, e.g., emphasis on "full time equivalents (FTE's) etc. Those policies may contradict the educational needs of emergency managers.

In summary, this study has drawn four general conclusions:

- There exists a high level of congruence between academics and practitioners regarding the core knowledge areas of the field of emergency management.
- The core and general knowledge areas within the field of emergency management have developed over time from the influences of a variety of originating disciplines. Since the development of the field has drawn on these many disciplinary influences, it is important that the future of the field remains interdisciplinary.
- There may be deficiencies in the coverage of general knowledge areas, although this study examined only syllabi that were specific to emergency management. Nevertheless, we conclude that it is critical that these general topics be included either in the over-arching disciplinary program of study or integrated within stand alone and certificate programs.
- Given the level of coherence that this study has found in core subject areas and incongruence that was identified regarding general knowledge areas, this methodology offers promise for application to other professional fields.

Recommendations for Future Research

There are several avenues for future research and expansion of the ideas in this study. What explains the degree of congruence between the academic and practitioner community for example? I suspect that the Federal Emergency Management Agency's aggressive training program for practitioners mentioned earlier in the study might be one contributor to this. The popularity of FEMA's Higher Education Program and list serve within the academic community could be another. FEMA has assumed a central role in an enlarging network that encompasses both practitioners and academics in the field of Emergency Management. One individual in particular, Dr. Wayne Blanchard, the current Director of FEMA's Higher Education Project, has assumed a policy entrepreneurship role in both the expansion and networking of Emergency Management related higher education programs. He has actively sought to create a social network encompassing the academic and practitioner community. FEMA is also looked on as a source for potential funding and support by both the practitioner and academic community. Therefore, there could be a positive relationship between the centrality of FEMA's role, and that of Dr. Blanchard specifically, in the forming and congruence of the core components of Emergency Management education. The network and policy entrepreneurship literature and an actual network analysis might provide a lens for future research to better understand the origins of existing congruence.

Another avenue to explore is the role and background of the instructor in bridging the gap between practice and academia. Emergency Management's presence in higher education is on a rise. Who are the cadre of instructors that teach in this rapidly expanding field? How do their backgrounds impact the content of their syllabi? For example, how does the status of the instructor, i.e., tenured faculty with little or no background in Emergency Management vs, Adjunct faculty with a practitioner background impact the findings and conclusions on congruence? The conguence could be explained by a large number of former practitioners within the academic community. On the other hand, if there are a substantial percentage of academics that do not have a practitioner background, how have they developed their theoretical frameworks that underlie the syllabi that are so closely congruent?

One additional limitation of this study is that syllabi were grouped together, irrespective of whether they were for required or elective courses. Future research might distinguish between these categories of syllabi.

This study is based on a cross-sectional design. The syllabi studied were those in existence at a given point in time. It is possible that retroactive studies of earlier syllabi might reveal differing patterns regarding curriculum emphasis and congruence. A cross-sectional study such as this can only demonstrate the existence of congruence. It is beyond the scope of this study to explain the causes of that congruence. To do that, longitudinal research of past curricula and network dynamics would be required. For example, it is likely that the dimension of terrorism and homeland security would have been less important prior to 911. Future events may similarly redefine the field. But it seems evident, that emergency management, as both an emerging profession and as a maturing academic field, is here to stay.

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BIOGRAPHICAL SKETCH

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TRAINING SAFETY MANAGERS TO UNDERSTAND EFFECTIVE EMERGENCY PREPAREDNESS & RESPONSE

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Abstract

The specific skills and knowledge a safety manager must possess to understand effective emergency management and implement an effective emergency preparedness and response plan will be presented in this paper. Examples of the information and materials an on-site safety manager at a business or industry will be expected to provide and use in the future to assist in the response of the facility during an emergency or disaster situation are provided. Standard terms used to categorize disasters by the main cause or hazard type are discussed. Keys skills a safety manager should employ at a business or industry to assist the facility in efforts to mitigate or respond to the impact of a disaster are outlined including the ability to coordinate and implement an emergency preparedness facility plan.

Introduction

Natural and technological disasters impact communities across the world at a greater rate than other disasters caused by man's intentional actions including terrorism. Disasters caused by terrorism include intentional bombing or the intentional release of a biohazard such as anthrax. Natural disasters impact more and more individuals as population increases and more individuals migrate from rural areas to dense urban areas. The term natural disaster is used to categorize damage to persons or property caused by tornadoes, floods, earthquakes, hurricanes (also called typhoons in the southern hemisphere), volcanic eruptions, landslides and wild fires caused by lighting strikes. The intensity of natural disasters can increase when the cause of a

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disaster such as a hurricane is influenced by changes in climate. For example, while global warming has not been determined to increase the number of hurricanes occurring within a season, it has been determined that the increase in temperature of a body of water which may be caused by global warming can increase the intensity of a hurricane event. This recorded increase in intensity typically increases the amount of harm to individuals and damage to property.

Both the number of fatalities and the costs associated with natural disasters have continued to increase across the world. As a large portion of the world's population continues to move from rural areas to urban centers the average death toll from a natural disaster is expected to continue to rise. Between 1990 and 2002 815,077 people lost their lives in 4,300 natural disasters world wide. In the last six years, examples of natural disasters causing catastrophic loss and damage to property included the major earthquakes in Haiti, and Brazil, hurricanes Ivan, Katrina, and Rita damaging the Gulf area in the United States and the extensive flooding in Australia, China and Europe (Smith S.M., J. Gorski and Hari Chandra Vennelakanti 2010) (Kahn M. 2005) (Chapman J. 2005) (Smith S. M., L. Peoples & P. Johnson 2008) (Smith S. M. Trementhic, M. J., Johnson, P. and Gorski J. 2009)

Technological disaster is a term used to categorize a disaster causing damage to persons or property caused by the unintentional malfunction of a system designed and or operated by man. Industrial disasters include fires, oil refinery spills and explosions fall into this category of emergencies. The number of technological disasters involving industrial sites has continued to increase since 1980. The number of industrial disasters impacting developing countries has increased at a faster rate than the increase in developed countries. Documented industrial disasters resulting in major explosions included the Longford gas explosion in Melbourne Australia, the explosion a sugar refinery in Savannah Georgia and the major explosion at gas refinery in Texas owned by BP Oil. Each of these industrial disasters resulted in a substantial number of injuries and fatalities as well as significant property damage Although the actual number of industrial emergencies/disasters has continued to increase since 1980, the average number of fatalities reported following a typical industrial disaster have been reported to decrease in developed countries in recent decades.

Technologically based disasters continue to increase at industrial sites. A majority of technological disasters still are characterized in explosions and fires. Technological disasters have also occurred in the transport of toxic, flammable, or explosive materials. The causes of transportation disasters involving chemical release have resulted from train derailments or vehicle collisions. On March11, 2011 the impact of both natural and technological disasters hitting Japan further demonstrated the complex nature of disasters involved both a natural and technological disaster occurring almost simultaneously. The 9.0 earthquake which hit Japan on March 11, 2011 was followed immediately by a tsunami. These two natural disasters caused catastrophic damage to life and property in many coastal and agricultural areas of Japan. The subsequent damage to the backup generator systems by the tsunami causing these generators to fail at a major nuclear power generation site caused a partial melt down and ongoing radiation releases in the Fukushima Prefecture of Japan. This power generation site included six reactors and the failure of the generation backup system resulted in an inability to shut down several of the reactors at the site resulted in the mandatory evacuation of communities adjacent to the nuclear power generation site. Much of this area overlapped with part of the part of the region already impacted by the earthquake and the tsunami. The radiation releases prohibited the ability of the local, regional or state agencies to conduct major search and response operations in that particular area follow the earthquake and tsunami. The long term impact of this combination of natural and related technological disasters in Japan on the health, economy, and social structure of citizens and communities has yet to be determined. Immediate impacts of these natural disasters have included over 15,000 deaths and many more persons still missing in Japan. These natural disasters also decimated coastal towns, and the technological disasters involving ongoing radiation releases also resulted in the mandatory evacuation of citizens living and working in the agriculture region impacted by the release of radiological materials into the air and water at the nuclear power generation site. This recent catastrophic disaster demonstrates how the impact of natural and technological disasters occurring almost simultaneously involving industrial sites and communities can result in complex catastrophes and a very recovery time (Smith, S. & Gorski J. 2010) (Chapman, J. 2005)(Kahn M. 2005) (Chapman, L. 1992) (Smith, Council and Rogerson 2006)(Earth Threats, 2011).

The increase in the occurrences of disasters associated with industrial processes or sites emphasizes the need for individuals training to become an industrial safety coordinator or manager to design out technological hazards, insure planning and training occurs to improve disaster response and quickly return normalcy to industrial facilities, hospitals, and other commercial businesses are created, practiced and implemented. Individuals preparing to be safety managers must practice creating emergency facility plans and have the skills managed drills, training and response.

Results

Safety managers who provide support for managers or administrators in everyday operations have been reported to be effective in responding immediately to on-site emergencies. Rapid and effective response had been demonstrated to reduce injury and property damage during an emergency regardless of its cause. Examples could be response to spills on land and in water, fires, train derailments, or weather-related events such as tornados or hurricane. To be successful the objectives of emergency preparedness and response plans and training have been found to include: keeping a crisis event from expanding into a disaster; returning to a "normal" state of operation quickly and maintaining the safety of all employees and customers during a crisis situation. Facilities who have created and practiced an up-to-date emergency preparedness and response plan and who have an ongoing process for training employees have reported a higher success rate in prevention, and response efforts. It is recommended that the emergency plan and its related protocols should address the response to a(n): fire, explosion, bomb threat, severe weather, utility failure, flood, earthquake, toxic chemical release, chemical contamination (from a spill, explosion, or miss handling of materials), workplace violence (disgruntled employee or customer), weapons on property, or a biological/radiological releases if these materials were used or stored at the facility (Haddow and Bullock 2003); (Smith, Council, and Rogerson 2006).

Effective emergency plans have been identified as those that address each hazard which could impact the facility and describe steps to deal with each disaster situation determined to be of high or moderate risk. The Centre for Research on the Epidemiology of Disasters (CRED) at the United Nations has defined a disaster as "a situation or event, which overwhelms local capacity, necessitating a request to the national or international level for external assistance… an unforeseen and often sudden event that causes great damage, destruction and human suffering" (www.unisdr.org). A disaster can also be described a major disruption impacting a facility or community occurs, caused by a natural or man-made industrial hazard, results in many injuries, the loss of lives, or the destruction of a large amount of property (Smith, Council, and Rogerson 2006).

A disaster or major emergency requires a rapid response to minimize damage. The facility emergency plan must provide guidelines for each department within an organization to use when responding to an emergency or a natural hazard (Smith, Council, and Rogerson 2006). For example, an emergency management plan should describe how a facility will provide back-up electricity or natural gas during a power outage to maintain essential services during a power outage.

When facilities prepare emergency plans, the plan should be required to include four major action areas that must be addressed in all types of emergencies, regardless of cause or hazard (Haddow and Bullock 2003). The four major action areas, or phases, are called emergency: preparedness, response, recovery and mitigation (prevention or reduction in impact of the disaster). Emergency preparedness has been defined as the ability, "to organize for emergency response before an event" (Drabek and Hoetmer 1991, 34). Examples of preparedness include: continuous training, drills, and review of exercises to ensure facilities are prepared if and when a disaster strikes; and maintaining emergency generators to maintain the electric power during a power outage.

Emergency response procedures should include a strategy to move employees or customers out of a facility and outlined steps in evacuation procedures. Plans should also include directions for the safest locations to find shelter within the buildings of the facility. Recovery strategies in a plan state describe how to get the facility back open and in full operation. The role of the safety manager in emergency preparedness planning and recovery would be determined by the plant manager. In emergency planning, mitigation is defined as any action to prevent or reduce the damage of a disaster (Smith, Council, and Rogerson 2006).

Federal and state guidelines in the United States have determined a facility must maintain an ongoing emergency planning process for disaster preparedness to be effective. This ongoing process should include team representatives from company management, as well as team members from each major department. Some facilities provide opportunities for all employees to also be involved in the overall planning process. Employee involvement can contribute to a more effective planning and response within the facility. The emergency facility planning process should include: identification of hazards; determining which hazards are the greatest risks; outlining actions that prevent or reduce hazards, and actions to ensure effective response and recover All written plans must include descriptions and actions for relocation to shelter in place and / or for the evacuation of employees and other occupants, such as customers. However, each facility's plan will be unique and should be designed to meet that facility's specific needs (Smith,Council, and Rogerson 2006).

A facility emergency preparedness plan should also address how the facility will interact with local community emergency response agencies during an emergency as well as the potential role of other state and federal agencies if an emergency situation arises at the facility. The plan identifies hazards, determines which hazards are the greatest risks, outlines actions that can prevent or reduce a hazard, and recommend actions to take to mitigate or respond to a disaster. As one of the first steps in emergency preparedness planning, an effective hazard analysis must begin with thorough hazard identification. During the hazard identification process, the hazards faced by a community or industry should be identified and grouped by types, potential impacts, and possible mitigation strategies. If hazards have common or similar characteristics they can be grouped together (Smith, Council, and Rogerson 2006).

Prior studies have determined that once hazards have been identified, the actual and perceived risk and vulnerability of critical structures at a facility need to be made part of the hazard analysis. The analysis should include a dollar figure and engineering information (e.g., type of structure, its square footage, and use) for facilities. The number of people occupying the structure and the types of materials stored in the structure should also be included in the hazard analysis (FEMA 2002.) Mitigation refers to actions that are designed to reduce or eliminate the damage or reduce deaths or property damage caused by hazards (Pine 2007) The results of an effective hazard analysis can help identify the types of mitigation needed. The earlier a safety manager can identify and identify what hazard exists, the greater the potential to reduce risks (Pine 2007).

Discussion

The most important skill in emergency management for those preparing to serve as a safety manager include the ability to create. update, exercise and participate in the implementation of a facility level emergency plan. The future safety manager must also be prepared to determine how employees working at a facility should most effectively be included in the development and implementation of an emergency plan for a business or industrial site. Recognizing the different phases of emergency management (planning, response, recovery and mitigation are important when working with a management team to develop and practice and emergency plan. coordinate efforts with those at the community and regional level responsible for disaster planning and response and support company management efforts to each employee is prepared for future disasters are also important areas to understand. Recent research by D. B. Reissman and J. Howard emphasize the importance of disaster planning incorporating support for worker safety and health preparedness to increase the resiliency of employees responding onsite when a disaster occurs. (Coleman, Les 2006) (Kahn, Matthew 2005) (Reissman, DB, & Howard J. 2008)

An awareness of the importance of maintaining a relationship and an effective working relationship among the operational levels of safety, security, and emergency management within a company or agency can support efforts to not only improve response to natural and/or technological disasters but can increased the ability of organizations to response to a terrorist attacks. since the terrorist attacks on the World Trade Center in New York City and the Pentagon in Washington, D/C. on 9/11/01 efforts to protect key facilities in both the public and private sector have increased (McEntire 2007). As the importance of preventing a disaster initiated by terrorists continues to be a priority for high risk industries, the importance of collaboration between the company manager, safety manager, the security office, and those responsible for emergency response continues to increase (Smith, Council, and Rogerson 2006).

Small or medium-sized companies, or those with many dispersed individual plant locations, typically organize all safety responsibilities, as well as risk management, under the safety office. The safety manager can support and contribute to disaster mitigation efforts at an industry or business and participate in emergency planning regardless of where these functions are organizationally located. In a 1992 published research study authored by Deutsch P.V., Adler J. and E. D. Richter, it was concluded that the safety manager as well as a safety inspector “can be trained to detect, or recognize and promote action to correct sentinel markers for industrial disasters,” p. 526. This study defined sentinel marker “as a pre-disaster warning sign of impending failure in prevention,” p. 526. Research authored by Judith Chapman further supported the conclusion that technological industrial disasters can be prevented or reduced through improved risk assessment and mitigation efforts (Chapman, Judith 1992).

Prior research has also indicated the presence on site, or at a facility of an individual designated as the safety manager whose main responsibility is to assess risk, facilitate actions and behaviors that reduce hazards, minimize risk, and support safe behaviors has been associated with a reduction in reported injuries and death in the construction industry in Tennessee (Findley, Smith, Kress, and Petty 2004). In many cases, the safety manager will be requested to provide detailed information related to facility design, industrial hazards and material handling and storage during the emergency planning process for a facility. (Chapman, Judith, 1992)

The safety manager is already the person who is typically the designated contact in the event of an on-site chemical spill resulting from process or transportation accidents that require hazardous material precautions. The safety manager is also the “natural person” a plant supervisor or manager expects to provide key information when working as part of an internal team to create an emergency response plan in situations where hazard chemical releases, storage or explosions are a potential risk. In an emergency or disaster response planning the on-site safety manger will be expected to have ready access todetailed building and site maps, the precise locations of all areas using or storing hazardous materials and the best route for emergency vehicles to approach all buildings on the site.(Drabek, T. & G. Hoetmer 1991) (Smith, Council, and Rogerson 2006).

A safety manager should be a member of the planning and emergency response team because this unit can assist other departments practice appropriate responses to an emergency. The emergency plan should outline responsibilities and actions for each department. To effectively respond to a disaster, the facility's emergency management plan should include an outline of actions by department, including: staff duties by department and assignment, measures to take for equipment failure, shelter-in-place locations, and evacuation procedures for that department (Smith, Council, and Rogerson 2006).

If the safety manager is not designated as the person primarily responsible for decisions related to emergency response, he/she should still participate as a part of the management team to ensure effective coordination and ongoing communication exists between the safety unit and other emergency operations units during an emergency situation. Ongoing planning must include operational training and drills, since training employees can enhance response capacity. The frequency and specific focus of training and drills at an industrial facility should be based on identifying the specific hazards present at a facility. The most emphasis should be on the hazards determined to be of greatest risks in the hazard assessment (Perry and Lindell 2007; Smith, Perry Moyer, 2006).

Many safety responsibilities and tasks are required of the safety manager at an industrial facility. The safety manager can also support emergency preparedness through education and training, and direct participation in developing plans. In an emergency, every department will play a role in maintaining a safe environment, and at many industrial sites the safety department will be central to an effective emergency response. In addition to gaining the skills needed to manage safety at a facility, an individual preparing to be safety managers should be able to categorize disasters by the main cause or hazard type, list and describe the four phases of emergency management, describe the objectives of emergency planning, and describe examples of the materials and information an on-site safety manager will be expected to provide to corporate or company management or collaborating agencies during an onsite technological disaster or related emergency.

While a safety manager should know the general needs of emergency preparedness and response prior to taking on a professional position; he or she will learn more about designated emergency roles for safety management at a specific facility through directions provided by the plant manager and by the participation of the safety department staff in plan development, implementation Published research by Planek and Fearn (1993) found, "Data suggest that the shift in expert opinion today has been toward a higher valuation of the safety manager's role, motivation, and communication, with less emphasis on engineering, record keeping, and related activities. The specific role of the safety manager in emergency management will continue to evolve as new hazards are identified and deficiencies in planning and training are identified. (Smith, Council, and Rogerson 2006).

Conclusion

To contribute effectively to the development and use of an effective emergency preparedness and response plan for a facility, it is important for safety managers to understand how disasters are classified based on their causes. Emergency management officials classify disasters by four main courses, or hazard groups (Drabek and Hoetmer 1991): natural disasters, technological disasters, civil disruption or violence, and ecological disasters causing long term changes. The type of hazard that causes a disaster can determine preparedness, planning, and recovery and response methods selected by a facility. Examples of such hazards include: natural disaster caused by weather, including floods, tornados, and severe storms; technical disaster caused by man-made technological hazards including tanker accident releases of a toxic gas or a radiation leak; civil disaster caused by a disruption or violence such as a bombing or the intentional release of harmful viruses and/or an ecological disaster caused by a hazard associated with a long-term change in the earth. Of the four types of disasters, ecological disasters are the hardest to prepare for and respond to (Drabek and Hoetmer 1991).

In a non-emergency situation, the safety manager is responsible for day-to-day facilitation and implementation of programs to maintain a safe institutional environment to prevent an onsite disaster. A facility with an excellent housekeeping record, appropriate management of material safety data sheets for all hazardous chemicals onsite, ongoing training for employees in critical safety and emergency response areas, and periodic safety inspections can lead not only to prevention of an emergency but also a more effective response in an emergency situation (Smith and Council 2006). Each of these functions is typically conducted under the ongoing supervision of an on-site safety manager. Many of the skills already needed for effective day-to-day safety operation of a facility, company or institution are even in more demand during a disaster (Smith and Council 2006).

If a safety manager has been designated to also serve as the emergency response coordinator for an industrial site, he or she must assess the emergency situation, the needed infrastructure, as well as the governmental response capacity currently available within the community. Some of the skills and knowledge a safety manager should be expected to bring to a safety management position should be those related to emergency planning, response and recovery. These specific skills should also include the ability to effectively communicate, use participatory planning methods, demonstrate leadership and the ability to work as part of a management team, knowledge of risk and hazard assessment, and the skills needed to prioritize actions necessary to implement the previously outlined mitigation, and response actions needed to minimize the damage that can occur from a disaster (Smith and Council 2006).

An ongoing challenge facing local businesses and industries is creating maintaining collaboration and coordination of all groups within a community involved in emergency planning and response. If responsible for emergency planning the safety manager must be able to recognize the factors that influence the ability of agencies or companies to maintain effective collaboration and coordination. Factors a safety manager must recognize as critical include: familiarity and trust; communication and work association; boundaries and resilience; collaborative training; drills; and exercises and actions to measure and reduce stress associated with emergency response (Millet 2003; Langer 2004; Manoj and Baker 2007; Little 2004; Nemeth 2007; Seynaeve 2001).

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ROMANIA'S EMERGENCY MANAGEMENT INTERNATIONAL TRAINING COURSE

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International training, emergency management, assessment and coordination

Abstract

Romania, during the last decades was inevitably prone to a series of disasters and catastrophic events such as earthquake, landslides and floods, as well as various technological hazards.

For this purpose, the emergency management became a priority for Romania, especially in regard to the training in emergency management.

Therefore, the paper presents a case study on the strategy on emergency management assessment and coordination of a disaster event, in this case, a seismic one, based on an international training course organized in Romania by the Johanniter Academy in collaboration with the Austrian Red Cross and General Inspectorate for Emergency Situations from Romania with the help of the Romanian National Red Cross Society, having as guidelines the IFRC's Guidelines for Assessment in Emergencies and trainers and evaluators from different GOs and NGOs in UK, Germany, Austria and Czech Republic.

The scenario of the international training course implied an earthquake with a magnitude of 7.7 on the Richter-scale and approximately 135 km depth with the epicenter in Vrancea region situated in the Eastern part of Romanian territory, in the Oriental Carpathian Mountains area.

The scenario envisaged a preliminary assessment that revealed a huge extent of damages that the national response capabilities were not capable to handle alone and an international assistance from EU Monitoring and Information Center was needed, in order to cope properly and efficient with the situation. The request was through CECIS - *Common Emergency Communication and Information System*.

The outcomes of the assessment were meant to improvement the quality of interventions and also to identify the National Society's capacities and role, based on its mandate, in times of shock/hazard.

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Introduction

Disasters are events that seriously disrupt the functioning of a community, inflicting widespread human, property and environmental losses, which exceed the ability of the affected community to cope, using its own means. Disasters, natural or man-induced, and depending on causal factors, can be either slow or sudden.

Many people are exposed to a wide range of hazards in the natural or man-made environment that adversely affect their lives and property. The range of disasters includes drought, desertification, soil erosion and land slides, deforestation, epidemics (human and livestock), refugee influx and internally displaced persons, unplanned urbanization and settlements amongst many others. Human induced disasters relate directly to human actions. They include fire, mines collapsing, and industrial pollution and construction structure failures. These latter have become common all urban centres and have generated a lot of concern due its frequency and loss of lives and damage to property.

The most difficult period of a disaster is the immediate aftermath. This period calls for prompt action within an exceptionally short period of time. In the aftermath of any disaster, a significant number of individuals will be injured and/or displaced.Many of them may still be living with the trauma they have encountered, including loss of loved ones. Affected individuals may also be without food or other essential items.They might be waiting in temporary shelters, with no idea what to do next. Some might need immediate medical attention, while the disaster aftermath environment also creates ideal breeding grounds for possible epidemics. Charged with leading the response, authorities may find themselves with limited resources and without any comprehensive plans to use them or to find more. They often need the help of a third party, which can include donors, both institutions and individuals. These institutions may have assistance to offer, but know no means in which they can provide it as they may not have any link with those who are working in the field. The following case studies illustrate how an international training course in assessment and coordination can be used effectively to address such problems in the immediate post-disaster period.

The paper presents a study case on an assessment and coordination training course, dealing with the issues regarding the medical assistance on crisis situations, thus offering the opportunity to complete their management development. That study distilled lessons learned and identified key issues to be considered when establishing or revising a national disaster management system. The structure of this paper follows the key issues identified during the training course. The study is elaborated upon by the findings from the training evaluation committee, concluded at the end of the training course.

To form training in disaster management there are some basic rules to be fulfilled:

- Protect yourself first. The first and by far the most important law seek to establish the hierarchy of importance of the different persons involved in dealing with a crisis situation.
- Other laws regarding crisis management, planning and leadership, includes a disaster unplanned = two disasters. A person with expertise in disaster management should act as a leader.
- The last one, but the most important the medical assistance must be a component of the national security system. Threats to national security pending the factor “health” are not only multiple but very serious. Medical management of disasters is not, but should be, a component of a country’s national security, especially in the context of a European country, such as Romania. The paper advocates the need for the existence of a disaster medicine education.

Thesis

Romania is among the countries that are most seriously affected by natural disasters of many types: floods, droughts and meteorological, seismic, geological, maritime and ecological disasters, as well as forest and grassland fires. Due to its geographical location and meteorological conditions, more than 70 per cent of cities and 50 per cent of the population are located in areas that are often afflicted with major meteorological, geological or maritime disasters.

Romania has been making disaster management one of its priorities at policy, institutional and operational levels. Romania has been improving its technical systems for monitoring and forecasting disasters, and it has established emergency response plans.

In the past few years, Romania has experienced natural disasters such as landslides, floods and small earthquakes in which properties were destroyed and lives were lost sometimes.

Romania is divided into 41 counties and 1 municipality (Bucharest). Each county is further subdivided into cities and communes, the former being urban, and the latter being rural localities. There are 319 cities and 2686 communes in Romania. Each city and commune has its own mayor and local council.

Each county is administered by a county council, responsible for local affairs, as well as a politically independent prefect appointed by the central government. The latter is responsible for the administration of national (central) affairs at county level. Since 2008, the president of the county council has been directly elected by the people, and not by the county council.

The civil protection structure is organised at national, county and municipal levels.

At national level, the inter-ministerial body, the National Committee for Emergency Situations (NCES) has complex responsibilities in terms of emergency management. The NCES is composed of decision-making representatives, experts and specialists designated by the ministries. The National Committee is established and acts under the direct guidance of the Minister of Administration and the Interior under the coordination of the Prime Minister.

The National Committee for Emergency Situations is composed of:

- The President: the Minister of Administration and the Interior
- The Vice President: one of the Secretaries of State within the Ministry of Administration and the Interior
- The members: one Secretary of State from each of the ministries involved or deputies representing heads of central public institutions
- Consultants: one or two experts/specialists from each ministry and the central public institution.

At national level, the General Inspectorate for Emergency Situations (GIES) is the national civil protection authority responsible for coordinating the implementation of emergency management actions and measures on national territory. The GIES is part of the National Emergency Management System and a component of the National Defence System. The GIES is an integrated body within the Ministry of Administration and the Interior managed by a General Inspector. The GIES was established on 15 December 2004 following a merger of the Civil Protection Command and the General Inspectorate of Military Fire Corps. The GIES is responsible for coordinating all organisations involved in the management of emergencies according to international regulations.

All competent institutions in the field of defence, public order and national safety are required to transmit to the GIES or, if necessary, to the Minister of Administration and the Interior or the Prime Minister information on potential emergencies, their expected evolution and consequences. The GIES communicates the decisions made by the Government or by the National Committee (through its Technical Secretariat) to the authorities of central public administration in order to secure coordinated management of emergencies.

At county level, the Professional Public Communitarian Services for Emergency Situations represent the de-concentrated services and work as the Inspectorates for Emergency Situations in the 41 countries/Bucharest. The Professional Communitarian Services for Emergency Situations are subordinate to the General Inspectorate for Emergency Situations (GIES) and provide - in their areas of competence - guidance and control of prevention and management of emergencies.

The Operative Centres for Emergency Situations are organized at ministerial level. The other central public institutions with responsibilities in the unitary management of emergencies are organized at municipal level (except Bucharest Municipality), city and commune levels. These centers can have a permanent character (for those ministries/institutions with complex functions within the National Emergency Management System) or a temporary character (they become active only when requested, following the decision by the National Committee for Emergency Situations).

To handle inter-ministerial and cross-cutting coordination, the Committees for Emergency Situations are structured at all levels from local to national. The National Committee is chaired by the Minister of Administration and the Interior and coordinated by the Prime Minister, the Ministerial/Central Public Institutions' Committees are chaired by the respective ministries/head of institution, the Bucharest Committee is chaired by the Prefect of Bucharest, county committees are chaired by the county prefect and local committees are chaired by the mayor and endorsed by the prefect.

Inter-agency coordination during emergencies is managed by a person (action commander) nominated by the National, Ministerial or County Committees or the Bucharest Committee for Emergency Situations, depending on the nature or the extent of the event or on the number of forces involved. He/she may receive support in executing the tasks from the operative groups and the advanced operative point according to the legislation in force.

Assessment and Coordination Training 2010 - Târgovişte, Romania

The General Inspectorate for Emergency Situations (GIES) – part of the Romanian Ministry of Interior and Administration – in collaboration with Johanniter International Assistance have organized a training exercise having the scope to support them with coordination and assessment capability after a scenario of an earthquake, under the Assessment and Coordination Training 2010".

Johanniter-Unfall-Hilfe e.V. is a German Christian nongovernmental organization, dedicated to excellence in the field of first aid, ambulance service, social service programs and other projects in the medical and social field. The Federal Headquarters are based in Berlin, Germany. Johanniter International is the department for development cooperation and Emergency aid, implementing and supporting projects world wide.

The Johanniter implemented in the past in Romania the following two programs:

- First aid Training, including Training of Trainers as well as courses for the general public
- Support for different projects based on a participatory approach involving local NGOs in the fields of community health and integral development

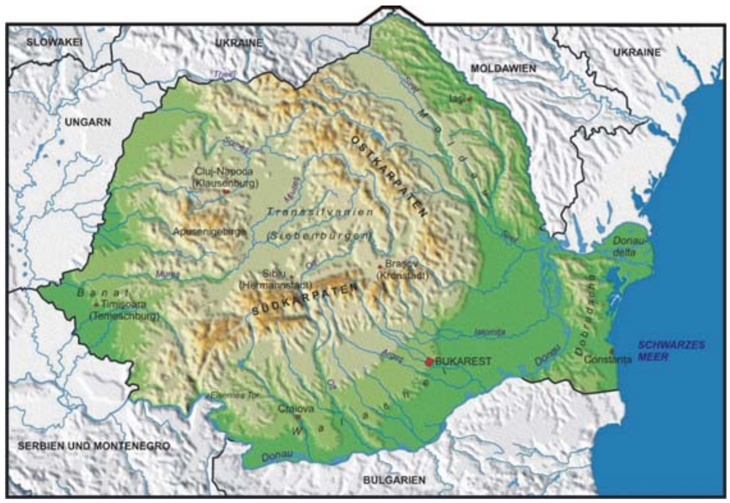
The reason Johanniter was chosen is that it have a long tradition of working in Romania, being already well known in the country.

The mission briefing was held by a representative of the HQ at the headquarters of GIES in Ciolpani. After the briefing, GIES handed over all the technical equipment, necessary for the exercise and ensured the transport in the country.

The information given to the teams participating to the exercise included excerpts of the UNDAC handbook, the FACT handbook and the course schedule.

Introduction into the Exercise:

The Govermnetnt of Romania issued an official press release, informing that on 14th October 2010, at 23:30 local time, an earthquake with a magnitude of 7.7 on the Richter-scale and approximately 135 km depth struck Romania. The epicenter was in Vrancea region, in the Eastern part of Romanian territory, in the Oriental Carpathian Mountains area.



Accordingly with the statistics and studies produced by the INFP (Romanian National Institute for Research and Development in Earth Physics), the main effects and damages of earthquakes occurred in Vrancea region are registered on 2 axes going in 2 directions from the epicenter, which include also cross border areas, as follows: North-East: Focsani-Iasi-Chisinau and South-West: Bucharest-Zimnicea-Sofia.

On 15th October 2010, in the early morning (04:00 am), Romanian authorities assembled at the headquarters of the National Centre for Response Command and Coordination (CNCCI) in Ciolpani (Northern part of capital city BUCHAREST) started to collect information in order to perform a preliminary assessment of the seism consequences.

Even if communication system is not working properly, as some of the technical facilities are affected, data provided by the local authorities during the morning show that the most damaged areas are: capital city Bucharest, Zimnicea town – Teleorman County, Giurgiu town – Giurgiu County, Craiova town – Dolj County, Iasi town – Iasi County, Vaslui – Vaslui County, Buzau – Buzau County, Vrancea County and Mehedinti County.

The outcome of the preliminary assessment reveals such an extent of damages that the national response capabilities are totally overwhelmed and international support in order to cope properly and efficient the situation is urgently needed.

Thus, the National Committee for Emergency Situations declared “status of alert” on 15 October around 07:00 a.m. and submitted to the Romanian Government the proposal to urgently request international assistance in order to cope with the “devastating” consequences of the seism.

Following that decision, on 15 OCT., at 09:30 am, the General Inspectorate for Emergency Situation sent a request for international assistance to EU-MIC, through CECIS, as well as to its neighboring countries, on a bilateral basis.

The preliminary assestment and the estimation performed by the National Institute for Building Research showed that the consequenses of the earthquake is as follows:

- In Bucharest – 6.500 deseased persons, 16.000 severly injured persons, 10.000 persons needing specialized medical treatment and 14.000 minor injured persons. There wer also 95.000 missing persons (trapped under debries) and 450.000 homeless persons.

  As material damages were estimated that 1.400 building were destroyed (residential buildings, private houses, administrative and governmental buioldings, commercial buildings, historical buildings, hotels, schools etc), 8 hospitals are collapsed, 15 hospitals are no longer the capacity to perform medical treatments. Thus, a severe shortage of medical capacities for treating patients was registred.

The water supply system is non-functional in 85% and the electricity supply system was destroyed in the Eastern and Southern parts of the city.

The 2 airports were partially damaged and was estimated to be fully operational between 16th to 18th of October.

The transport infrastructure was also affected, 35% of the streets were blocked due to buildings collapsed, the railways are non-operational, the main train station is collapsed, the underground transport is non-oparational a few tunnels have collapsed and the bridges and underground passages are severly affected, therefore were closed for traffic.

The Communication infrastructure was also affected: land communication - 65% operational, mobile networks – 70% operational, special communications – 100% operational through the TETRA system operated by Romanian Special Telecommunications Service, using Network Emergency Response Vehicles.

The monuments, sites and edifices were destroyed in 90% in the old city centre.

Also, more than 100 gas stations destroyed 25 gas explosions and fires at natural gas supply network.

- In Giurgiu, the old part of the town was entirely destroyed as well as a lot of damages were recorded in the new part of the town, at the industrial chemical platform and in the port at Danube River

  The local authorities indicated a necessity for urgent assistance to manage the earthquake's damages, due to the lack of resourses for intervention.

- In Piteşti the authorities informed that they are able to cope with the earthquake's consequences. The damages reported consisted in: 23 persons deceased, 1000 persons injured, out of which 150 severely injured, 252 buildings affected, hospitals with minor damages, all functional, water supply systems interrupted, electricity supply system interrupted, transport infrastructure partially affected, 2 road bridges collapsed, communication infrastructure is functional
- All other counties hit by earthquake reported casualties and damages, but informed that they are aable to cope with their own resourses supported by less affected neighbouring counties. Still, they declared a necessity for medical assistance (medicines, medical material supplies), drinking water, power generators and tents to provide temporary sheltering for population until the assessment of the building is finished.

The Romanian government has sent a request for humanitarian assistance, especially focusing on field of medical assistance.

Following the request for international assistance, lot of offers were received and accepted consisting in specialized teams and medical supplies, equipment and medicine, tents, canned food, bottled drinking water etc.

Many NGO's offered their support consisting in man-power and humanitarian relief for the affected population. Among those, Johanniter unfall Hilfe offered teams of experts to assess the civilian population needs and to coordinate the relief to be sent following their assessment. Their offer was accepted and the teams were expected to arrive in Romania by air by 16th of October 2010.

On 16th of October 2010 at 04.00 hrs local time, a second earthquake of 7.3 magnituude struck Romania at 35 km depth, having the epicenter at Cumpana (Fagaras Mountains) in Brasov County and afterwards 2 aftershocks of 6.5 and 5.8 magnitude followed at approximately 2 hrs distance each, affecting Campulung Muscel area and Pitesti city in Arges County.

Due to the current situation and the fact that several international assessment teams are on site, the GIES has agreed with JUH to focus on Bucharest, Giurgiu and Argeş regions.

To speed up the results of the assessment, pre-fixed meetings were arranged in accordance with JUH. Full support of the regional administration was guaranteed by the local authorities.

GIES supported teams assessment mission by providing a car including English speaking driver and also as interpreter as needed.

The 3 teams participating to the exercise included 6 members each, one trainer, one evaluator and one interpreter.

Exercise Control

Team ALPHA	Team BRAVO	Team CHARLIE
Trainer: Evaluator: Interpreter:	Trainer: Evaluator: Interpreter:	Trainer: Evaluator: Interpreter:

Course Evaluation

The general tasks for the teams involved in the assessment and coordination training were:

- To assess the local ensure that the assessment remains within its original remit, budget and is in line with Johanniter guidelines
- To liaison with government authorities, donors, local authorities, international and local nongovernmental organizations concerning the implementation of the program, including legal matters
- To represent the Johanniter in Romania – in close cooperation with the country representative
- To manage and recruit local staff if necessary
- To maintain regular communication with Berlin HQ and within the country team
- To report procedures
- To carry out needs assessments
- To prioritize security, ensuring that guidelines are followed and adapted as required, that maximum preventative measures are taken and that the team is safe and well informed at all times
- To support Media and Press work in conjunction with Johanniter spokes person

Each team was given task sheets focusing on Bucharest, Giurgiu and Argeş regions. The tasks were:

- To asses local disaster management structure,
- To identify starting points for possible projects or relief missions,
- To identify possible partners for the implementation of projects,
- To estimate the probable budget of the projects,
- To find out the structure of GIES,
- To identify points of contact to GIES
- To find possibilities where JUH disaster relief assets can be used best,
- To assess the possibility for transport medical relief items on road via Bulgaria to Romania; focus on the Danube river crossing,
- To find out customs regulation for the import of relief items,
- To assess possible warehouse capacity,
- To find details about the public health service,
- To show up any deficiencies and subsequently possibilities for JUH emergency relief assets.

The teams' responsibilities at the end of each mission were:

- To carry out assessment according to the specific task handed out each day
- To submit to the Berlin Headquarter till 1700 hours a Daily Report, a Plan of action for the next day and a Security Plan.
- To report via mobile to exercise control at minimum every three hours, when you are outside of the "camp".
- Briefing communication to exercise control at 1800 hours

Findings and Discussion

After a disaster, there are often a large number of individuals missing. It is common to find families scattered and children separated from their parents. Outside relatives and friends, especially those living overseas, naturally want to know the latest information about the condition of their loved ones. The psychological strain on children can be severe and it is essential that they be reunited with their families as soon as possible. One objective is to assist victims in connecting with their families and friends as soon as possible. Even if the victims or families do not have access to informations themselves, it is quite easy for any authorized NGO or civil society group to provide that service in the areas they are working.

In the immediate aftermath of the earthquake, there was a massive outpouring of support from international NGOs, local NGOs and community groups working on the same goals, though they used different approaches. In an environment where resources are in short supply, it is essential that response efforts should not be duplicated. Otherwise, such duplication can result in issues such as congested supply routes, competition between organizations, double vaccinations and saturation of support provided to some areas while other affected areas are neglected. Consequently, goodwill can be lost. This coordination task is too much for an authorized emergency controller to handle manually. An ICT solution can thus be the ideal solution. For instance, an electronic organization registry can help immensely. It can effectively track who is doing what, where, when and, more importantly, whether there are areas in which services are not adequate. This awareness can enable volunteers and organizations to distribute themselves evenly across affected regions.

In a disaster situation, there are usually no pre-planned locations for camps and shelters. A temporary shelter or camp can be anywhere and can range in size from a large government-maintained camp to an individual house. Due to these differences, it is necessary to record the locations and populations of all camps. This is paramount to distributing aid effectively and ensuring that no affected areas are inadvertently ignored.

In this situation, NGOs played a central role in the provision of discussion lists for the coordination of donations so that donors could find the most in need, identify what they were in need of, and in some cases, determine how to get there.

The importance of information security and privacy can never be underestimated in ICT-based humanitarian systems. In these cases, data privacy is not just a matter of encryption; it can also be a matter of life and death. If data falls into the wrong hands, it can result in rape and sexual harassment, child and female trafficking, child soldier recruits, prostitution and even ethnic cleansing. This is especially the case when a disaster occurs in an ethno-politically volatile region, where the technology and frameworks conceptualized and implemented need to be deeply cognizant of ground realities and tensions between ethnic groups, factions and non-state actors.

Romania has been making great efforts in disaster risk reduction—a priority area of its national economic and social development programme—through the formulation of disaster response plans from the national through the community level, and it has established relevant institutional arrangements, technical support and financial mobilization mechanisms. Such preparedness proved to be effective and efficient in response to many major disasters in recent years. The increased capacity greatly reduced losses of both human lives and property, and it contributed to the country's stable long-term social and economic growth.

Although seismic building codes were in place, older buildings had not been retrofitted and the overall enforcement of the codes might not have been optimum. Experts have judged that most of the significant damage to buildings could have been prevented through better observance of seismic codes for newly built buildings, the identification of dangerous buildings and the protection of key facilities against seismic shocks.

The earthquake saw foreign rescue teams joining domestic rescue efforts, but they missed the "golden" window of the first few days, arriving on the scene two days after the quake. This indicates that Romania needs to make regional or subregional arrangements on the acceptance of international humanitarian assistance, and particularly on procedures for the entry of specialized foreign rescue teams, before any major disasters occur.

If buildings such as schools or hospitals are to be occupied immediately after a disaster for shelter or emergency operations, they should be designed and constructed to a higher standard than normal buildings.

To facilitate national economic and social development, efforts in disaster management should be considered a priority: legislative documents should be formulated; disaster response plans should be prepared at all levels, from national to community; and relevant institutional and technical preparation and financial mobilization mechanisms should be established.

Disaster management and emergency response planning is the responsibility of governments at all levels, beginning with the national Government. While policy is formulated and relevant institutional arrangements and technical capacities are established at the national level, local governments are more able to carry out certain prescribed actions and to mobilize community resources to support the response effort. These response plans may serve as a basis for the international community in designing more efficient supportive processes for future disasters.

Armed forces and/or other disciplined services, including the police, are important core forces for emergency response. The mobilization and deployment of armed forces for emergency response should be a critical component of response plans at the national and provincial levels. Organization and coordination mechanisms among the armed forces and relevant government bodies should be kept operational, as mandated for civil defence tasks.

Many technical support systems are based on information and communications technologies, and they may tremendously improve the effectiveness and efficiency of disaster prevention, preparation and emergency response actions. They should be built as integral parts of national emergency response plans. Building such a technical support capacity or sharing existing capacities regionally or subregionally may greatly improve cost efficiency and reduce the burden borne by individual countries. In this regard, ESCAP may assist its members and associate members in developing such cooperative mechanisms for the development of and access to these technical support systems.

Closer cooperation among ESCAP members and associate members in experience-sharing and capacity-building for the development of comprehensive national emergency response plans, the integration of disaster risk reduction into national development planning and the sharing of technical support capacities should be developed or enhanced.

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Author Biography

Mrs. Stela Petrescu is General Director of Project Management Unit for the Hazard Risk Mitigation and Emergency Preparedness Project in the Ministry of Regional Development and Tourism of Romania since April 2004.

Previous to leading the MRDT PMU for Component B of HRMEP Project, Mrs. Petrescu was Chief of Department regarding Projects for seismic risk and landslides mitigation in the General Technical Directorate of MDRT. She had the responsibility of coordinating the proper implementation, of the ongoing national/international projects in the field of seismic risk and landslides mitigation and to propose and prepare new projects to be financed by international organisms/donors. The most significant projects she was working on were:

- Project on the Reduction of Seismic Risk for Buildings and Structures, a technical cooperation program organized by the Japan International Cooperation Agency;
- EUR-OPA Major Hazards Agreement, Euro-Mediterranean partnership coordinated by the Council of Europe, to prevent, mitigate and solve crises situation generated by natural and/or technological disasters;
- Creating a nation-wide, unitary Geographical Information System (GIS) through a Pilot Assistance Project for Pan–European transportation priority investment, included in the High Technology and Cross Border Operations Working Groups of the "Action Commission for an Enlarged Euro-Atlantic Community" under the authority of Center for Strategic and International Studies, Washington D.C.

Mrs. Petrescu was the Chief of Technical Department in the Project Management Unit for School Rehabilitation Project, Project co-financed by The World Bank, the European Council Development Bank and the Government of Romania. The Project financed civil works/building constructions (retrofitting existing schools and erecting new ones), professional architectural and engineering services to complete technical survey and design, school mapping, preparation of detailed building plans, specifications and bidding documents.

Mrs. Petrescu is member of the National Technical Committee for Seismic Risk Reduction of Buildings, National Union of Romanian Architects and of the Professional Association of Romanian Architects.

FP7 PROJECT ACRIMAS – AFTERMATH CRISIS-MANAGEMENT SYSTEM-OF-SYSTEMS DEMONSTRATION

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Abstract

Large-scale incidents (man made and natural) inside and outside the EU require a coordinated response from crisis managers and first responders from different agencies across Europe and with resources from all levels of government. Among others, a common operational picture, well trained and equipped teams, secure communications, and mission flexibility are core assets for successful crisis management.

Currently, crisis management in the EU can be regarded as a highly diversified and heterogeneous “system-of-systems” integrating diverse organisations and components with different cultures, policies and assets, and various stakeholders and procurement schemes. This “system-of-systems” incorporates technology, procedures, organisational concepts, and human factors. It is the aim of the ACRIMAS project to prepare a large scale European demonstration and experimentation programme within the FP7 Security Theme, facilitating European wide collaboration, cooperation and communication in crisis management and improving cross-fertilisation between Member State organisations.

ACRIMAS, a 15 months project with 15 partners from 10 European countries, started in February 2011, and addresses organisational and legislative frameworks, situational awareness, decision support, logistics, communications, training and exercises, restoration of services and media involvement, by following a user-centric and scenario-based approach. It will lead to the validation of shared user needs and the definition of a demonstration and assessment method with associated metrics to define a continuous process of capability improvements. The outcomes of ACRIMAS will be the definition and preparation of this method, documented in a roadmap (Phase I) that will prepare the actual demonstrations and experiments (Phase II).

This paper describes the scope, approach, and envisioned results of the ACRIMAS project.

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Introduction

The FP7 security research project ACRIMAS – Aftermath Crisis Management System-of-systems Demonstration Phase I – is not a research project as such, but a so-called Support Action to prepare the actual, large Demonstration Programme on Aftermath Crisis Management – the Phase II –, which will be published as a call for proposals in the last work programme of the FP7 security research in 2012. As a Support Action, ACRIMAS will not deliver new research and related results on aftermath crisis management, but a strategic roadmap setting out the main areas and relevant topics of crisis management to be addressed by concrete demonstration and experimentation activities in Phase II, which have to be identified and sequenced in the roadmap to be delivered. In addition, ACRIMAS has to deliver a demonstration concept for Phase II, describing how and where the demonstration and experimentation activities in Phase II should be conducted.

Besides these two main deliverables, an important objective of ACRIMAS is to raise awareness among the relevant stakeholders in Europe about the upcoming Demonstration Programme and its preparation by ACRIMAS. It is the aim of this ACRIMAS contribution to the TIEMS 2011 conference to assure that the broad stakeholder community present will be made aware of the opportunities for participation in the Phase II Demonstration Programme. By doing so, ACRIMAS also intends to critically discuss and validate its work approach and initial findings so far, and to incorporate the feed-back of the TIEMS community into its successive work.

Crisis Management – current situation and work approach of ACRIMAS

Crisis Management (CM) is a core capability of modern societies. Managing the return to normal life in case of major incidents as quickly and swiftly as possible is paramount for limiting damage, chaos, and panic. At the same time, CM is a complex multidimensional discipline, incorporating both the managerial aspect of organising the mission and the technical facilities employed to assist. This mixture becomes even more intricate as CM evolves along the phases of a crisis, ranging from pre-incident to post-incident phases. CM requires the involvement of a wide range of stakeholders with different responsibilities, backgrounds, capabilities and perspectives, including civil protection forces, first responders such as Police, Fire Fighters, Civil Protection, Health Services, Non-Governmental Organisations, sometimes even the military, and the public at large. CM, thus, is a highly diversified and heterogeneous area with different approaches developed in terms of CM cultures, used technologies and available assets in the Member States (MS) of the European Union (EU).

To add to this picture, the growing globalisation and interdependence between countries calls for an increased number of cross border or external (outside Europe) operations. They have an increasing geographical emprise, with regional or even trans-national impact, involving a diversity of responding services, adding complexity to the other challenges crisis managers and first responders face. The close collaboration and effective, targeted information sharing between all the actors involved is therefore crucial if the response to an emerging crisis requires has to be quick, efficient and decisive. These elements, together with the resulting necessity to inter-operate in a multi-national set of multiple organisations including the affected public generate new challenges for the management element of CM.

On the technical side, a number of new technologies has evolved to address the above mentioned challenges. Above all, these technologies greatly enhance situational awareness. New sensors allow for a more accurate detection, identification and classification of a situation, and information management infrastructures foster the compilation of a growing amount of information at command and control level, requiring new forms of display and interaction. This includes agreed-upon protocols and integrated mechanisms and tools that allow in particular for an improved effectiveness of multinational crisis response and interaction. In addition, new field systems allow more efficient location of the teams and better knowledge of the missions, making the job of the decision-makers to task the teams in the field easier.

Current situation of aftermath crisis management in the EU

The ultimate goal of CM in the EU is to ensure a timely, co-ordinated and effective response to any large-scale crisis, man-made or natural, be it caused by terrorist or criminal means, natural disasters, major industrial or technical accidents, both inside and outside the EU, as recently outlined by ESRIF (European

Security Research and Innovation Forum, 2009). In the context of this project, a crisis is understood as an:

"incident affecting a society with the potential to cause loss or damage to persons, property or the environment which requires extraordinary coordination, resources, and skills in response". Subsequently, CM relates to a *"process of planning and implementing measures aimed at preventing, reducing, responding and recovery from a crisis" (ISO, 2010).*

The multi-faceted CM landscape is reflected in policies, operational procedures, organisations, assets, budgets and personnel at all levels of the 'CM System'. This highly diversified and complex "CM architecture" reflects the EU maxim of "National responsibility and European solidarity", based on the subsidiary and proportionality principle. National sovereignty and responsibility has led to different CM approaches in the MS, ranging from more centralistic approaches (e.g. France, Italy, Spain) to fully federal, subsidiary approaches (e.g. Germany, The Netherlands, Scandinavia). CM approaches are further characterised by different degrees of involvement and collaboration of civil and military institutions – some MS being much more advanced in the "joint" vision –, and by individual and specific CM system solutions that generally exhibit little or no interoperability across borders.

While the role of the EU predominantly was limited to facilitate the "European solidarity" by e.g. co-ordinating requests for support in catastrophic incidents from MS and outside the EU and the deployment of available MS assets, recent EU initiatives in CM respectively with relevance for CM have been launched to improve the performance of the EU itself in crisis situations. The main initiatives, covering partly the internal as well as the external dimension of EU security, which are to be acknowledged by ACRIMAS, so far include:

- The *Community Mechanism for Civil Protection*: co-ordination of the deployment of civil protection units from MS in major disasters via *MIC, the Monitoring and Information Centre* of the EU, run by DG ECHO, Civil Protection Unit, and facilitated by a set of supporting tools (CECIS, the Common Emergency & Information System, the training programme and the concept of Civil Protection modules),
- The provision of strategic assets like *GMES* (DG ENTR) and *GALILEO* (DG TREN) and *ESA* (including space research), and of *CM-related R&D*, in particular *security research* (DG ENTR), *ICT* (DG INFSO) and *policy research* (DG RTD),
- *ESRIF, the European Security Research and Innovation Forum,* which focused in its final report among other areas on the mid- to long-term research and innovation needs in CM in Europe,
- *Humanitarian aid*, co-ordinated by DG ECHO,
- The *Instrument for Stability (IfS)*, external aid instrument for quick response to political crises or natural disasters in 3rd countries (complementary to humanitarian aid), supporting non-proliferation and countering "global threats", co-ordinated by DG RELEX,
- *Civilian & military CM capability development* (implications of the Lisbon Treaty).

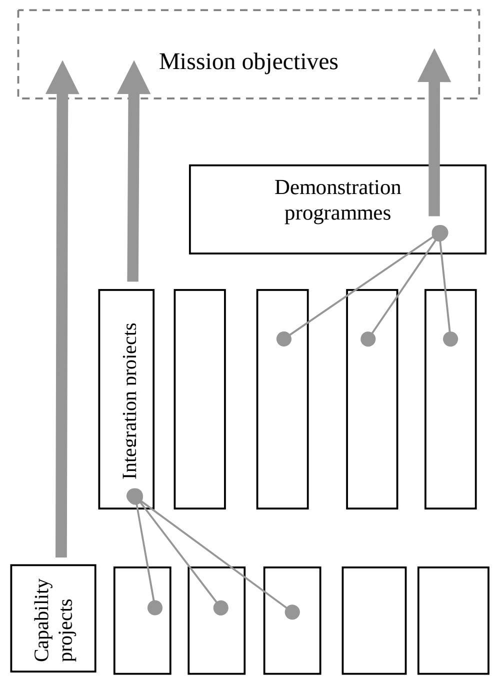
In contrast to military operations, the civil crisis management system-of-systems does not belong to one entity as civilian operations do not obey to a strict unique chain of command. Although the coordination and the tactical command and control are joint, the various organisations keep their chain of command to a large extent and use their respective legacy systems. This situation increases complexity as no central organisation can impose the same organisational, procedural and technological choices to everybody. Any development – be it technological, methodological, procedural or policy-related – of CM based on a blueprint, or even a static vision, will therefore not be feasible. This is the common understanding of the ACRIMAS consortium, and as such the baseline for our work identifying and highlighting those CM areas and individual topics, which should be addressed by the Demonstration Programme to allow for a gradual evolvement of CM policies, procedures and technologies.

Before illustrating the ACRIMAS work approach, first the background of the FP7 Security Research Program will be described.

<u>Programmatic structure of FP7 Security Research Program</u>

Research in the FP7 security theme consists of several building blocks, representing three - in some cases parallel, in others subsequent - routes that contribute to the overall objectives (European Commission, 2010, see also figure 1).

Figure 1: Research routes to meet the FP7 security theme objectives



On the lowest level of the building block structure, ‘capability projects’ aim at building up and/or strengthening security *capabilities* required in the security missions of FP7. On the medium level of the building block structure, ‘integration projects’ aim at mission specific combination of individual capabilities providing a security *system* and demonstrating its performance. On the top level of the building block structure, ‘demonstration programmes’ will carry out research aiming at large scale integration, validation and demonstration of new security *system-of-systems* going significantly beyond the state of art. They depend upon the compatible, complementary and interoperable development of requisite system and technology building blocks of the integration projects and capability projects. They intend to promote the application of an innovative security solution, which implies a strong involvement of end users, taking into account the relevant legal and society related issues, and strong links to new standardisation.

Demonstration programmes will be implemented in two phases:

<u>Phase I projects</u> will define the strategic roadmaps and trigger Europe wide awareness, both elements involving strategic public and private end users as well as industry and research. The strategic roadmaps will take into account relevant completed, ongoing and planned work and indicate further research needs for Security theme integration projects and capability projects, but also for other themes of the FP7 or for the national level.

<u>Phase II projects</u> will then technically implement the system-of-systems demonstration, taking already into account steps which have to follow the research, like certification and/or standardisation (if and as appropriate), development of marketable products and pre-procurement. This will mobilise a significant volume of resources.

Upcoming EU research & demonstration activities in the area of CM – and so ACRIMAS – need to carefully take into account and assess the described current situation, in order to achieve improved coherence and transparency in the development of this vital European capability.

<u>ACRIMAS working approach</u>

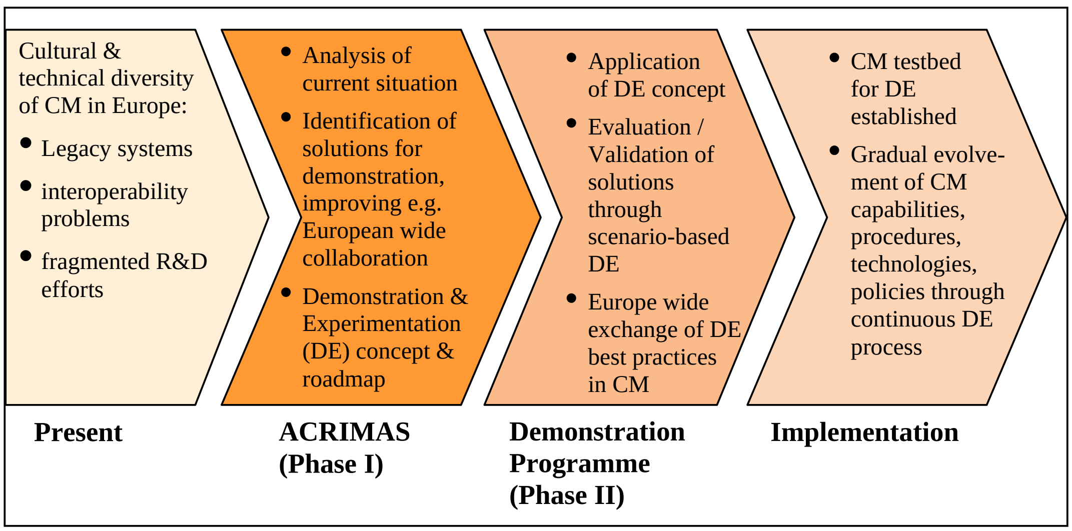
The Phase I project ACRIMAS elaborates a systematic CM integration process, to be implemented within a Demonstration Phase II programme (figure 2). The process allows for gradual evolvement of CM capabilities through **demonstration and experimentation (DE) activities**, facilitating Europe wide collaboration, cooperation and communication in CM at different levels of decision making, and respecting the different CM approaches and ambitions of the EU MS. This process will improve the transfer of related knowledge between agencies and states and promoting an environment for co-development of technology and methodology where users and providers work together.

ACRIMAS further emphasises community-building which will be considerably supported by the execution of the subsequent demonstration programme, bringing together the various key stakeholders and the available demonstration and experimentation infrastructures in a case-by-case demonstration or experimentation activity.

ACRIMAS is **scenario-based** in the sense that characteristic CM scenarios will be identified, selected and developed to constitute a sound basis for ensuring the work of posing user needs and requirements, finding solutions and documenting corresponding R&D needs and demonstrations topics to be integrated in the roadmap. The scenarios embrace four major different categories of crises; terrorist attack, natural disaster, industrial accident, and a specific "EU external CM intervention" scenario. The selection of the concrete scenarios to be developed is driven by the aim to provide a structured, top-down approach to identify the most relevant/urgent/critical areas of European CM, which need to be addressed by the subsequent Demo Phase II programme.

ACRIMAS is **user-driven** in the sense that users and other stakeholders in terms of first responders, authorities and governmental bodies are actively involved throughout the project process, some of them as full project partners, most of them linked to the project through a supporting Expert Group. They play a central part in the identification of relevant CM topics which should be addressed by DE activities in Phase II, and the demonstration concept to be elaborated.

Figure 2: ACRIMAS general concept and vision



The ACRIMAS consortium consists of 15 partners from 10 European countries: Fraunhofer (Germany), Crisis Management Initiative (Finland), NCSR Demokritos (Greece), Netherlands Institute for Safety (The Netherlands), T-SOFT (Czech Republic), Swedish Defence Research Agency – FOI (Sweden), Joint Research Centre – Institute for the Protection and Security of the Citizen (Belgium/Italy), Center for Security Studies – KEMEA (Greece), The Netherlands Organisation for Applied Scientific Research – TNO (the Netherlands), The Turkish Red Crescent Society (Turkey), Technologies Sans Frontières (Belgium), United Nations University – Institute for Environment and Human Security – UNU-EHS (Germany), Cassidian (France), SELEX Sistemi Integrati (Italy), and the Public Safety Communication Forum Europe – PSCE (Belgium).

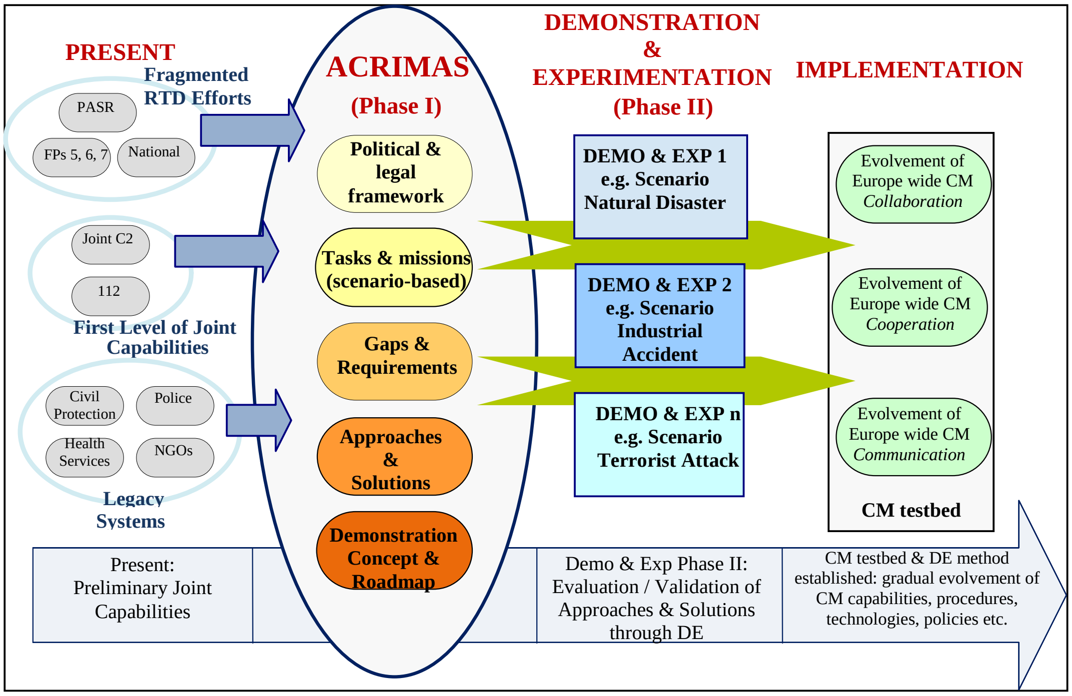
ACRIMAS demonstration concept

Demonstrations or experiments (DE) provide excellent means to address problems that are inherently complex, for example in its interaction of technology, people, and methodology and external factors. As such, DE are key activities to achieve progress in the system-of-systems layer of EU-level enterprises.

The given cultural, technical and organisational diversity of CM approaches in Europe, reflecting national responsibilities, requires the mentioned user-driven, broader system-of-systems view, focusing on the need to achieve continuous management of the CM complexity (which most likely can never be solved once and for all by one solution). The aspired CM demonstration concept should allow for addressing the diversity of CM approaches in Europe while keeping its local specificities, and continuously identifying its weaknesses which need to be addressed by future research and demonstration efforts.

The ACRIMAS approach to work will lead to the definition and preparation of such a systematic CM integration process (Phase I). In Phase II the method will be applied on a larger scale in the European CM community, addressing concrete needs within selected critical areas, by demonstrating candidates for solutions to the needs, and by gathering and disseminating the knowledge thereby gained. One outcome of the Phase II will thereby be an established "CM testbed" which shall lead step-by-step to a more harmonised and coherent development of CM policies, capabilities, procedures and technologies in Europe (figure 3).

Figure 3: ACRIMAS demonstration concept and scope of Phase I

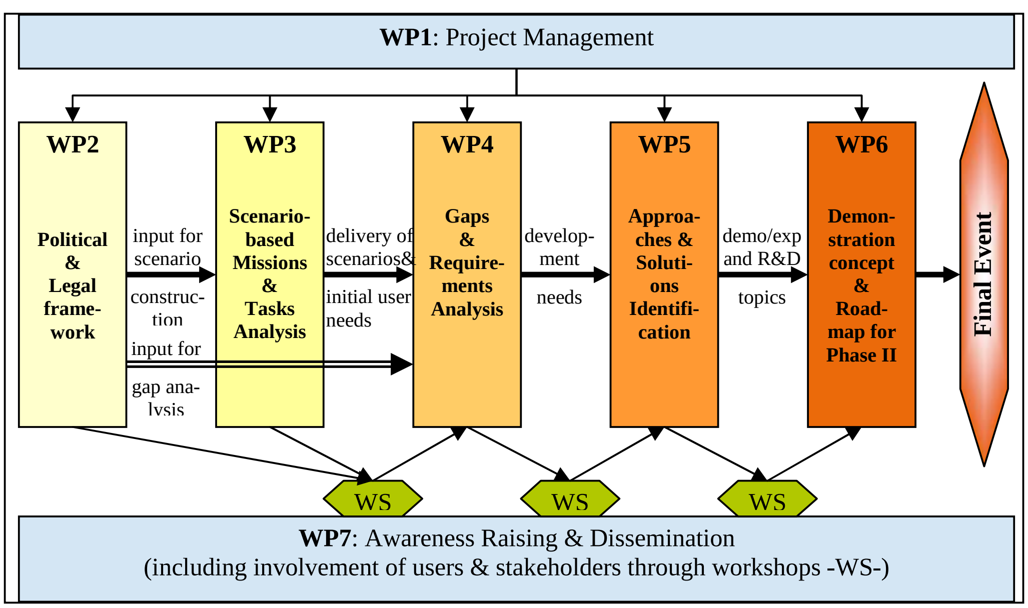


ACRIMAS thereby aims at preparing a systematic and continuous CM integration process, to pave the way for a continued incremental development of the CM community in Europe and its capabilities.

ACRIMAS Work plan

The ACRIMAS work plan is depicted in Figure 4 below.

Figure 4: ACRIMAS work plan



WP1 - Project management: Deals with the project management, including technical, financial and administrative management.

WP2 - Political and legal framework: Analyses the political, legal and societal aspects of CM. Together with WP3, this will provide a basic framework for all other WPs to consider.

WP3 - Scenario-based missions and tasks analysis: Analyses the CM process to clearly identify the missions and tasks relevant for Phase II and to sort out related commonalities and differences in the MS and on the EC level. Selected scenarios will be identified and analysed in terms of likeliness, severity, consequences, cross-border character, multi-nationality, complexity and type of complexity (technical, human, legal etc.), thus providing an initial CM mission and task (user need) analysis to be elaborated on in WP4.

WP4 - Gaps and requirements analysis: Uses the outcome of WP2 and WP3 to identify and validate the gaps, shortcoming and discrepancies of current CM missions, tasks, procedures etc. to be addressed in Phase II. Collected user needs, expanded from the initial input from WP3, and requirements will be set and prioritised to define the main axes and objectives for Phase II.

WP5 - Approaches and solutions identification: Dedicated to identifying and analysing potential solutions to the needs and gaps with respect to the thematic areas as found in WP4, by particularly taking into account the results of completed and ongoing EU projects in the CM domain (FPs 5, 6, 7, and PASR). By performing a quick scan on these EU projects results solutions will be identified. Consequently, promising solutions will be selected based on their relevance to cope with the WP3 scenarios and to solve the gaps as defined in WP4. Next, there will be an investigation of the selected technical solutions, consisting of an assessment of maturity, usability in different crisis situations, upgradeability and interoperability. The outcome is a list of potential (technical and non-technical) topics for demonstration & experimentation in Phase II, and a list of topics that require additional R&D.

WP6 - Demonstration concept & Roadmap for Phase II: Uses first the outcome of WP4 and WP5 to provide a list of prioritised topics where there are critical development needs that need to be addressed with experiments and demonstrations. This will be complemented by an assessment of what other activities must be performed, such as research and technical developments. Additionally WP6 will assess what infrastructure will be needed for demonstrations within CM, such as demonstration platforms or mechanisms to assure the dissemination of demonstration results. Top-level guidelines on how to perform demonstrations in the area of CM will be developed. Methodology for the selection of an optimal portfolio of demonstrations, in contrast to simply viewing them as isolated projects, will be provided, taking into account their interconnectedness. The ACRIMAS demonstration concept of a continuous integrative CM process will be prepared, based on the above tasks, together with the experience from previous WPs and an adaptation of available DE methods to the CM context.

WP7 - Awareness raising and dissemination: Gathers all essential activities of awareness rising and dissemination. The results of ACRIMAS, although validated by the users and stakeholders linked to the project through their dedicated involvement in three ACRIMAS workshops and the Final Event, also need to be known and accepted by the greatest audience possible as the CM community shall adhere to the objectives, approach and content of the Phase II.

Expected results

The mentioned EC initiatives and related efforts, namely in the European Framework Programmes (FPs) 5 – 7, and moreover in the 27 MSs, underline the importance of an improved CM capability in Europe. It is the understanding of the ACRIMAS consortium that it has to support the achievement of a holistic, comprehensive view on all these diverse and still fragmented activities in the CM area.

ACRIMAS is going to successively assess these problem areas in the light of those “hot spots” which need to be addressed in the Phase II demo programme. In this way, a widely shared and accepted development way forward through a set of identified DE activities to enhance pan-European capabilities for effective aftermath CM has to be achieved. This way forward will encompass the following thematic areas, as so far identified:

Common organisational and legislative frameworks: to harmonize existing procedures within organisational boundaries and provide unified response planning.

Situation awareness: to gather the information available and display it in order to provide the end-users with the most accurate view possible of the incidents, at tactical, operational, strategic and political level, whilst taking into account the human aspects of information processing such as information overload in a stressed environment.

Decision support: to provide the end-users with adequate (collaborative) tools to support their decision processes, such as collaborative planning or modelling the spread of contamination.

Deployment of resources: to aid decisions taken at operational, strategic, national and international levels on the timely and effective deployment of resources (personnel, equipment, medical centres, decontamination chain).

Communications: to allow all organisations and teams to exchange information between themselves and with media and the public, through reliable and secure communications networks, using hybrid networks combining infrastructure, satellite and mobile networks while warranting the security of the information.

Training tools/methods: to provide common preparatory activities for the involved organisations as a means of promoting a common response to major incidents, including joint training facilities and exchange of experts. This aspect is essential to reach an optimal level of preparedness.

Systems and procedures for restoration of basic services and infrastructures (water supply, energy, transport, telecoms) including psycho-social support of first responders and victims (prevent/deal with psycho-traumatic stress).

Media involvement in crisis situations*:* to adequately involve media in the development of crisis situations, as a means to provide responsible and helpful information to the public and minimising undesirable interference. Moreover the media and public may serve as valuable information sources, in effect additional sensors, for managing the crisis.

Discussion

The ultimate aim of the ACRIMAS project is to finally contributing to an improved operational effectiveness of CM within Europe, by preparing the Phase II demonstration programme, which in turn has to address and support the improvement of the operational effectiveness. This improvement is expected to take place by undertaking selected DE activities, in which current CM systems, procedures and technologies together with new or emerging ones will be tested and evaluated in defined, concrete CM scenarios. The European added value has to be achieved by choosing those DE scenarios and CM assets, which have a clear European impact, e.g. because of its demand of cross-border and multinational capabilities to fight a crisis.

Furthermore, ACRIMAS will provide a sound basis for continuous R&D on European level, taking into account all the dimensions mentioned in this paper, making CM a complex process, both in a technological, organisational, human factors and political perspective.

Finally, the active participation of end-users, stakeholders, industry and researchers in this process is essential not only for the relevance of the outcomes of the ACRIMAS project, but also for the success of European research on CM issues in the long term. Within ACRIMAS the means of choice to achieve this involvement are the three open project workshops and the final event (figure 4), in which each main step of the ACRIMAS work and its findings towards Phase II will be discussed with and validated by the CM stakeholder community present. Also, these workshops and related awareness raising and dissemination activities of the ACRIMAS consortium are dedicated to the need to support and initialise the required active participation of the CM stakeholder community in the DE activities of Phase II.

All relevant project information including information on the project workshops and the final event can be found in due time on the project website: www.acrimas.eu.

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Author Biography

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Hans-Martin Pastuszka is graduated in economics (diploma degree). Since 2001, he is a senior researcher in the department "Meta Analyses and Planning Support" at the Fraunhofer Institute for Technological Trend Analysis (INT). In his current work he focuses on analyses and scientific support regarding strategic aspects of long-term oriented defence research planning of the German FMoD. These aspects comprise organisational and conceptual issues, the planning process itself and related activities, like current R&D initiatives on European level, namely the European Defence Agency (EDA) and the FP7 European Security Research Programme. On project level, he is participating in the FP7 project CRESCENDO. In 2008/09 he was Sherpa of ESRIF working group 4 "Crisis Management", and is a member of the FP7 Security Advisory Group to the Commission since October 2009. Hans-Martin acts as ACRIMAS coordinator.

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Merle Missoweit is graduated in biology (diploma degree) and obtained a PhD in biology at the Faculty of Science of Bonn University (Germany). Since 2007 she is a senior researcher in the department "Meta Analyses and Planning Support" at the Fraunhofer Institute for Technological Trend Analysis (INT). In her current work she focuses on analyses and scientific support regarding strategic aspects of long-term oriented defence research planning, especially in the field of international defence co-operations (EDA, LoI-EDIR-FA 6) for the German FMoD. At EU level she was involved in a number of recent EDA initiatives (Capability Development Plan, European Defence Research & Technology Strategy, European Defence Centres Initiative) and, on the security side, in the ESRIF working group 4 "Crisis Management". Further, she is active in the field of research planning tools for biological hazard assessment being e.g. member of the respective governmental expert group of the German Federal Office of Civil Protection and Disaster Assistance (BBK), Commission for Civil Protection. Merle is co-coordinator of ACRIMAS.

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Martin Hamrin is an analyst at the FOI's Division of Defence Analysis. He holds a Licentiate in Mathematics as well as a Bachelor in philosophy. He has worked with operations analysis at a strategic level, in intelligence and in several projects concerning CM, for example in the collaboration with US Department of Homeland Security. He is involved in FP7 projects Wimaas and DeMASST.

A Tale of Two Cities: Leadership in Organisational Recovery Post Significant Natural Disaster.

Paul Swain AFSM
Chief Officer
Australian Capital Territory Fire Brigade

Canberra

The Fires

In 2003 the city of Canberra, Australia's national capital with a population of approximately 350,000, experienced bushfires that burnt into the suburbs. 550 homes were lost and four people died. After the fires, years of soul searching, enquiries and litigation, have impacted on the Fire Service.

Many changes to organisational structure with numerous Commissioners and Chief Officers have added to cumulative organisational stress and ensured that moving forward is impacted by constantly looking backwards.

In 2003, the Canberra community was devastated by bushfires. Four people died, a total of 470 homes were destroyed, and 2000 businesses, homes and vehicles were damaged. Prior to Black Saturday in Victoria in 2009, the Canberra bushfires were the second most expensive bushfires in Australian history, second only to the Ash Wednesday bushfires of 1983, which devastated Victoria and South Australia and killed 75 people.

Southern Australia's natural environments are some of the most fire-prone areas in the world. High temperatures and limited summer rainfall produces conditions of very high fire danger, particularly in eucalypt forests. Sudden strong wind changes often hamper efforts to control blazes and threaten the lives of firefighters.

On 7th and 8th January 2003, upper level thunderstorms over the Australian Alps, associated with a cold front and pre-frontal trough, resulted in numerous lightning strikes which ignited at least 89 fires in Victoria, 74 in New South Wales and three in the Australian Capital Territory. These lightning strikes ignited 160 separate fires, which burned for ten days in the adjoining Kosciuszko National Park, before advancing into Canberra suburbs. Severe drought conditions – low relative humidity and high temperatures that endured – and winds of more than 200kmph led to the severe firestorms. Fires in Victoria and New South Wales burnt for 60 days, during which there was little substantial rainfall, and eventually covered 1.96 million hectares of the Australian Alps and nearby areas, including 164,000 hectares, or nearly 70% of land in the ACT.

Many have questioned the development of new suburbs so close to natural bush land in Canberra. Preparing residents for the fire season, training and equipping emergency response teams and developing adequate building codes to protect houses in fire-prone areas are obvious imperatives.

Many people suffering from smoke inhalation and other fire-related illnesses flooded the Canberra Hospital. Due to a blackout, power was cut to the hospital and it was forced to rely on auxiliary power. The authority coordinating the bushfire response, the Emergency Services Bureau, based in Curtin, also came under threat.

Parts of the Lower Molonglo Water Quality Control Centre were destroyed by fire. Had fire breached and ignited chemical storage tanks, the release of toxic gases could have required large scale evacuations of the national capital.

The Aftermath

Canberra suffered not just economic loss but significant social devastation. The deaths of four people in this tight-knit community affected many. Those who lost their homes, loved ones, and livelihoods were affected by depression. Much criticism was unleashed against the emergency services crews responsible for controlling the blaze. Accusations of a lack of preparedness and adequate warning meant that many believed more could have been done to avert disaster. As a result, some emergency workers have also been affected by depression, following the disaster.

The ACT, NSW and Federal governments initiated a number of community and official responses to the Canberra bushfires. In particular, the McLeod inquiry delivered a number of findings ranging from recommending an increase in the provision of equipment, to an increase in the number and training of fire brigade crews. The importance of community education and timely information provision were also highlighted.

Since March 2003, there have been seven Emergency Services Commissioners, six Fire Brigade Chief Officers and six Rural Fire Service Chief Officers in the ACT. A number of official enquiries have been conducted into the cause of the fires, the handling of the response to the fires both in the Australian Capital Territory and the adjoining state of New South Wales where the fire burnt relatively unchecked for 10 days prior to descending into Canberra. There have also been a number of organisational structures and reporting systems. It is only recently that the fire service has settled down and started to look forward instead of backwards. Legal proceedings as a result of the fires continue today.

Melbourne

The Fires

In 2009 the city of Melbourne, the Australian state of Victoria's capital was also impacted by bushfires. The majority of the fires ignited and spread on a day of some of the worst bushfire-weather conditions ever recorded. Temperatures in the mid- to high 40 degrees Celsius (approx. 110–120 °F), and wind speeds in excess of 100 km/h (62 mph), precipitated by an intense heat wave and almost two months of little or no rain, fanned the fires over large distances and areas. This created several large firestorms northeast of Melbourne, where a single firestorm accounted for 120 of the 173 deaths. A cool change hit the state in the early evening, bringing with it gale-force southwesterly winds in excess of 120 km/h (75 mph). This change in wind direction caused the long eastern flanks of the fires to become massive fire fronts that burned with incredible speed and ferocity towards towns that had earlier escaped the fires.

The fires destroyed over 2,030 houses and more than 3,500 structures in total, as well as damaging thousands more. Many towns northeast of the state capital Melbourne were badly damaged or almost completely destroyed, including Kinglake, and Marysville. The fires affected 78 individual townships in total, and displaced an estimated 7,562 people. Many of those displaced sought temporary accommodation, much of it donated in the form of spare rooms, caravans, tents, and beds in community relief centres.

The majority of the fires were ignited by fallen or clashing power lines, or were deliberately lit. Other suspected ignition sources included lightning,http://en.wikipedia.org/wiki/Black_Saturday_bushfires - cite_note-lightning_Gippsland-4 cigarette butts, and sparks from a power tool. Also implicated in the underlying conditions was a major drought that had persisted for more than a decade. By early to mid-March, favorable conditions aided containment efforts, and helped to extinguish the fires.

A week before the fires, an exceptional heat wave affected southeastern Australia. From 28–30 January, Melbourne broke records by sweltering through three consecutive days above 43 °C (109 °F), with the temperature peaking at 45.1 °C (113.2 °F) on 30 January, the third hottest day in the city's history.

A total of 3,582 firefighting personnel were deployed across the state on the morning of 7th February in anticipation of the extreme conditions. By mid-morning, hot northwesterly winds in excess of 100 kilometres per hour (62 mph) hit the state, accompanied by extremely high temperatures and extremely low humidity. Also a total fire ban for the entire state was declared.

As the day progressed, all-time record temperatures were being reached. Melbourne hit 46.4 °C (115.5 °F), the hottest temperature ever recorded in an Australian capital city, and humidity levels dropped to as low as six percent. The Fire danger Index reached unprecedented levels, ranging from 120 to over 200.

By midday wind speeds were reaching their peak, and by 12:30 pm power lines were felled in Kilmore East by the high winds. These sparked a bushfire that would later generate extensive pyrocumulus clouds, and become the largest, deadliest, and most intense firestorm ever experienced in Australia's post-European history. The overwhelming majority of fire activity occurred between midday and 7:00 pm, when wind speed and temperature were at their highest, and humidity at its lowest.

The Aftermath

Since Black Saturday, the State of Victoria conducted a Royal Commission into the fires. Issues of pre-fire warnings and post fire recovery have been emphasised. The Victorian Bushfires Royal Commission's final report has recommended the "stay or go" policy remain and criticised the actions of the state's emergency chiefs on Black Saturday.

The 17-month long Royal Commission recommended Victoria's "stay or go" policy remain but a bigger emphasis be put on encouraging people to leave early. Victoria will develop a comprehensive approach to emergency evacuation to ensure communities exposed to devastating bushfires can escape in time. The strategy would encourage people in fire-prone areas to leave early and would include plans for assisted evacuation.

The report is scathing of the role the Chiefs of Victoria's police force and two regional fire fighting bodies played on Black Saturday. It criticised the Country Fire Authority Chief Officer and Department of Sustainability Chief Fire Officer over a lack of leadership in the incident control room. The report states both Chiefs should have done more to warn communities about the approaching fires.

The commission labelled the Police Commissioner’s approach to emergency co-ordination "inadequate". The report found that the Minister for Police and Emergency Services "acted properly" on Black Saturday but should have urged the Premier to declare a "state of disaster". "The circumstances clearly met the criteria for such consideration," the report stated. "Such a declaration would have recognised the gravity of the situation and might have sharpened emergency agencies' focus on community safety and warnings."

The report also flags amendments to the Emergency Management Act that would designate power to the Chief Commissioner of Police.

The Leader of the Opposition in Victoria’s Parliament claimed the report vindicated his attacks that the Government did not properly prepare for the Black Saturday bushfires. He said the Government failed to properly prepare the state and allowed a break-down in leadership and communication during the fires and there was an urgent need to increase fuel reduction and change the command structures.

Since February 2009, the Chief Officers of two of Victoria’s three fire services have been replaced twice and the Chief Police Officer replaced. The enquiries are finished, however recovery for Firefighters and Senior Operational Staff has a long way to go. The experience of Firefighters in the Australian Capital Territory is that eight years after their fire disaster, many staff and the community have not moved on. They either bear resentment of their treatment in enquiries, by Government and the media, or they have witnessed the revolving door of senior management post incident. Organisational health has been slow to return while individuals battle their demons of not being able to save community lives and property from the devastation of fire.

Lawyers for the Government at the Royal commission claimed that what went wrong on Black Saturday cannot be pinned on those in charge or how they executed their roles; while lawyers for the Commission claimed leadership was central to understanding the anatomy of the disaster. Other failures identified a lack of fuel reduction burning, planning codes that allow people to build in heavily timbered areas and questionable regulation of the powerlines that cross country Victoria.

Chief Officers and the Police Commissioner claimed that they took a strategic, state-wide view and that issuing of public warnings was not their job. The media were less than complimentary with comments about a passive management style, a lamentable lack of responsibility and leadership and a complete breakdown in strategic incident management. The criticism encompasses virtually the entire leadership group and amounts to a failure to give the community the one thing that could have made a difference in what amounted to catastrophic fire conditions; timely, locally targeted information that allowed communities in the fire path to get the hell out of there. No excuses were accepted by the media, the Government and ultimately the people of Victoria. After a politically acceptable period of time, Fire and Police Chiefs were moved out of their positions.

Lessons Learnt

The impact of major natural disasters can be all pervasive, impacting on Service culture; industrial harmony; the job, the organisation and its people; and the community and their perception of those employed to protect them. Nevertheless, what can be done to allow wounds to heal and restore Service pride and the feeling of community worth? Leadership is critical, both situational leadership post disaster and strategic leadership re-positioning the emergency service for the future. But there cannot be leadership where there are no leaders.

The Media

Increasingly the media is playing a greater part in community perception of disaster management; government response to instigation of enquiries, implementation of measures to improve disaster mitigation and identification of ‘who is to blame’; and also to Emergency Services post incident analysis, improvement plans, public education and all types of administrative and managerial response to the scrutiny the media puts those in charge under.

Real time images often transferred by members of the public via face book or twitter can and often do, provide more up to date intelligence than the Fire or Emergency Service can generate. If tapped into in a timely manner, social media can be a huge bonus for Emergency services in planning response and particularly recovery measures to a natural or man-made disaster, however it comes with a catch: Services no longer have control of information and can therefore be made to look slow or unresponsive in the protection of life, property and the environment.

Solid partnerships and cooperative arrangements with media outlets should ensure that pre-emergency messages are provided to the community in a consistent and timely manner; response and recovery advice is disseminated across the community, government and agencies; and importantly a sound relationship between Emergency Services and the media should help in mitigating the fall out post disaster. At the very least, Fire and Emergency Service Chiefs should be able to tell their story along with the stories of those impacted within the community.

The Community

Chief Officers of Emergency Services are employed to ensure adequate response to emergencies; to prepare community members for an emergency; to protect the community from emergencies as best they can; and to help the community to recover from emergencies and disasters. The community expects the people they employ as Firefighters, Police Officers, and Ambulance Officers to provide a high level of service and to be the best they can be in protecting themselves and their families. They also increasingly expect to be warned of impending harm, to be given adequate and timely warning so they can prepare for fire, flood or storm, or evacuate to a safe area free from harm.

Warnings must also be provided in a manner most likely to reach recipients using traditional methods via television and radio, community and ethnic radio, news print, internet, mobile phone messaging, and social media including face book and twitter. Emergency Services are expected now and will increasingly be in the future, expected to know the best media to use to warn the community of impending disaster, welfare of others and the steps to recovery for individuals and the community as a whole. Because we have never done so in the past is no longer an acceptable excuse and Service Chief’s will be held accountable not only for their Agency response but for the information they provided pre, during and post emergency.

The Emergency Service

The Chief Officer and their leadership team will not be there for the next big disaster, however there needs to be a period of time when in concert with others imported into the Service, that team can provide the link between past real or perceived failures, incorporation of lessons learnt from the disaster and future organisational and operational improvements. The system in place at the time of the disaster, stood or fell on the calibre of its leaders, and so will future systems. It is all dependent on fire or police officers, fire or police leadership and the community perception and trust in those people. Post disaster recovery for Emergency Services cannot occur without three components: existing leadership sponsoring future leaders, Government support for Services and the right calibre of personnel within the Service or imported into a Service to lead into the future.

Wholesale reform by changing structures and changing personnel at the top will not succeed without the right people in charge and the support of the Government.

Australia is a land of fire, flood, drought and storms. Emergency Services must prepare for the worst; plan for the future; engage with the community, media and Government in honest and open dialogue regarding emergency response and recovery; warn the community in every way practical of impending disaster; and establish an internal structure able to learn from past mistakes whilst providing confidence to the community and Government that those mistakes will not be repeated.

Paul Swain is the Chief Officer of the ACT Fire Brigade which looks after the city of Canberra, a position he has held for the past 12 months. Previous to this position, Paul was Assistant Chief Officer in the Metropolitan Fire Brigade in Melbourne where he came up through the ranks over a 27 year career. Paul has a Master of Industrial Relations, a Master of Management and a degree in Psychology as well as extensive qualifications and experience in emergency management.

DISASTERS IN NEPAL AND BEYOND: POLICY TO ACTION

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Keywords

Warming, environment, livelihoods, emissions, measures

Abstract

Nepal is highly prone to various types of disasters like: floods, landslides, fires, epidemic, avalanches, earthquakes, windstorms, hailstorms, lightning, glacier lake outburst floods (GLOFs) and droughts. The trends of losses from disasters are increasing due to the lack of proactive disaster management plan and policies. Therefore, proactive disaster plans and policies focused on preparedness works are highly necessary in Nepal. In this paper historical occurrences of floods and landslide disasters and 2 case studies have been presented to show the gravity of problems and suggest some policy and technical measures.

As the lack of adequate coordination among the various organizations related to the disaster management, technological gaps, lack of proactive policies and lack of resources compound the problem of preparedness against impending floods, landslides and other disasters in Nepal, the main objectives of this paper are to identify the problems of floods and landslide disasters in Nepal and suggest some policy and technological measures.

In order to address the disaster problems in Nepal and reduce the loss of lives and properties, proactive policies and plan are desirable. In addition, to bridge the gaps and meet the areas of need - development of early warning systems, catchments management, afforestation and coordination of development activities aiming at relieving drainage congestion are highly necessary. Great potential exists for harnessing the water resources by creating reservoirs at upstream reaches for optimal and multiple uses of water resources which inter-alia could also achieve flood peak attenuation at lower reaches in Tarai area of Nepal, India and Bangladesh. Nepal, India, Bangladesh, Bhutan and China could benefit, if worked together to resolve the disaster problems.

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1. Introduction

Nepal is exposed to various types of natural disasters like floods, landslides, fire, epidemics, earthquakes, avalanche, windstorm, hailstorm, lightning, glacier lake outbursts (GLOFs), drought and so on. The main reasons of her vulnerability to natural and man-made disasters are - the rugged and fragile geophysical structure, very high peaks, high angle of slopes, complex geology, variable climatic conditions, active tectonic processes, unplanned settlement, increasing population, weak economic condition and low literacy rate. Apart from the above reasons, the lack of coordination among agencies related to disaster management, no clear-cut job description of those agencies, resource constraint, lack of technical manpower, lack of public awareness, difficult geo-physical condition, absence of modern technology and so on are the major factors that have made Nepal incapable to cope with the natural disasters.

Heavy precipitation, high wetness and steepness of watersheds and river channels contribute to flood magnitudes. Mainly, the middle Hills are prone to landslides and the Tarai to flood and fire. Thus, flood, landslide and fire disasters are quite frequent in Nepal. These disasters occur almost every year in one part of the country or the other causing heavy loss of lives and damage to physical properties.

The earthquake of 1934 A.D., 1980 A.D. 1988 A.D. and the flood of July, 1993 A.D. are the most devastating natural disasters which not only caused heavy losses of human lives and physical properties but also adversely affected the development process of the country as a whole.

Therefore, it is a great challenge to the nation to protect infrastructure and property from frequent natural disasters. Heavy precipitation, high wetness and steepness of watersheds and river channels are the fundamental reasons of flood and landslide disasters. The middle Hills of Nepal are prone to landslides and the Tarai to floods. These disasters occur almost every year in one part of the country or the other. Hence, many people of the country are living with flood and landslide disasters. In other words, living with floods and landslides is their way of life. Landslide is a prominent and chronic natural disaster in Nepalese hills mainly due to its very young and fragile geo-physical structure, steep hill slopes and degrading environment (deforestation, road construction on the hills, mining activities, rice cultivation, farming on the hill slopes, particularly rice cultivation, animal grazing etc.).

The details of the loss of lives and properties caused by flood and landslide disasters in the past seven years (1998-2008) are given below in Table 1.

Table 1

Loss of Lives and Properties by Floods and Landslides (1998 to 2008)

Description	Unit	Years										
		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Dead/ Missing	Nos.	276	303	192	241	462	290	203	203	241	511	138
Injured	Nos.	58	92	97	88	265	76	220	220	150	186	16
Affected Families	Nos.	33843	9768	15430	7901	38859	7167	16997	16997	4273	129649	20831
Animal Losses	Nos.	572	309	759	377	2024	865	888	905	727	22140	6895
Houses destroyed	Nos.	13922	2538	5343	3934	18160	3017	4818	4818	3168	13655	14633
Cattle Sheds destroyed	Nos.	1180	132	406	212	771	174	290	290	49	28	9
Land Losses	Ha.	326.89	182.40	490	N/A	N/A	N/A	N/A	N/A	500.30	4029.00	21016
Total Est. Losses (In millions)	NRs.	1093.3	364.95	109.27	251.09	416.91	234.78	341.09	341.00	381.00	2230.00	15380.00

Source: Ministry of Home Affairs

2. Types of Flood and Landslide Disasters

The types of flood and landslide events that occur in Nepal can be classified as follows:

- 2.1. Normal floods and landslides due to regional precipitation over large areas;
- 2.2. Debris flows due to mass movement of loose sediment and boulders in the middle Hills and Siwalik (Churia) range;
- 2.3. Landslide and debris temporarily damming rivers, causing devastating flood events after such dams are overtopped and broken;
- 2.4. Extreme events due to:
  - 2.4.1. Glacier Lake Outburst Floods (GLOFs) occur when the moraine damming the glacial lake suddenly collapses and releases large volume of water resulting in a high velocity surge, causing devastating floods and debris transport downstream;
  - 2.4.2. Sudden cloud burst over a localized area due to "break" in the monsoon trough resulting in a precipitation of 300 mm to 500 mm within 24 to 48 hours;
  - 2.4.3. Flash floods on the southern rivers.
- 2.5. The following factors also are responsible in causing floods in Nepalese:
  - 2.5.1. Drainage congestion caused by intervention in the flood plains on the other side of the international border to the south;
  - 2.5.2. Continuously increasing sediment loads in the rivers;
  - 2.5.3. Heavy load of debris flow in the rivers particularly due to landslides;
  - 2.5.4. Ad hoc river training works that address the expedient needs of the moment.

3. Historical Occurrences of Floods and Landslides

There are many occurrences of flood and landslide damages in Nepal. The devastating flood experienced in the Budhi Gandaki river of Gorkha district in 1974 is one such striking example. The river was blocked due to a big landslide that occurred at a place called Labu Besi. The damming continued for a several days and was overtopped. As a result a heavy load of debris flow occurred and washed out a suspension bridge. A part of Arughat Bazar was also washed away, in which some people were drowned and heavy property damage occurred.

In 1978, the Tinau River badly affected some part of the Khaseuli Bazar of Rupandehi district, which caused heavy loss to human lives and properties. In the 1980 monsoon, the main current of the Koshi suddenly changed its course towards the left and eroded the left bank near the Chatara main canal. The main reason of this event was the heavy amount of debris carried by rivers from mountains to the Tarai triggered by the onslaught of heavy rain. In August 1987, the central and eastern Tarai was submerged up to 1-meter depth causing havoc in the affected areas. In the same year a flood in the Sunkoshi basin caused much damage. The floods of the Koshi in 1980 and the 1989 cloudburst over Chitwan affected Parasi and Butwal areas. The root cause of the above events, of course, was numerous landslides in the upper catchment areas.

4. The 1993 Floods and Landslides

The devastating floods, landslides and debris flow events of July 1993 are the most severe in the history of floods and landslides of Nepal. Heavy downpours from 19 to 21 July 1993 produced severe floods in several rivers of South and Central Nepal. The 24-hour rainfalls of 540 mm at Tistung of Makwanpur district and 482 mm at Ghante Madi in Sindhuli district were recorded on the morning of July 20, 1993. These are the first and second highest values ever recorded in Nepal. It was found that the daily rainfall at 08:45 A.M. on 20 July was concentrated in the upper Kulekhani catchment and the headwaters of the Marin River tributary. On the following day, the heavy rainfall had moved westwards to the region surrounding Hetauda.

The 1993 floods caused widespread damage, heavy loss of human and animal lives, disruption in economic and developmental activities and panic in the society throughout the Mahabharat Range and the adjoining Tarai areas. Severe damages were caused to roads, irrigation works, hydroelectric installations and other physical infrastructures. About 500 thousand people were affected from the damage to houses, cattle sheds, rural infrastructures, buried farmland and disconnected rural roads. Such disrupted communities are still in a precarious situation because they continue to be vulnerable to future disasters, since unstable debris remaining along river courses and hill slopes may easily collapse and flow down if triggered by even a small storm. The data on the damage caused by this devastating flood and landslide events is given below in Table 2.

Table 2
Loss of Lives and Properties due to the Floods & Landslides (July 19-22, 1993)

Dead	**1,336 persons**
Missing	**201 persons**
Injured	**110 persons**
Families Affected	**85,451**
Houses: **Completely Destroyed** **Partially Destroyed**	 **18,322 Nos.** **20,721 Nos.**
Public Buildings	**452 Nos.**
Land Loss	**57,013 ha.**
Animal Loss	**25,628 Nos.**
Roads Washed Out	**366.89 Km.**
Bridges Destroyed	**213 Nos.**
Dams Destroyed	**34 Nos.**
Irrigation Channels Destroyed	**620 Nos.**
Total Estimated Losses:	**NRs. 4,901.00 million**

Source: Ministry of Home Affairs

5. Deficiencies in the Existing Disaster Management System:

There are serious lapses and deficiencies in the areas of disaster management legal system in Nepal, which are as follows:

5.1 The government has not yet formulated rules and regulations to back up the NCRA, 1982. Neither there are any Standing Order or Procedures sufficient codes like Fire Codes. Code of Conduct for the disaster responders is also lacking.

5.2 Definition of the disaster in the Act is narrow. Hence, it has failed to incorporate all kinds of disasters in it e.g. plane crash, bus accident, cold waves and so on.

5.3 Only the role of the Central Disaster Relief Committee and the Ministry of Home Affairs as its secretariat has been defined and spelled out clearly in the Act, while the role of other disaster management related organizations has not been clearly outlined.

5.4 The Act is focused more in rescue and relief works. The preparedness, rehabilitation and reconstruction works have been over shadowed. Neither has it made any organization responsible for the above areas.

5.5 Relief and Treatment Sub-committee and Supply, Shelter and Rehabilitation Sub-committee are dormant. Similarly, the government has not yet formulated Local Disaster Relief Committee, which is very important at the grass roots level of disaster management system as a whole.

5.6 The Act or any other rule or regulation has not set up a compensation scheme for volunteer emergency workers in case of serious injury, fatal disease or death, which is necessary to motivate them.
5.7 The Act has not paid any attention towards the research and development.
5.8 Disaster management has not been adequately addressed in the Tenth Plan. Similarly, the provisions of disaster management and the responsibilities of local bodies, government and non-government organizations are insufficient and ambiguous in the Local Self Governance Act, 1999.

6. Policy Measures to be Taken

Though we can find a well-structured institutional arrangement in the coping mechanism of Nepal, there are a number of inadequacies not only in the legal aspect but also in the organizational aspect of the disaster management system as a whole. Hence, two important areas – *proactive policies and their effective implementation* – are lacking in Nepal. It is needed to incorporate disaster risk reduction measures into post-disaster recovery and rehabilitation processes and use opportunities during the recovery phase to develop capacities that reduce disaster risk in the long term, including through the sharing of expertise, knowledge and lessons learned.

6.1. The government should formulate rules and regulations to back up the NCRA, 1982. Standing orders, codes, guidelines and manuals should also be prepared.
6.2. As the disaster mitigation is a multi-sectoral activity, the government should ensure that disaster risk reduction is a national and local priority with a strong institutional basis for implementation.
6.3. The two dormant sub-committees namely, Relief and Treatment Sub-committee and Supply, Shelter and Rehabilitation Sub-committee shall be activated. Their temporary provision should be transformed into permanency and they should be formulated at the district level too.
6.4. Establishment of a separate agency for disaster management in the form of a multi-sectoral national platform is highly necessary for disaster risk reduction, as an agency for facilitating policy coordination and action on disaster risk reduction at this point of time.
6.5. Disaster management cell should be established in each disaster management related ministries.
6.6. Special stress should be given for more effective integration of disaster risk considerations into sustainable development policies, planning and programming at all levels, with due emphasis on disaster prevention, mitigation, preparedness and vulnerability reduction.
6.7. It is necessary to increase awareness of the importance of disaster reduction policies, thereby helping and promoting the implementation of those policies. To attain this goal it is required to promote the engagement of media, so as to energize a culture of disaster resilience and strong community involvement in sustained public education campaigns and public consultations at all levels of society.
6.8. There should be the clear-cut and definite policies on the role of NGOs, local community, and private sector. Moreover, people's participation should be encouraged and enhanced.
6.9. Disaster management should be incorporated in school and university curriculum.
6.10. Community participation in disaster risk reduction and management is highly necessary through the formulation and implementation of specific policies, the promotion of networking, the strategic management of volunteer resources, the attribution of roles and responsibilities and delegation and provision of the necessary authority and resources.
6.11. Adaptation of indigenous knowledge will be simple, adaptable, easily understandable by the community and highly cost effective in disaster mitigation works. Hence, it is necessary to share good practices and lessons learned to further disaster reduction within the context of achieving sustainable development goal and to identify gaps and challenges.
6.12. The construction of warehouses in strategic locations is also needed. Training on warehouse management and supply of relief materials shall be provided to the concerned officials.
6.13. Stock piling of emergency relief supplies and rescue equipments and personnel in strategic locations of the country is necessary, so that they can be easily mobilized in case of an emergency.

6.14. Evacuation plan and drill exercise should be done periodically.

7. Government responsibilities for Emergency and Disaster Management at Local Levels

Following provisions should be made for effective disaster prevention, preparedness, response and recovery through:

7.1 Legislative and regulatory arrangements within which the community and various other agencies operate;

7.2 Provision of police, fire, ambulance, emergency services, medical and hospital services; and

7.3 Government and statutory agencies that provide services to the community.

8. At National Level

Managing disasters from the center alone is neither possible nor effective. Hence, the basis of the national system for managing major disasters and combating them is a partnership between regional, district and local governments, and the community. The mission of such partnership should be to:

6.1 Minimize vulnerability to hazards;

6.2 Protect life, property and minimize suffering during emergencies and disasters;

6.3 Facilitate rehabilitation and recovery; and

6.4 Disaster prevention should be included in the national program as a development work in itself

6.5 Disaster management component should be incorporated in related development projects

6.6 Disaster management should be included in school and university curricula.

9. Conclusions

There are a number of specific gaps and challenges in the field of risk identification, damage assessment, monitoring, early warning, public awareness, preparedness, mitigation, rehabilitation and reconstruction in Nepalese disaster management system. These are the key areas for providing legal and policy framework for future actions. Hence, it is needed to incorporate disaster risk reduction measures into post-disaster recovery and rehabilitation processes and use opportunities during the recovery phase to develop capacities that reduce disaster risk in the long term, including through the sharing of expertise, knowledge and lessons learned.

More importantly, it should be ensured that programs for reintegration of displaced persons, returnees and ex-combatants do not increase risk and vulnerability to hazards in localities concerned. It is necessary to take advantage of the opportunities provided by disaster risk management to promote conciliation and peace building in areas affected by conflict.

The most fundamental best practice guideline is the need to adopt a pro-active response to disaster management in Nepal. It is also pertinent to maintain a global information platform on disaster risk reduction and a web based register of disaster risk reduction programs and initiatives implemented by States and through regional and international partnerships. Nepalese disaster managers, perhaps ignore that effective policy and legislation are essential to provide a reliable social and legal foundation for disaster management. It should be kept in mind that there should be an integrated policy framework within all agencies (central, regional, district and local) that supports policies and addresses reduction of disaster risk to life and property.

The limited potential land resources of Nepal should be protected from the ravages of floods and landslides. To redress the sufferings and social disruption of the people and to provide security for appropriate economic activities in the damage prone areas, it is urgently needed to reduce the loss of lives and damage to properties due to floods and landslides. On the other hand, the fragile environment of the country should be preserved through the conservation of natural watershed and riverine resources together with the sustainable development of water resources. Research and development activities should also be carried out at the same time for the development of inland and trans-boundary waterways. Poverty alleviation should be supported by creating a suitable environment through structural intervention and regulatory measures for increased economic activities in the flood and landslide prone areas.

For effective disaster management, local government should be empowered by providing adequate funds and resources on the one hand and the local community should be enabled by education and training on the other. River training works in disaster prone areas of the country should be initiated and encouraged by involving local communities.

In order to attain the above objectives, firm political commitment with due integrity and determination is an indispensable precondition for better floods and landslide control in Nepal. The government should prioritize disaster management. A separate Ministry or Council for disaster management is highly desirable for effective disaster prevention, preparedness, response and recovery.

§ § §

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Prof. Chhetri earned his doctorate degree in Economics from the University of Vienna, Austria in 1995. He also holds an MA and Law degree. He carried out 14 months drug abuse research study at the Johns Hopkins University, Baltimore, U.S.A. from 2002 to 2003. Apart from the above, he has carried out a number of research works in various fields in Nepal and beyond.

DEVELOPING AN INTELLIGENT SYSTEM FOR THE ANALYSIS OF SIGNS OF DISASTER

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Risk Assessment, Disaster Signs, Intelligent system, Incident degree, Countermeasure

Abstract

The objective of this paper is to develop an intelligent decision support system that is able to advise disaster countermeasures and the degree of acceptable risks of the incidents on the basis of the collected and analyzed signs of disasters. The concepts derived from ontology, text mining and case-based reasoning are adapted to design the system. The system provides various functionalities such as term-document matrix, frequency normalization, confidence factors, association rules, and criteria for judgment. The collected qualitative data from signs of new incidents are processed by those functions and are finally compared and reasoned to past similar disaster cases. The system provides the varying degrees of how dangerous the new signs of disasters are and the few countermeasures to the disaster for the manager of disaster management.

The system will be helpful for the decision-maker to make a judgment about how much dangerous the signs of disaster are and to effectively carry out specific kinds of disaster countermeasures in advance in order to prevent the disaster in the future.

Ⅰ. Introduction

Analyzing data related to signs of disaster based on the public media and resources as well as correlation of disasters by type, disaster sign information will be the foundation for building an intelligence system and policy making data/rules for human disaster incident through the prediction of disaster accident beforehand. Moreover, analyzed results of disaster signs information secure the standards and systems of various complicated human disaster types and also encourage systematic prevention and inspection activities between related organizations. In addition, after gaining the system and capacity to excavate and cope with disaster signs data, the creation of social issue through the negative ripple effect of human disaster damage can be prevented beforehand. Therefore, in order to minimize human disaster damage, the enhancement of scientific and detailed management of the intelligent system through the analysis of human disaster damage is necessary.

The purpose of studying the development of an intelligent system for the analysis of signs of disaster is to collect and analyze human disaster signs data in order to produce information on disaster signs and direct and recommend risk levels and preventive measures based on the analysis, so that a decision making system framework can be studied. This study is focused on four stages of disaster management: prevention, preparedness, response and recovery. It also concentrates on decision making framework by creating disaster signs information based on disaster risk elements and deciding risk levels.

In order to proceed the risk level decision making framework after creating disaster signs intelligence based on disaster signs data, the following research methods are used. Disaster sign information collected through various sources should be converted to disaster sign intelligence. At the same time, disaster sign intelligence is applied to generated rules and provided as preliminary risk predictor data. In fact, to collect disaster sign data from various human disasters and other related source, and to generate the most realistic and highly predictable disaster sign intelligence, Ontological engineering technique, text mining technique and case-based reasoning methods are used. Risk level is computed by calculating the disaster sign index value based on these three methods. Along with risk level presented, accident probation and countermeasures from past cases and response and measures derived from legislation and required from experts' opinion will be provided for utilization.

Ⅱ. Literature Review

For the study on disaster signs intelligence system, ontology, text mining, cased-based reasoning methods are applied. In order to create and manage disaster sign intelligence, ontological engineering technique based on object-oriented data modeling and semantic web is used from the collected data and information. Through this ontology technique [1][4][5][6], the following modules are recommended: basic element classification module, appropriate matrix calculation module among basic elements and decision making analysis module that can be used as evidence and documentation.

Next, based on basic elements categorized through ontology technique, text mining technique [2] is used in order to calculate the value of quantitatively associated rules. Moreover, along with text-mining technique, case-based reasoning has been applied [3] in order to determine new disaster sign intelligence risk level based on disaster cases that actually occurred in the past.

Ⅲ. Definition of Sign of Risk Intelligence and Source

"Sign of risk" is defined as the cautions/signals or changes that can become a 'risk', which take place due to the vulnerability of infrastructure. As an intelligence that includes, the dangerous risk possibilities, sign of risk intelligence signifies the necessary signal for safety checks and measures on safely hazards including human disaster, accident and etc. In this context, the source means the origins of generated signs of risk.

Signs of risk source can be categorized as basic and concreteness data. Basic data is also referred as environment data. [Table 1] explains the category, definition, type and source of signs of risk intelligence.

[Table 1] Features of signs of disaster

Classification, Division	Definition	Type, Category	Data Collection Site
Concreteness Data	- Speech is a lifestyle safety net, and presently can be a source of danger	- the media information - civil complaint information - local government officer public opinion - police trend report content - private monitors	On-Line Website - portal site - newspaper & broadcast the media site - central ministry & local government homepage - E-opinion/E-petition etc

Classification, Division	Definition	Type, Category	Data Collection Site
Basis [Foundation] Data (Environment Data)	- Current and society atmosphere, seasonal surroundings and environmental sources	- rumor(whisper)-trend information-knowledge (experience) information & inspection result information - basis[foundation] currently(local, location, scale, owner state situation) - pertinent parties opinion - promote particular(safe check, take action currently) - seasonal, related law	Off-Line Websites - national emergency management agency disaster situation room - Central security checks - each local government - Korea intrastructure & safety public corporation

Ⅳ. Collection and Generation of Signs of Disaster Intelligence

Continuous monitoring system for signs of disaster intelligence management include: collection of basic and concreteness data from public media and opinion trends (use of various websites) focusing on safety inspection activities, and production of signs of disaster intelligence after filtering stage based on collected data. At the filtering stage, all the data unrelated to signs of disaster are excluded, duplicated data are deleted and data with low risk level are separated and omitted. The finalized sign of disaster intelligence are categorized according to infrastructure/building and disaster types as shown in the template below [Illustration 1]. The template includes sign of disaster intelligence and disaster incident cases based on basic elements of ontology.

[Illustration 1] Template to store information about signs of disaster

Integrate Database Template about Signs of Disaster

Basis Currently	Title	So Rae Railroad	Occurrence Date	2010.02.26
	Location	Si_Heung_Si Wal_Got_Dong 520-89 ↔ In_Cheon Non_Hyeon_Dong 111-11, So Rae Railroad		
	Information Type		Source	
	A Registrant		Registration Date	
	Management Classify	Public	Order Authority	Ministry of Land
Information about Signs of Disaster	Facility Structure	Rebar Concrete	Facilities Type	Bridge
	Disaster Type		Details Type of Disaster	
	The Ministry & Office Concerned	Korea Rail Network Authority	Threat Level	
	Details	On February 26th 2011, the Sorae Bridge that connects Namedonggu, Incheon and Wolgot, Siheung Si has been collapsed particularly on the Siheung Si area after being closed for security reasons since February10th.		
Resources	Human resources	Citizen, Vendor, Tourist		
	Material resources	Pier, Concrete, Rebar, Pillar		
Requirement	Related Law	Special Act on the Safety Control of Public Structures <Amended December 29th 2009>		
	When you don't keep law, Application	When Safety Checks or precision diagnosis and other necessary management such as repairmen or reinforcement are not processed. Based on Article 39 of Special Act on the Safety Control of Public Structures shall be imprisoned for less than ten years. If a man has been died for the same reason as above, the responsible person will be imprisoned for more than three years.		
	Obligation Authority	Korea Rail Network Authority		
	Cooperation Authority	In_Cheon Nam_Dong_Gu, Si_Heung		
Vulnerability	Safe Check List	The phenomenon where the bridge might be shifted and portions of its pier foundation stone might be damaged and cracked		
	Etc Factor	Seasonal Factor	the ground be weaken Thaw	
Threat	Threat Classify	Bridge Collapse		
	Single/Compound Disaster Classify	Single(Collapse)		
	Cause of Disaster	Crack, Corrosion, Be destroyed, Decrepitude, Be washed away		

Ⅴ. Signs of Disaster Intelligence Analysis

1. Basic Element Extraction

In order to categorize the generated signs of disaster intelligence, certain standards, five types of basic elements have been extracted following the ontology principle ([Table 2]).

[Table 2] Definition of each basic element

Vulnerability	breakout frequency of material resources (rupture, etc) and the defective actions of human resources (shoddy construction, etc)
Threat	stimulating the fragility can cause accidents (disintegration, drop, etc)
Counter-Measure	means to prevent accidents and loss (suspension of traffic, demolition, etc)
Resources (material/ human)	configure and compensate the preceding articles for material resources (intersection, construction equipment, etc) installation of the preceding articles, operation and application of human resources (builder, workers, etc)
Stakeholder	official court controls the risk obligation and has the authority (intellect agency, fire station, etc)

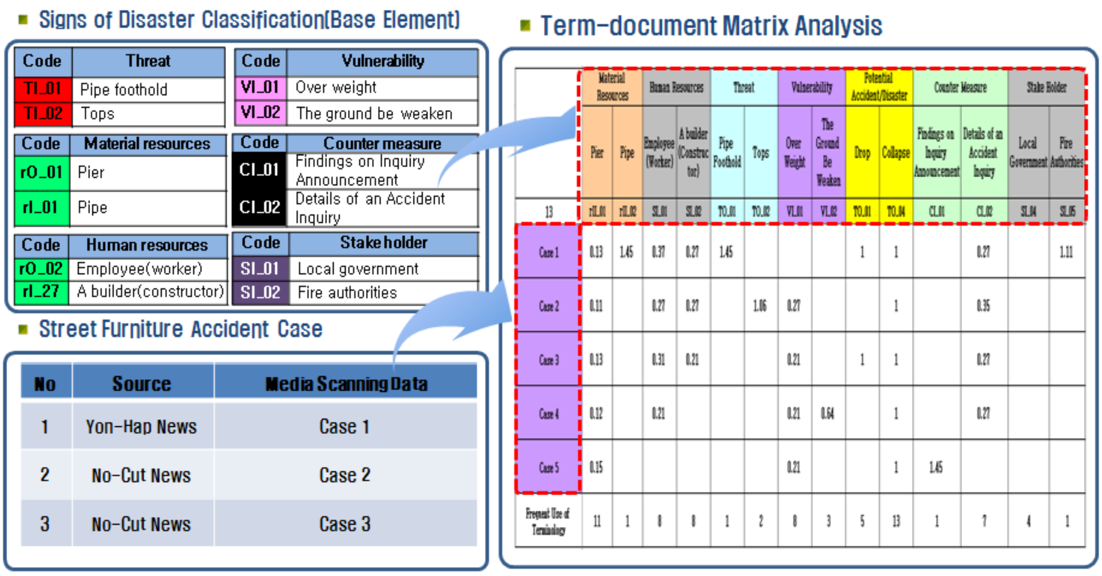
2. TDM Formation

Using the basic elements (physical, human resources ,risk, vulnerability, response actions, stakeholders, and potential accidents/disasters) categorized from legal information such as collected statues(law), specification, manuals and past cases all based on experts' perspective, term and term-risk document matrix (TDM) are established [1][2] [Illustration 2]).

In this study, instead of utilizing full processing related to text mining, the process until TDM that extract, classify or index the terms according to the study objective is performed.

Then the index that have been mentioned in each case study based on the collected information from the public opinion, the media and internal report data using ontology method, is entered after calculating the frequency.

[Illustration 2] Term-Document Matrix



3. Normalized Frequency

Although a specific term may often appear in a document more frequently than other terms, this word may contain more meaning than others or it may not. Thus, after examining the frequency of a term that appears throughout the document, normalization is processed by the following method. After investigating the frequency of a term that continues to appear in a document, the normalized value must be found through normalized equation [2].

[Normalized formula]

$$idf(i,j) = \begin{cases} 0 & (if,\ wf_{ij} = 0) \\ (1+\log(wf_{ij}))\log\dfrac{N}{df_i} & (if,\ wf_{ij} \geq 1) \end{cases}$$

[Exemplar]

N : Total number of case studies
df_i : within document term (i) frequencies (number of documents that mention the term)
i : i^{th} basic element (term)
j : j^{h} case study (document)
wf_i : term frequency (number of times basic element (i) appears in a related specific case study)

4. Reliability Calculation

Through the number of term frequency for each case, the normalized value is calculated and is placed in the rule document matrix. Based on the reliability calculation, the value of associated rules for each cell can be computed ([Illustration 3]).

- Probability of Y (accident/disaster) in cases that include X (Field)

i.e.) probability of Y (collapse) in cases that include X (aged pier)

$$\text{Confidency(C)} = P(Y|X) = \frac{P(X \cap Y)}{P(X)} = \frac{\text{Sum of normalized value of X and Y rules) / Sum of normalized related rule}}{\text{Sum of normalized value for related case X / Sum of normalized rule of X}}$$

[Illustration 3] Confidence Table

	Association Rule-1								Sum	Reliability Value	Reliability Value Priority
	Threat	Vulnerability		Material Resources				Potential Accident/ Disaster			
	Bridge decrepitude	Poor construction	Corrosion · Crack	Concrete	Rebar	Bridge	Tops	Collapse (Drop)			
13	TO_06	VI_03	VI_05	rII_08	rII_04	rII_10	rII_07	TO_04			
Case 1	1.32	0.34	0.41	0.16	0.34	0.16	0.34	2	5.07	0.78	50.9%
Case 2				0.16	0.34	0.24		1	1.73	0	0.0%
Case 3		0.34		0.16	0.34	0.26	0.57	1	2.66	0	0.0%
Case 4			0.41	0.21		0.21	0.34	1	2.17	0	0.0%
Case 5		0.34	0.41	0.27	0.34	0.28	0.34	1	2.98	0	0.0%
Case 6	0.64	0.54	0.79	0.16		0.36		2	4.48	0	0.0%
Normalization Value Sum	2.79	2.22	2.57	1.69	2.01	2.17	2.57	18	34	0.78	

5. Sign of Disaster Index Development

In order to decide the risk level of sign of disaster intelligence, there is a need of sign of disaster index with five categories including possibility of disaster and safety accident like in [Table 3].

[Table 3] Index of Sign of Disaster

<table>
<tr><th>Item</th><th colspan="2">Index</th></tr>
<tr><td>① Accident and safety hazard possibility for occurrence (50 points)</td><td colspan="2">○ the relation to the dangers and weakness of the facilities, uncertainty of the actions of human resources, the possibility of the safety hazards of material resources</td></tr>
<tr><td>② Intimate citizen lifestyle (20 points)</td><td colspan="2">○ heavy traffic areas, the influence of crowded areas and business sections and the impact on the citizens</td></tr>
<tr><td>③ Possibility of damage to a life (15 points)</td><td colspan="2">○ past examples of accident and safety hazard cases that impact the possibility of damage to a life</td></tr>
<tr><td rowspan="2">④ The effect of societal influence (15points)</td><td>preceding article breakout frequency</td><td>○ a majority of media related civil affairs, press and public opinion expresses the dangers in preceding articles about the amount of breakouts</td></tr>
<tr><td>estate loss amount</td><td>○ based on previous examples of accident and safety hazard cases the amount is determined</td></tr>
<tr><td>⑤ Severity(15points)</td><td colspan="2">○ the severity is determined by the collected opinions of the manager
○ the urgency of the safety measures, seasons, national emotions, and consideration of time</td></tr>
</table>

6. Generation of Associated Rules

Logic basics (associated rules) for computing each category's score are as the following:

① The possibility of disaster and accidents

- X (risk, vulnerability, human resource, physical resource) ⇒ Y (potential accident/disaster)
- IF (risk) AND (OR) (vulnerability) OR (human resource) OR (physical resource), THEN signifies (potential accident/disaster)

② Density of Resident Living

- X (corresponding action item, risk, vulnerability) ⇒ Y (potential accident/disaster)
- IF (corresponding action item) AND (OR) (risk) AND (vulnerability), THEN signifies (potential accident/disaster)

7. Reliability Ratio

When the total value of reliability of associated rules is 100%, the proportion index of the reliability value is computed by the percentage taken by the reliability of related associated rules from the total value. In order to compute the logical value (associated rules), the reliability ratio is calculated.

i.e.) When considering the total value of the reliability ratio of an accident case related to two associated rules as 100%, the reliability ratio(0.78) of associated rule-1 is converted to 51%([Illustration 4]).

$$\text{Confidency Weight} = \frac{\text{Confidency value of related rule}}{\text{The sum of confidency for related rules}}$$

[Illustration 4] Confidence Weight Table

	Association Rule-1								Sum	Reliability Value	Reliability Value Priority
	Threat	Vulnerability		Material Resources				Potential Accident/ Disaster			
	Bridge decrepitude	Poor construction	Corrosion · Crack	Concrete	Rebar	Bridge	Tops	Collapse (Drop)			
13	TO_06	VI_03	VI_05	rII_08	rII_04	rII_10	rII_07	TO_04			
Case 1	1.32	0.34	0.41	0.16	0.34	0.16	0.34	2	5.07	0.78	50.9%
Case 2				0.16	0.34	0.24		1	1.73	0	0.0%
Case 3		0.34		0.16	0.34	0.26	0.57	1	2.66	0	0.0%
Case 4			0.41	0.21		0.21	0.34	1	2.17	0	0.0%
Case 5		0.34	0.41	0.27	0.34	0.28	0.34	1	2.98	0	0.0%
Case 6	0.64	0.54	0.79	0.16		0.36		2	4.48	0	0.0%
Normalization Value Sum	2.79	2.22	2.57	1.69	2.01	2.17	2.57	18	34	0.78	

8. Index Value Computation

Associated rules based on the proportion of TDM reliability should investigate rules that can be mapped with the new sign of disaster intelligence from the original rule/accident case table. As a result, rule A, rule D, rule E and rule N of the original rule can be mapped as shown as the dark pink part below in [Illustration 5].

A. Possibility of Disaster and Accident Occurrence Index

- Creation of Associated Rules for new Sign of Disaster Intelligence (i.e. So Rae Bridge)
- Extract the matching associated rules by comparing with the similar past case study
- Sum of the weighted average that matches (24.1) is allotted as (50), which is converted to (12.04)

[Illustration 5] Index of possible occurrence about an incident

Classification	Association Rule																				Sum
Rule	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	
Case1	100																				100
Case2		49	51																		100
Case3				51	49																100
Case4						20	19	19								21	21				100
Case5									50	50											100
Case6											56	44									100
Case7													100								100
Case8														100							100
Case9															100						100
Case10																51	49				100
Case11										50								50			100
Case12																			100		100
Case13																				100	100
Ai (Average)	7.7	3.8	3.9	3.9	3.8	1.5	1.5	1.5	3.8	7.7	4.3	3.4	7.7	7.7	7.7	5.5	5.4	3.8	7.7	7.7	100.0
WAi (Weighted Average)	8.0	3.9	4.1	4.1	3.9	1.6	1.5	1.5	4.0	8.4	4.5	3.5	8.0	8.0	8.0	6.0	5.9	4.0	8.0	8.0	105.2
Association Rule Appearance the Frequency	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	2	2	1	1	1	23
Weight	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.09	0.04	0.04	0.04	0.04	0.04	0.09	0.09	0.04	0.04	0.04	
Weighting the Average Cost Sum	Association Rule of Weighting the Average Cost Sum =>8.0(Rule A)+4.1(Rule D)+3.9(Rule E)+8.0(Rule N) =24.1																				24.1
Point Conversion	Conversion to Point 50 24.1 * (50/100) = 12.04																				12.04
Association Rule Priority	33%			17%	16%									33%							100%
So Rae Railroad Association	o			o	o									o							

B. Possibility of casualties, Social Impacts, Weight

Possibility of causalities is determined by the size of casualties from the past accident and disaster cases. Social impact is decided based on how the accident will become an issue in the media and other various communication networks as well as the amount of expected property damage. Weight refers to the subjective score (no more than 20 points) given by the responsible personal after considering the urgency of safety measure, seasonality, public sentiment, timeliness and etc ([Illustration 6]).

[Illustration 6] Other Index Table

Classification / Case	The Likelihood of Saving (15Point)		Influence of Society (15Point)		Weighting (15Point)	Sum & Threat Level
			Destroying an Estate (5Point)	Sign of Disaster Occurrence Frequency (10Point)	Seasonal, Safety Measure, Urgency, Timeliness	
Rule	Death	Injury	₩, $	Media		
Case1	–	–	o			
Case2						
Case3	2	–	18억			
Case4						
Case5	–	4	o			
Case6						
Case7	–	–	o	So Rae Railroad Two Report Media (Civil Complaint, The Media Report)	Medium	
Case8	–	182	o			
Case9						
Case10						
Case11	–	5	o			
Case12						
Case13	2	2	o			
Ai (Average)				8	15	
WAi (Weighted Average)						
Association Rule Appearance the Frequency				8	15	
Weight			Over a Billion => 5	Two Report Media => 8		
Weighting the Average Cost Sum	Death 2 => 2, Injury 48 => 5		5.00	8.00	Working Level Decision 'Medium' => 10	
Point Conversion	7.00		13.00		15.00	57.88
Association Rule Priority						D(Attention)
So Rae Railroad Association						

9. Risk Grading

After considering all the calculated item of “So Rae Bridge” disaster sign intelligence index: possibility of causalities, density of resident living, social impact and weighted value, the risk level D (interest) is suggested and the content is as follows in [Illustration 7].

○Sum of all category (item) in the disaster sign intelligence index = (Possibility of causalities + Density of Resident Living +Social Impact+ Weighted Value)
○ Value of each category in disaster sign intelligence index = 56.17
○ Risk grading = D (interest)

Level	A(Serious)	B(Warning)	C(Caution)	D(Attention)	E(Watch)
Point	Exceed 90 ~ Below 100	Exceed 75 ~ Below 90	Exceed 60 ~ Below 75	Exceed 40 ~ Below 60	Below 40

[Illustration 7] Comprehensive Index Table

classification / case	Accident and Safety Hazard & Possibility for Occurrence(50Point)																				
	Association Rule																				Sum
Rule	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	
Case1	100																				100
Case2		49	51																		100
Case3				51	49																100
Case4						20	19	19								21	21				100
Case5									50	50											100
Case6											56	44									100
Case7													100								100
Case8														100							100
Case9															100						100
Case10																51	49				100
Case11										50								50			100
Case12																			100		100
Case13																				100	100
Ai (Average)	7.7	3.8	3.9	3.9	3.8	1.5	1.5	1.5	3.8	7.7	4.3	3.4	7.7	7.7	7.7	5.6	5.4	3.8	7.7	7.7	100.0
WAi (Weighted Average)	8.0	3.9	4.1	4.1	3.9	1.8	1.5	1.5	4.0	8.4	4.5	3.5	8.0	8.0	8.0	8.0	5.8	4.0	8.0	8.0	105.2
Association Rule Appearance	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	2	2	1	1	1	23
Weight	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.09	0.04	0.04	0.04	0.04	0.04	0.09	0.09	0.04	0.04	0.04	
Weighting the Average Cost Sum	Association Rule of Weighting the Average Cost Sum =>8.0(Rule A)+4.1(Rule D)+3.9(Rule E)+8.0(Rule N) =24.1																				24.1
Point Conversion	Conversion to Point 50 24.1 • (50/100) = 12.04																				12.04
Association Rule Priority	33%			17%	16%									33%							100%
So Rae Railroad Association	*			*	*									*							

classification / case	Intimate Citizen Lifestyle(20Point)														The Likelihood of Saving (15Point)		Influence of Society (15Point)		Weighting (15Point)	Sum & Threat Level
	Association Rule													Sum			Destroying an Estate (5Point)	Sign of Disaster Occurrence Frequency (10Point)	Seasonal, Safety Measure, Urgency, Timeliness	
Rule	AA	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM		Death	Injury	W, $	Media		
Case1	35	33	32											100	-	-	o	So Rae Railroad Two Report Media (Civil Complaint, The Media Report)	Medium	
Case2		100												100						
Case3			100											100	2	-	18억			
Case4				100										100						
Case5					59								41	100	-	4	o			
Case6						100								100						
Case7							49				51			100	-	-	o			
Case8								100						100	-	182	o			
Case9									100					100						
Case10										100				100						
Case11											100			100	-	5	o			
Case12												54	46	100						
Case13											62		38	100	2	2	o			
Ai (Average)	2.7	10.2	10.2	7.7	4.5	7.7	3.8	7.7	7.7	7.7	16.4	4.2	9.6	100				8	15	
WAi (Weighted Average)	2.6	11.8	11.2	8.1	4.8	8.1	4.0	8.1	8.1	8.1	19.0	4.4	11.1	109.1						
Association Rule Appearance	1	2	2	1	1	1	1	1	1	1	3	1	3	19				8	15	
Weight	0.05	0.11	0.11	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.16	0.05	0.16				Over a Billion => 5	Two Report Media => 8		
Weighting the Average Cost Sum	Association Rule of Weighting the Average Cost Sum => 11.2(Rule AC)+4.8(Rule AE)+8.1(Rule AH)+19.0(Rule AK)+11.1(Rule AM)=54.2													54.2	Death 2 => 2, Injury 48 => 5		5.00	8.00	Working Level Decision 'Medium'	
Point Conversion	Conversion to Point 20 54.20 • (20/100) = 10.84													10.84	7.00		13.00		15.00	57.88
Association Rule Priority			21%		9%			15%			35%		21%	100%						D(Attention)
So Rae Railroad Association			*		*			*			*		*							

Ⅵ. Reasoning and Recommendation

1. Reasoning based on the computed Disaster Sign Intelligence Index

Reasoning is composed by each disaster sign intelligence index that is matched based on associated rules. Particularly for specific reasoning content, associated rules matched with disaster sign intelligence, related past case name and related associated rules are output.

- Dangerousness composes of bridge strain and deformation, while vulnerability includes deteriorated corrosion, cracking due to seasonal conditions and safety negligence. *Related cases: corrosion of Jeong-rim Bridge, Chang-sun Bridge, and Chung-buk Bridge)
- Bridge deformation and strain, deteriorated corrosion, cracking due to seasonal conditions are in relation to associated rules, there is 33% correlation with the case 1.

2. Experts Decision Making on Disaster Sign Intelligence Index Value

When system computes reasoning the value of Disaster Sign Intelligence Index Value for decision making, the decision actually made and inserted by the expert is based on associated rules produced by knowledge manager. Through this process, the associated rules that is computed from the actual system can be compared to verify the accuracy and also further modify and secure, in order to include the content that may not be automatically inserted.

3. Response Measures

Response measures are derived from related data on disaster sign and disaster sign category system along with general feedback on disaster sign intelligence. It is significant to use these response measures early ahead of a disaster as a preventive means. Response measures that can be applied for So Rae Bridge are as the following: 1) demolishment of collapsed bridge and bridge construction for pavement purpose (incident case 1), 2) Control medium sized vehicle and support transportation source for residents (incident case 2), and 3) Carry out emergency repair and install temporary road (incident case 3).

Ⅶ. Research Summary

The purpose of Disaster Sign Intelligence System Study is to investigate a decision making system and risk level measure that can direct disaster risk level by analyzing signs of human disaster data to prevent disasters beforehand. By collecting and analyzing various human disaster (excluding transportation and fire related incidents), this research examined the following contents to develop a decision making system for risk level.

○ Definition of Sign of Risk Intelligence and Source
○ Building a Continuous Monitoring System for Risk Sign Data
○ Determining a systematic management method for Disaster Sign Intelligence source
○ Establishing decision criteria and category system for Disaster Sign Intelligence Risk Level
○ Forming up algorithm for disaster sign intelligence management by disaster case analysis by type
○ Propose Disaster Sign Intelligence management rule and policy recommendation

The final objective of this study is to develop an Intelligent DSS by providing information and knowledge in order for decision maker to process a rational decision making. For a prompt decision making to be well formed, various information and experts' knowledge are needed. But, there are limitations only with human source. In order to resolve these problems, ontology, text mining and case based reasoning methods must be used to provide efficient information and knowledge to support the decision maker. Therefore, further research and modification must be followed up, in order to establish a decision making system at an expert level, then more effective knowledge based decision making system can be achieved.

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LANDSLIDE HAZARD MAP AND RISK ASSESSMENT. CASE STUDY OF THE TIBANESTI COMMUNE, IASI COUNTY (ROMANIA)

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landslide, risk elements, vulnerability, hazard map, risk map

Abstract

The main aims of this study are: a) identify all landslides affecting the territory of Tibanesti commune, b) estimate the influence coefficients of landslides formation, c) calculate the hazard average coefficient, based on the values estimated for the influence coefficients, d) establish and estimate the vulnerability elements, e) calculate the landslide risk, f) draw the landslide risk map and g) establish construction restricted areas.

A number of 365 observation points were covered, and a series of vulnerable elements were identified on site. Landslides were identified and consequently 14 landslides identification sheets were prepared. The value of the influence factors was estimated in all points of observation; each influence factor was estimated at values ranging from 0 to 1. The influence factors values estimated in situ were used to calculate the average hazard coefficient. Based on the average values of the hazard coefficient, a 1:25,000 distribution map was drawn. For the inside built-up areas, the maps were detailed at the scale of 1:5,000.

The risk factors involved in the vulnerability assessment are: population, transport and utilities system, constructions, industry, services, tourism, natural resources. For the loss of human lives, the vulnerability represents the probability for a certain human life to be lost in case of landslide occurrence. A scale ranging from 0 (no losses) to 1 (total damage) is used.

Material damages and loss of human lives are directly associated with landslides, and the risk is defined as the product between landslide probability and the value of material damages plus the loss of human lives. For the calculation of the material and life losses, three values of the landslide average hazard were used.

The map of the landslide risk areas and of the construction interdictions was drawn using as support the General Urban Plan.

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Introduction

Landslide hazard and risk maps are used to slip by all organizations interested in local investment, urban development, insurance, real estate, construction permits.

In Romania, the first attempts to standardize the methods of hazard mapping in general and landslides risk maps in particular were done in 1997 (Benga et al., 1997) and 1998 (Dobre et al, 1998). The Government Decision no. 382/2003 (Anonymous, 2003a) presented the methodological regulations regarding the requirements for the documentation of the territory arrangement and urbanism in the areas subject to natural risks and the Government Decision no. 447/2003 (Anonymous, 2003b) establishes the methodological norms regarding the drawing up and content of the landslide hazard and natural risk maps. Landslide risk is a relevant one for all European Countries. Chacon et al. (2006) showed that the landslides inventory during the 2000s covered between 0 and 25% of the entire surface of Europe. It is estimated that almost one third of the Romanian territory is affected by landslides, and their study and recording is still precarious.
This paper has several aims: identifying all the landslides existing in the area under study, calculating the material and human risk, and pegging out the areas where building is forbidden.

The study area

The study area refers to the administrative surface of the Tibanesti locality, Iasi County, within and outside the build up area (inside build up and outside build up territory). Tibanesti commune is situated in the north-eastern part of the country, at the south-western border of Iasi County (fig.1). Tibanesti commune comprises the following villages: Ţibăneşti, Glodenii Gândului, Grieşti, Jigoreni, Răsboieni, Recea, Tungujei and Văleni.

Figure 1: Location of the area under study

Stratigraphically, Tibanesti commune is located in the Moldavian Plain, characterized in this sector by the occurrence of only one part of the Neogene covering deposits (Sarmatian and Miocene) represented by sandstones and sands at the basis, and in the upper part by clay, sandy clay and sometimes by sandstones occurred following the ash flow solidification. The Quaternary deposits comprise sands, clayey sands, gravels. (Petrescu et al., 1968; Mutihac et al., 2007).

As the hazard is a mathematical estimation of the probability of human lives loss and material damage foreseen for a future period and within a given area, the following factors must be generally taken into account: earthquakes, floods and landslides (Law 288/1998; Anonymous 1998). The Romanian Law 575/2001 (Anonymous, 2001), presents the hazards for the Tibanesti area. The seismic intensity on MSK scale is 8_1, with a recurrence period of about 50 years. The design land acceleration, for seismic events having an average recurrence interval IMR = 100 years, has a value a_g = 0.20 g and an earthquake acceleration Tc=1.6 sec (Anonymous, 2006).
The precipitations can reach up to 150-200 mm/24 hours and several zones are already affected by floods. The generally estimated potential of landslide occurrence is medium to high, and the landslide probability, high. Most of the landslides are primary, but reactivated ones can occur as well.

Thesis

The landslide hazard map is drawn based on the topographic layouts and maps, by means of researching, performing land studies and surveys, taking into account data about the geology, geomorphology, hydrogeology, hydrology, meteorology, the existence of landslides and of their remedy works, data regarding the interventions on slopes (Anonymous, 2003b). The landslide hazard maps represent isolines regarding the distribution of the landslide probabilities.
The landslide risk is defined (Anonymous, 2003b) as a mathematical assessment of the probability of human and material losses occurring in a reference (future) period and in a given area, during a certain type of disaster, and represents the product of the probability of landslides occurrence and the material losses and their value (for the material risk) or the product of the landslide probability and the value of the human losses (for the human risk). The natural landslide risk map includes: areas declared as landslide risk areas, areas covered by constructions exposed to landslides, areas where the high landslide frequency and complexity do not allow for carrying out remedy works and need the establishment of an interdiction for locating final constructions there.

Application

Collecting the available information

Data on topography, geology, geomorphology, climate, forest, seismicity, population, as well as information regarding the history of the area. The data were acquired from the existing literature, Romanian standards, national statistics, urban plans, questionnaires, geodesic fund, information from the utilities owners, previous studies and papers.

Field activities

Filed activities included in situ inventory and mapping of geological, geomorphologic and anthropic elements. A number of 365 observation points covered as many vulnerable elements as possible (constructions, roads, various utilities etc). Landslides were identified and consequently 14 identification sheets for landslides were prepared (Anonymous, 1998). These landslides were mapped on site, marking the GPS points on the contours of landslides and positioning the data on the topographic plans, scale 1:25,000. The value of the influence factors was estimated in all points of observation according to local conditions and using methodological norms. (Anonymous, 2003b).

Geotechnical and geophysical surveys were also carried out. The geotechnical investigations and surveys were performed by observing the provisions of the Romanian norms (Anonymous, 2007). They comprised geotechnical surveys, geotechnical drillings, dynamic penetrations by the light dynamic penetrometer and geophysical surveys (vertical electrical surveys). The geotechnical surveys revealed that the investigated landslides fall into the category of average depth landslides (with the depth of the landslide surface ranging between

1.50-5.00 m), and in terms of primary landslides they are progressive (advancing in the direction of the movement) and in terms of reactivated landslides they also have progressive tendencies, being landslides which continue to develop (on various directions), occurring from very slowly to slowly. The landslide occurs in the sequence of silty clay, sandy clay and silty sands due to the humectation after the seepage of the pluvial and snow melting waters in the more permeable strata.

<u>The estimation of the influence factors values and drawing up of the partial maps.</u>

According to the actual Romanian laws, the factors influencing the hazards risk are: the lithological factor K(a), the geomorphological factor K(b), the structural factor K(c), the hydrological and climatic factor K(d), the hydrogeological factor K(e), the seismic factor K(f), the forest factor K(g) and the anthropic factor K(h), respectively. Depending on the characteristics identified in situ and/or the information collected from previous studies, each influence factor was estimated at values ranging from 0 to 1 (Table 1).

Table 1:Categories of hazard coefficient acc. to the Law 447/2003 (Anonymous, 2003b)

Criterion (factor)	Probability of landslides occurrence (p)					
	Low		Average		High	
	Probability of landslides occurrence and corresponding hazard coefficient					
	Practically zero	Low	Average	Average-high	High	Very high
	0	<0.10	0.10-0.30	0.31-0.50	0.51-0.80	>0.80

The resulted six categories represent the probability of landslides occurrence and the corresponding risk coefficient. The work basis for the theme maps, for distributing the theme maps, was the topographic map, scale 1:25.000. The theme maps as well as the final hazard map were processed using Bentley (Power Draft) and ESRI (GIS) working stations. The maps were drawn up by interpolating the values determined in the measuring points. The interpolation method used was the ordinary kriging method. The interpolation was performed by using the ESRI (GIS – ArcMap) software. The isolines were also drawn using the ESRI (GIS – ArcMap) software. The isolines interval was of 0.05.

<u>Calculation of the average hazard factor and elaboration of the landslide hazard map.</u>

Using as basis the calculation points from the territory of Tibanesti commune, the number of values of the influence coefficients and implicitly of the average hazard coefficients was increased. After increasing the number of the previously mentioned values, 1025 calculation points were obtained. Values of the influence coefficients (lithologic, geomorphologic, structural, hydrological and climatic, hydrogeological, seismic, forest and anthropic values) were established for each calculation point, taking as standard the values of the influence coefficients established for the observation points.

In agreement with the Law 447/2003 (Anonymous, 2003b), the influence factors values estimated in situ were used to calculate the average hazard coefficient K(m), based on formula (a).

$$K(m)=\sqrt{\frac{K(a)\times K(b)}{6}\times[K(c)+K(d)+K(e)+K(f)+K(g)+K(h)]} \qquad \textbf{(a)}$$

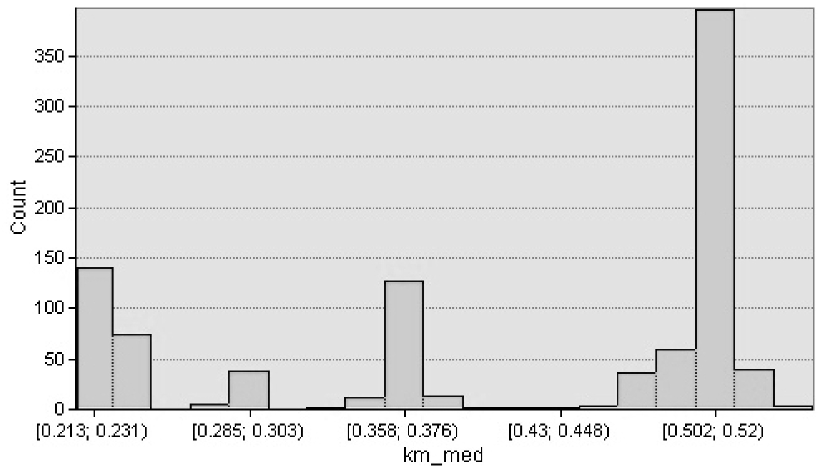
The minimum and maximum values were determined for the respective points as well as the value of the average hazard coefficient (Table 2).

Table 2: Values for average hazard factor

No. of points	Minimum value	Maximum value	Average	Standard deviation
1025	0.213	0.556	0.413	0.120

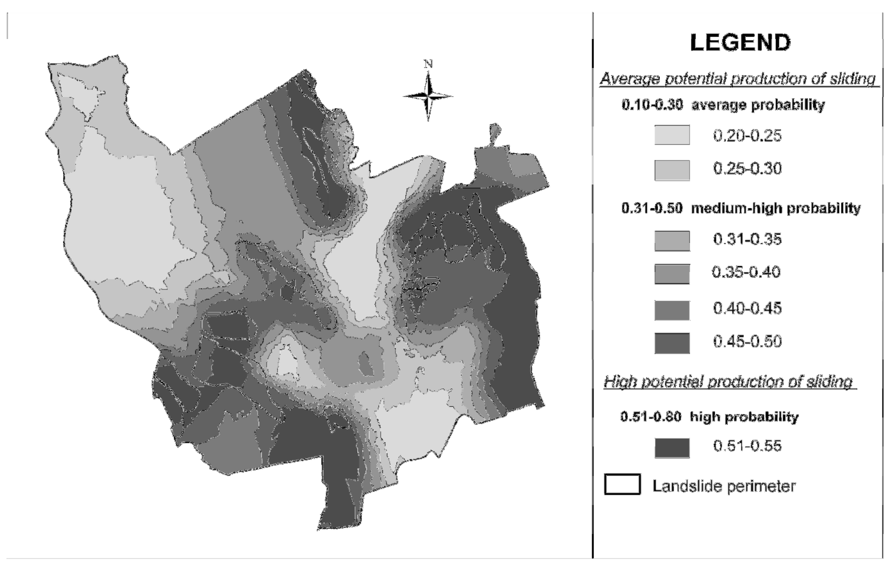
The distribution histogram of the values of the average hazard coefficient to landslides shows groups of the sizes calculated around the values of 0.500-0.520 (over 400 values). (Fig. 2)

Figure 2: Distribution of the average hazard coefficient values (Km)



Based on the average values of the hazard coefficient, a 1:25,000 distribution map (with isolines) was drawn. For the inside built-up areas, the maps were detailed at the scale of 1:5,000. The equidistance between the isolines is 0.02 (Fig. 3). The landslide hazard map showed the division of the territory into three areas: area with average potential of landslide occurrence, average probability; area with average landslide occurrence, average-high probability; are with high potential of landslide occurrence, high probability.

Figure 3: Landslide hazard map



Vulnerability assessment**.**

The risk factors involved in the vulnerability estimation are: population, transport and utilities system, constructions, industry, services, tourism, natural resources (van Westen, 2005). The vulnerability can be defined as the degree of damage underwent by an element or group of elements within a surface affected by landslide (Chacon et al., 2006). For the loss of human lives, the vulnerability represents the probability for a certain human life to be lost in case of landslide occurrence. A scale ranging from 0 (no losses) to 1 (total damage) is used. Roberts et al, (2009) divides the vulnerability in: physical vulnerability, social vulnerability, economic vulnerability, administrative vulnerability and environment vulnerability. The assessed vulnerability values, obtained after field evaluation of the risk factors are presented in Table 3.

Table 3: Assessed vulnerability values for the Tibanesti area

Risk factors	Vulnerability (V)			
	High	Medium	Low	Very low
Population	0.42	0.01	0.01	0.005
National roads	0	0	0	0
County roads	1	1	0	0
Village roads	1	1	0	0
Exploitation roads	0	0	1	1
Road bridges	1	0	0	0
Railways	0	0	0	0
Railways bridges	0	0	0	0
Utilities	1	1	0.25	0
Buildings	1	0.1	0	0
Industries	1	0.25	0	0.25
Agrarian fields + grassland	0	0	1	0
Forest	0	0	0	1
Services	0.75	0.25	0.1	0
Tourism	0.75	0.25	0.1	0.1
Natural resources	0.25	0.25	0.1	0
TOTAL	0.51	0.26	0.16	0.15

Calculation of the risk associated with landslides**.** Material damages and loss of human lives are directly associated with landslides, and the risk is defined as the product between landslide probability and the value of material damages plus loss of human lives, using (b) and (c) formulas (Law 447/2003; Anonymous 2003b):

$$R(m) = K(m) \times \sum (V_i \times PM) \quad \text{(lei/year)} \qquad \text{(b)}$$

$$R(u) = K(m) \times \sum (V_j \times PU) \quad \text{(deceased/year)} \qquad \text{(c)}$$

K(m) = landslide probability
PM = maximum material losses caused by the total destruction of all exposed elements
PU = losses of human lives
V = vulnerability of exposed elements
R(m) = annual rate of material losses
R(u) = annual rate of human losses
The sum refers to the all elements exposed to landslide hazard.

For the vulnerability areas, the possible annual rates of material and human losses (material risk) were calculated (Tables 4 and 5) (Anonymous, 2003b). For the calculation of the material and life losses, three values of the landslide average hazard were used: K(m) = 0.370, K(m) = 0.499 and K(m) = 0.589, in order to obtain an accurate description of the land conditions. The obtained values are shown in table 4 (probable material risk) and table 5 (probable human loss).

Table 4: Calculated material loss for the Tibanesti area

Km (average hazard factor)		Calculated material loss (RON)			
		High Vulnerability	Medium vulnerability	Low vulnerability	Very low vulnerability
Min	0.213	196022215.7	5460656.29	88374460	36101807
Med	0.413	380080634.2	10588033.1	171355173	70000217
Max	0.556	511682403.4	14254107.5	230686383	94237580

Table 5: Calculated Human loss for the Tibanesti area

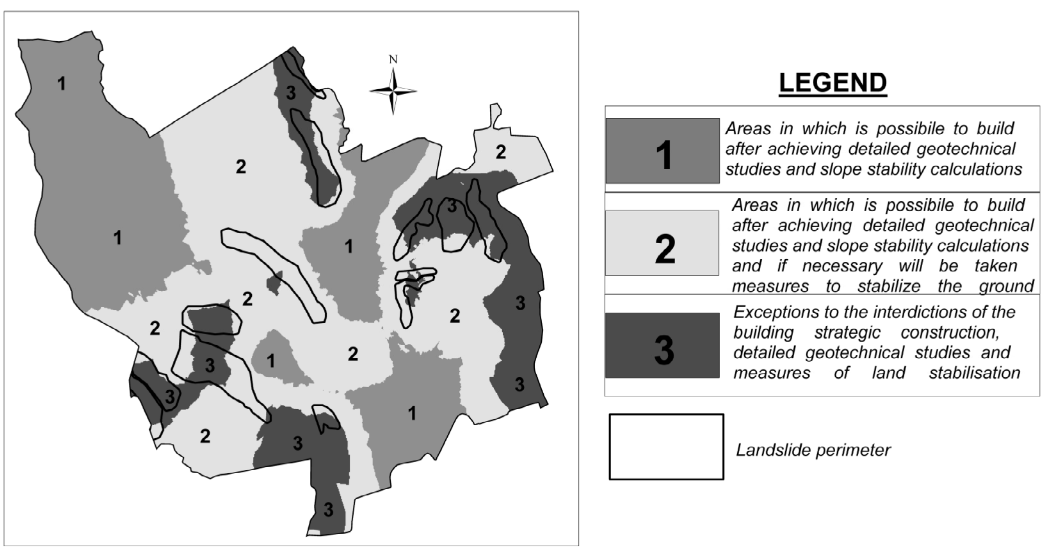
Km (average hazard coefficient)		Calculated human loss (no. of persons affected)			
		High Vulnerability	High Vulnerability	High Vulnerability	Very low vulnerability
Min	0.213	880	16	16	8
Med	0.413	1322	31	31	16
Max	0.556	1914	43	43	22

Elaboration of the landslides risk maps**.**

During this last phase of the study, a 1:25,000 scale landslide risk map was drawn. For the inside built-up areas detailed risk maps were performed at the scale of 1:5,000. The map of the landslide risk areas and of construction interdictions was drawn. This map was drawn at the scales of 1:25,000 and of 1:5,000. The support used was the General Urban Plan through the territory layout plans (scale 1:25.000) and the regulations drawings, scale 1:5,000. The map is drawn up in STEREO 70 coordinates using the GIS platform which allows the overlapping of any types of maps with the only conditions that they should be geo-referenced. The landslides risk map contains both the areas were landslides were identified, as well as the areas where there is lower or higher probability of landslide occurrence, according to the landslide risk map.

The territory of the Tibanesti commune was divided into areas according to construction conditions, taking into account the value of the average risk coefficient, as follows: (Fig.4) areas with construction interdiction; areas with exceptions related to the construction interdiction, and areas where construction is possible.

Figure 4: Map of the landslide risk areas and of the construction interdictions



Findings

After creating the landslide hazard map, the territory of Tibanesti commune was divided into natural hazard areas, as follows:

a. area with average potential of landslide occurrence, average probability, average hazard coefficient, Km = 0.10-0.30. These areas can be found in the meadow region of the Sacovat stream and in the north-eastern part, in the area of Tibanesti forest

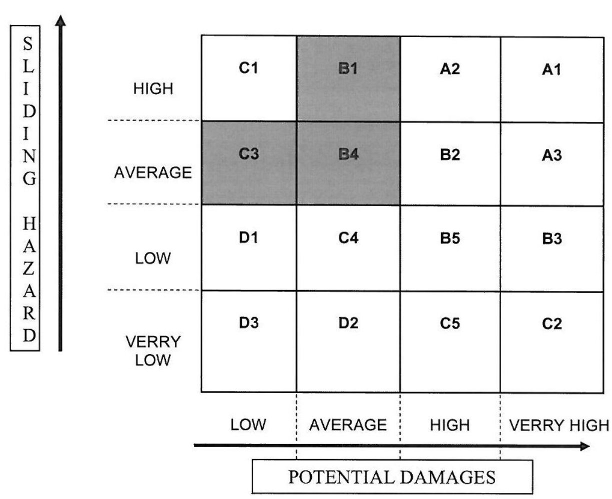
b. in the area with average potential of landslide occurrence, average-high probability, average hazard coefficient, Km = 0.31-0.50, 4 subareas can be delimited, where the occurrence probability increases from average to high

- the subarea at Km = 0.30-0.35, in the region surrounding the Tibanesti forest and the meadow of Sacovat stream.
- the subarea at Km = 0.35-0.40: in the northern region of the commune, on the territory of Glodenii Gandului village, in the central part, on the territory of Tibanesti commune and scarcely at the limit of the Tibanesti forest and of the Sacovat stream meadow.
- the subarea at Km = 0.40-0.45: in the southern region of the commune, between Valea Gaureni and Jigoreni Hill and on each side of the Sacovat stream meadow.
- subarea at Km = 0.45-0.50: in the eastern part of the commune on the territory of Tungujei village, in the southern part containing a large area of the territory of Valeni and Jigoreni villages, in the central part between the Porcariei peak and Duraceasa Valley and in the northern area with Cercelului Hill.

c. in the area with high potential of landslide occurrence, high probability, average hazard coefficient, Km = 0.51-0.80. These can be found in the northern area of the commune, in the southern part of Jigoreni Village and on the Rediului Hill; in the eastern part of the commune, starting from Cimitirului Hill, the territory of Recea village and Gorgana Hill; in the northern part, between Cercelului Hill and Sacovat stream; a small region in the central part, representing the Porcariei Peak; in the south-western part there is the northern area of Valeni village, the Candachia Coast until nearby the Duraceasa Valley.

After calculating the material risk and after performing the matrix of landslide risk (Van Westen, 2005) (fig. 5), it resulted that the territory of Tibanesti commune is divided into areas in which the high landslide hazard may cause potentially average material losses (inside the built-up area of Recea, Tungujei, Jigoreni, Valeni) and into areas in which the average potential landslide hazard may cause average material losses (inside the built-up area of Tibanesti, Griesti, Rasboieni, Glodenii Gandului) or low material losses (the area of forests, agricultural land, pastures).

Figure 5: Sliding risk matrix



Discussion

The method described by Law 447 (Anonymous, 2003b) highlighted the areas with various probabilities of landslide phenomena occurrence, and it was useful for the calculation of the related material and human losses. After performing this case study, besides the drawing up of the hazard maps and besides calculating the related material and human loss, the following aspects resulted, aspects which should be improved within the calculation method:

a. the influence of the anthropic factor on the value of the average hazard coefficient should be at least equal to the influence of the lithologic and geomorphologic factors. Without the share increase of this factor, paradoxes could occur, as for instance, in completely flat, uninhabited areas the average hazard coefficient would not have the smallest values, or in areas where there are no large excavations at the basis of the slope or there are no massive loads on a potentially unstable slope, the average hazard coefficient would not reach the maximum values.

b. When calculating the human losses, the material risk should be expressed in individuals affected/year and not in deceased individuals/year. In general, in Romania, landslides are slow, and only rarely they are violent, which is why the number of the individuals who might decease is much higher than the likely consequences.

c. The material risk should be calculated for small surfaces, such as for personal private properties, local investments, road alignments or local interest areas. The more the surface for which the material risk is calculated increases, the more the approximation degree is higher and the time needed to perform this calculation augments exponentially.

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NGN PLATFORMS FOR EMERGENCY

PLATFORMS FOR CONTROL AND DELIVERY OF SERVICES TO BE USED FOR COMMUNICATION DURING CRISIS MANAGEMENT

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Emergency communication, public safety, accidents and natural disasters, fixed-mobile convergence, IMS

Abstract

Communication among rescue agencies involved in the management of emergency situations is a fundamental but critical topic for which effective and easy-to-use solutions are still missing..

The paper presents PICO (Platforms for service control and delivery in convergent networks) [MIUR - 2006] project results, aimed to the development of “innovative platforms for control and delivery of services in next generation networks (NGN)” proposing it as an innovative communication way to be used during prevention and management of emergencies situations.

The project developed a new telecom services to be delivered on large bandwidth networks, focusing on convergence between fixed-mobile phone networks based on IMS (IP Multimedia Subsystem) platform [Camarilli and García-Martín, 2006].

The new proposed system makes available telecommunication services based on IT platforms to different end-users allowing advanced communication during critical situations for prevention and/or management of emergency crisis. These services allow the establishment of communication channels not limited to voice, but which involve the use of ad-hoc designed applications able to enhance the flow of information exchanged between the caller (requiring the intervention of emergency) and the control room, optimizing the association client - server able to exploit the full potential of both parties.

An experimentation based on IMS platform will be presented, focussing on how the complex IMS structure must be adapted and extended to provide a fixed access to fixed and mobile telecom operators. In particular it specifies the way for implementing a prototype analysing the features offered by IMS system for "context-aware" application streaming, and, in general, in remote applications usage by means of a virtual access to different protocols compliant

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with IMS system. In such a way, during the prevention and emergency management it would be possible to easily activate different services which would improve communication allowing data exchange.

Introduction

The management of crisis events, like natural and anthropic disasters, requires the simultaneous involvement of a large number of actors belonging to different agencies which are requested to constantly coordinate and interact, often even in very harsh conditions, or to supervise the situation ready to promptly intervene in case of necessity.

In such a variety of scenario, effective communication is a very crucial and strategic factor which still remains, together with the adoption and use of proper procedures, one of the key components from which it depends the good management of such events.

Emergency scenarios, especially those at large scales, need very reliable, robust and effective communication systems to enable all involved actors to easy coordinate and interact on field and/or with a remote command and control room. The use of innovative service control and distribution platforms, under the Next Generation Network paradigm, able to provide advanced telecom services addressed to heterogeneous actors can strongly improve the management of these scenarios, exploiting the capabilities of Internet Technologies while providing new advanced services complementary to the traditional ones (voice).

In fact, through an adequate exploitation of the opportunities offered by IT, it is possible to establish communication channels, especially on large bandwidth networks, which are not limited to voice communication, but which involve the use of ad-hoc applications designed to enhance the flow of information exchanged between all involved actors.

Project PICO aimed to create innovative telecom services focusing on convergence between fixed-mobile phone networks and on technologies for service creation, provisioning, and management, for advanced and high added value service delivery. In particular the main project goal was the development and experiment of an innovative service on large bandwidth networks based on IMS platform, properly adapted and extended to provide access to both fix and mobile telecom operators. As specific goals the project implemented a sever prototype compliant with the features offered by IMS system for "context-aware" application streaming.

The paper illustrates in details the IMS based PICO’s platform features as a concrete example of an effective and advanced system to be used for communication during crisis management over large bandwidth networks.

After a general introduction to the PICO platform it will be presented the IMS architecture and the protocols for application streaming which have been used for the PICO demonstrator design. Demonstrator will be described in its main components identified in two different parts: the user device and the application server.

Finally PICO project results will be reported with the list of PICO applications used for the definition of typical use cases over which the prototype has been implemented and tested in a typical scenario.

Theory and Method

<u>Introduction to PICO Platform</u>

The design idea behind the whole PICO system is the development of a broadband innovative telecommunication system for a variety of applications in security, prevention and intervention in case of natural disasters. The project's objective is to develop and test innovative services in an IMS environment, in which the structure of the IMS platform architecture is adapted and extended to fit the context of work. In particular a prototype was implemented analysing the performance of the services offered by the IMS in terms of streaming application having context-awareness properties. More generically, the developed architecture allows, via remote virtual infrastructure, to access to broadband communication applications based on the use of specific protocols while responding to specific requirements and verifying the compatibility of the end user characteristics.

The platform is set up by two different elements: the client and the server. Client devices are used by end users whereas the server is supposed to be in a remote location, not necessarily related to any specific involved end-user agency. As an example within the project, three entities engaged in the management of public safety were considered playing the role of end-users: Fire Fighter (FF), police (Law Enforcement, LE) and Emergency Medical Services (EMS) operators. Each single operator is defined as a PSCDU (Public Safety Communications Device User) which is the real user of the device.

IMS Architecture for PICO

IMS is the network architecture for deploying IP multimedia services enabling multimedia experience richer than the circuit-based technology, allowing multiple types of network access, geographical location of utilities and high customization of services according to the needs of end users.

IMS technology is the key element in 3G and NGN (Next Generation Networks) architectures that merges Internet with the cellular world. It makes possible to provide ubiquitous cellular access to all services provided by Internet (i.e. web, email, instant messaging, presence, and videoconferencing) making them available everywhere. IMS therefore fills the gap between the two most successful communication paradigms, mobile and Internet technology.

In PICO project the following IMS basic principles were considered:

- IMS enables access independence. This means that all existing networks could work with IMS, through appropriate gateways and interfaces.
- IMS works with terminal and user mobility.
- IMS allows operators and service providers to use different underlying network architecture.
- IMS offers extensive IP-based services, such as VOIP (Voice over IP), POC (Push to talk Over Cellular), multiparty gaming, videoconferencing, presence information, instant messaging, and content sharing, and so on.

PICO architecture and prototype description

PICO system is composed by two different main elements:

- User device, called Public Safety Communications Device (PSCD): a next generation device used by operators which allows them to access the IMS subsystem and its services;
- Application Server called Public Safety Communication Server (PSCS): an application server that belongs to the IP Multimedia Subsystem, and performs the functionalities of users' authentication and authorization based on their profiles, mobility handling, application on demand handling and many others.

To be effectively used, both PSCD and PSCS must be authenticated by IP Multimedia Subsystem while communication is based on SIP protocol [Rosenberg, J., et al., 2002], [Roach, A., 2002], [Niemi, A., 2004], [Rosenberg, J., 2004], MSRP protocol and, ConteXML.

The server platform has several key features guaranteeing efficient communication operability: connection speed, interoperability, functionality, security operations, providing high-bandwidth to allow the transfer of multimedia content.

Similarly, also devices have a series of specific features: they must have different interfaces to suit users and to interact with existing communication systems, and must be resistant to environmental conditions, often very harsh. In addition to user devices, they can be part of the PICO system also sensors present on-site, whose job might be tracking weather, monitoring risk areas, measurement of vital signs of rescuers, and so on. All used devices, however, must be able to interface with the selected NGN platform.

As a general procedure the system requires that a User with a PSCD (PSCDU) before to start the communication with the central assistance center must make a specific authentication procedure. During the authentication and identification phase the PSCDU provides the server with information related to its own category, so to be filed in accordance with his/her profile which enable him/her to access to specific sub-set of data, compliant with the registered profile. This operation is done also assuming a hierarchical organization of the networks. Figure 1 shows examples of elementary operations that a public security user can perform: Authentication, Identification, Selection of the requested application (chosen from a list of applications available in streaming from the operations center), Execution of the selected application, Removal of the application once finished its use. The removal of the application is made to avoid unnecessarily occupation of the device memory.

Figure 1 - Basic actions using a PSCD

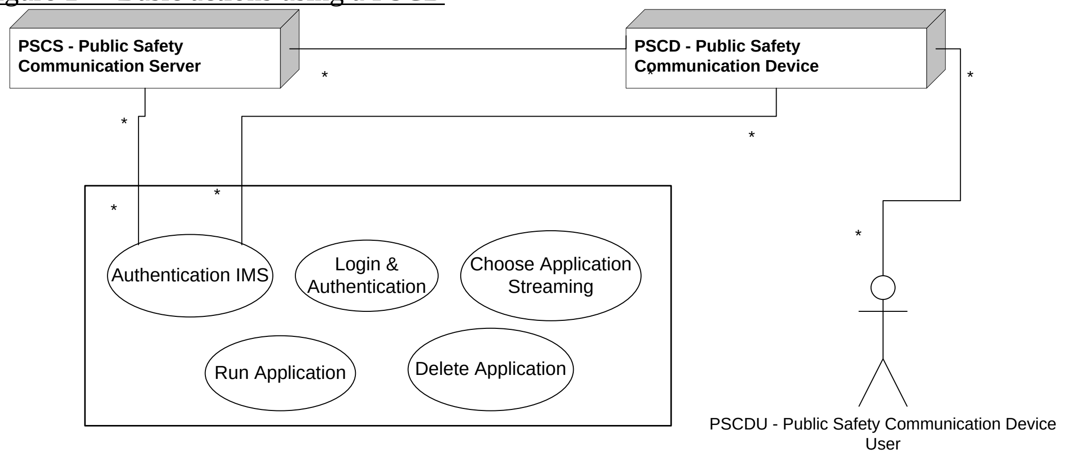
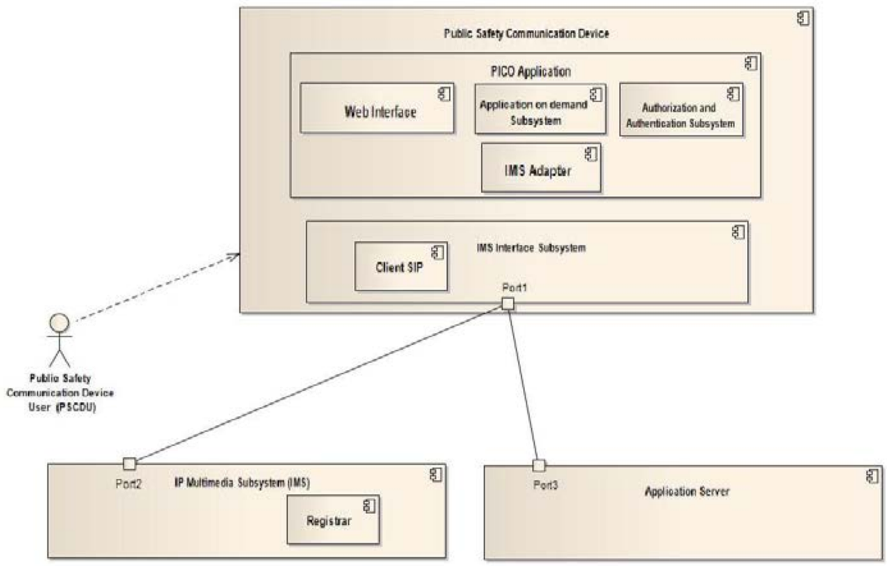


Figure 2 shows an overview of the system logic architecture. The PSCD is composed of two main parts: the application components and the IMS application interface needed to interact with the system. The application part includes the web interface used by the user, the system for managing on-demand applications and the authentication and authorization block.

Figure 2 – System logic architecture



Interface contains the SIP client, which is related to the Application Server (the database that contains all the applications accessible by the user) and to the IMS platform, which manages all communication parts like system registration, calls routing, etc. Both PSCDUs and the operation centre interface with the IMS platform, respectively by mean of the PICO Device (PSCD) and the PICO Server (PSCS).

The PSCS is an application which performs an IMS registration and is considered in the system as a Robot. All PSCDU using a PICO client (extended IMS client) are registered to the IMS as well for the geographical area relating to the PICO server. Each user has a PICO robot as buddy and periodically sends its context using MSRP protocol and the IMS-SIP session. The context is a XML File (ConteXML) which contains several contexts information such as user location, battery level, disk usage, type of user and so on. PSCS processes the context of all users in a specific area and also analyzing the context of emergencies, it performs reasoning to offer or send relevant context application.
PSCS uses a rule engine (Reasoner) and some preset rules to perform these actions. The application are exchanged, organized and installed using the MSRV protocol and this extends the IMS platform with full application support.

Public Safety Communications Device (PSCD)

PSCD indicates any professional device involved in emergency scenarios It is a next generation device and must have additional tools to perform advanced multimedia required services, like video camera for videoconferencing and recording, a microphone for audio calls or a GPS device for geo-location.

Moreover, the device could have additional sensors to register vital parameters, like the EKG unit, a respirator monitor, and a blood pressure monitor so that, for example, a paramedic operator on field could monitor vital signals of injured people or analyze blood and chemical air composition, or substances that intoxicated the patient. In addiction also streaming service is helpful for analysis purposes. Devices transmit to an application server belonging to IP Multimedia Subsystem; the server manages users' information like profiles, resource access grants, and allows the authenticated ones to download applications among the downloadable set.

A logical view of the PSCD is described in Figure 3, which identifies five main blocks (or subsystems):

- IMS client, responsible for implementing all the IMS client features required by the PSCD. The main IMS features available are user authentication to the IMS, audio/video call setup, presence service and IM. More generally, the IMS client manages all the multimedia sessions required by the PSCD; it exports a proper set of APIs to the other PSCD subsystems and implements the MSRP protocol to allow file transfer. It provides the application transfer from PSCD Server.
- Base Features, which is the core of the PSCD.
- User Driven Applications. This subsystem collects all the applications required by the PSCD during operations specified accordingly to the user profiles and needs
- Device Driven applications which groups all the applications required during operations by the PSCD and specific for the device type and the application installed on it.

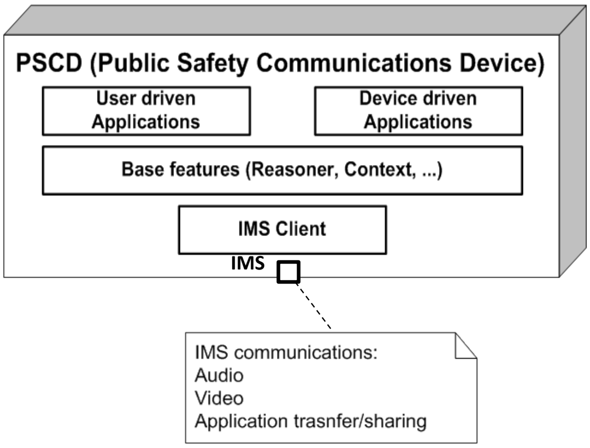
PSCDU, after IMS authentication and PSCS authorization, reaches his own home page where he/she can choose the Application On demand to download.

The PSCD is an extended IMS Client and provides all SIP functionalities such as:

- Audio call
- Video call
- Chat
- Application transfer (file transfer)

This type of communications can be established among users or between PICO client and PICO server.

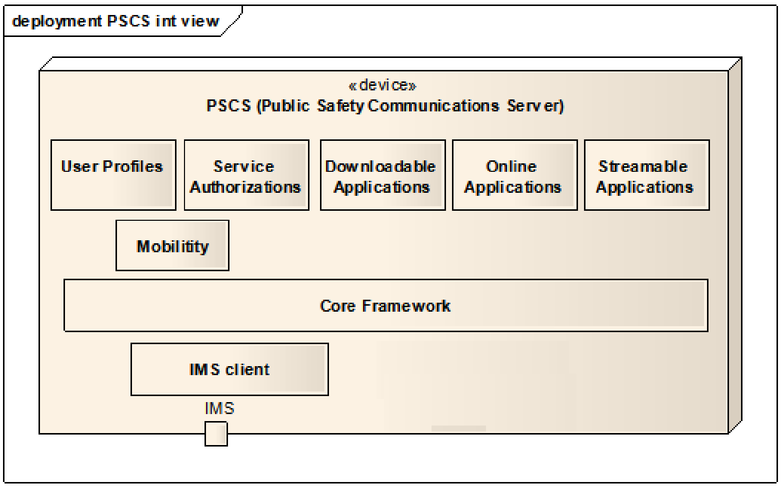
Figure 3 - PSCD internal view



Public Safety Communication Server (PSCS)

The PSCS is the server of the PICO demonstrator which enables the PSCD to access to the PICO services and applications. PSCS can be considered as an application server of the IMS but can be also identified as a client of the IMS with special functions. Figure 4 shows the internal view of PSCS. It is made up by the following different elements:

Figure 4 - Public Safety Communication Server



- User Profile: all the users have a user profile that describes the configuration for a specific user, including the user's access permission for the applications on demand, the user type (FF, LE or EMS) and preferences settings.
- Service Authorizations which sets authorization for the required service at user level.
- Downloadable Applications: it refers to the downloadable applications on demand.
- Online Applications which are available on line when the user performs authentication.
- Stream Applications: applications that can be streamed on demand.
- Mobility, the module which manages mobility among the three IMS architectures (FF, LE and EMS Network).
- Core framework, the module which performs all the basic functionalities.
- IMS client: this module performs the functionality of IMS client allowing registration on IMS, invitation to a session, file transfer using MSRP protocol and so on.
- Reasoner: this module performs reasoning based on rules that consider emergencies for a specific area and all users near that area.
- Context: this module manages all Context parameters based on Geo Coordinates of the PSCDU, the battery level of the device, network traffic and so on

PICO Applications

PICO platform is an application centric system which allows each operator to access a set of applications customized to his/her own profile, depending on its belonging entity cluster.

In a scenario of IMS Internetworking, for each category there is a different IMS network. In the PICO example there is one for FF, one for LE and one for EMS and each user has its home network and Server. When in the location of the emergency scenario not all the three networks can be reached, the user can connect through the home network of one of the other present actors, after authorization and authentication by this last server. Another aspect to be managed in an application-centric network is the context of application. Assumed that the framework is extended for the application sharing (actually is one of the goals of PICO), the operating system should handle the applications that could be installed onto device. Many are the contextual parameters that could be analyzed for each device when an application starts downloading.

Applications On Demand

For what it concerns the application-centric network, one of the goals of PICO was to assume that the framework is extended for the application sharing so that the operating system handles the applications to be installed onto device. Many are the contextual parameters that could be analyzed for each device when an application starts downloading, like disk usage, location, battery level and network traffic.

On the basis of these parameters, the application is made available ready to be directly downloaded or, in case of low disk space, to download a lite version of it instead of full version, if instead there is a low battery/bad network situation it can be made available with less media usage.

Besides these assumptions, PICO takes care also of more context parameters such as user account and privileges, existing emergencies in the interested geographical area, status and proximity of neighbors (EMS, FF and Police)

In the project PICO example scenario, three classes of application were considered, specific for the selected users (EMS, LE and FF), to be selected on demand, when necessary, and then downloaded and run locally. Furthermore also common classes can be considered to be shared by all the users like Workforce, Incident Command and On board resources status.

Test scenario

As an example of concrete application, the emergency related to a car accident in urban area has been developed. Due to a three cars crush there are three unconscious injured. A policeman reaches the accident place and on his device appears the list of buddies and his position in that moment. From it, he selects the operator of the police station and begins an audio call using an IMS Client. Meantime, via a web interface the operator inserts all initial data about the accident into PICO Server while the policeman launches the first emergency call application and starts scanning the QRCode of the first victim to identify them.

The QRCode provides a pop-up message with the name and last name of the victim and calls automatically the first number of an important person (i.e parents) using the IMS Client. At the same time, the application using the information embedded in the QRCode, sends the name and other important information related to the victim to the nearest PICO Server available using LoST (Location-To-Service Translation Protocol) protocol. Moreover all Accident information such as name and current location are also sent to victims important facebook contacts. PICO Server processes the information related to the accident and the information related to all users' contexts connected to the PICO Server. An ambulance with two paramedics near the accident zone is alerted by the PICO Server via the Reasoner with a message. The paramedics' device that contains all medical information gained on the accident place by the policeman using the embedded IMS Client, automatically connects with an audio call or video call the paramedic and the policeman.

Meantime, the policeman manages also the removal of the cars. From the contextual application list he starts an application to find the nearest tow truck to the zone and sends a SMS with all accident details (location, number of cars, and similar information).

A squad of fire fighters is in a near zone attached to a different PICO. Through the Server connection a request for availability to intervene is forwarded to the squad, using LoST, from a PICO server to the other. PICO Server starts the application that shows the best path to the FF and begins also a communication session between the FF and the policeman that, based on network condition, can be a chat session (low traffic condition also with all accident details), audio session (medium traffic condition) or video session (high traffic condition)

The policeman having different set of data available decides to share a picture using IMS session to the FF because a small fire started after the accident. So the FF can see how big is the fire and position of the cars. Meanwhile an update about the ambulance appears on the desktop of the policeman device based on his context. Finally, a notification message on the device alerts the policeman that the contextual application list has been updated, so the policeman can switch the desktop, selects the First Aid Application (or PDF file from third desktop) and download/launch it. When the ambulance arrives to the accident place, paramedics select from the contextual application the list the application to monitor the heart rate of the victim and rescue activities start.

PICO technologies

PICO uses several technologies. PICO server is a JAVA EE application which uses PostgreSQL as database to collect all information related to the PSCDU and Emergencies for a specific area. As Rule engine, PICO uses Drools from JBOSS. It takes some rules as input and provides the best action to do for each user, for example, a relevant application in case of emergency or an audio/video call to other PSCDU, etc.

As IMS framework (server side), PICO uses *doubango* which is a 3GPP IMS framework for both embedded and desktop system. It is written in ANSI-C and is very powerful and performing. It exposes a Java wrapper to allow communication with the PICO JAVA EE application. PICO client is the mobile application written in JAVA and converted by Dalvik machine for Android system.

As IMS framework (client side), PICO uses *imsdroid* which in turn is based on *doubango* as well. PICO extends its capabilities for full application support.

As operating system PICO uses Google Android a software stack for mobile devices that includes an operating system, middleware and key applications. The actual version of Android SDK is a beta version; it provides the tools and APIs necessary to begin developing applications on the Android platform using the Java programming language.

User interface and visual design

With PICO some guidelines have been defined for the user interface development. Essentially on the mobile application there are three main desktop, or three main applications.

a. Main Desktop. It is the main desktop for the PSCD which contains all useful information related to the emergency. It consist of Status Info Widget/Box with Emergency details, Buddies List which includes Operator + other buddies associated to the emergency and Map with the location of all PSCDU and/or best path available to reach the Emergency.

b. Second Desktop. It contains the contextual application list, with already installed or to be installed applications, previously installed applications or not installed applications..

c. Content Desktop. It contains file list with useful contents to PCSDU (i.e PDF, Images, …).

Moreover all notifications to the PSCD users are delivered through a notification area on top of the main widget using SIP/IMS messages.

Results

The paper intended to demonstrate the effectiveness of IMS system to manage rich communication even in very harsh conditions, allowing actors involved in the response activities to use a number of potential applications customized and generalized which can improve the management of critical emergency situations, through the access to data and tools, for the moment not available with traditional available systems.

PICO system demonstrated that during a crisis scenario is possible to access and use:

- o A context aware presence, by using the IMS protocols, in order to have the opportunity to see and interact with the end users present on field and involved in rescue activities;
- o An intelligent communication system based on the context awareness (i.e. battery status, end user profile, and other similar) elements accessible via IMS;
- o Customised applications, selected for a specific crisis scenario, which are accessible by mean of the MSRP protocol and which can be later deleted once the crisis will be over.
- o Different protocols like ConteXML to define the context.

Discussion

The flexibility and dynamism of PICO platform can pave the way to a new paradigm of managing emergency and crisis scenarios, by the access to a variety of applications devoted and customised to the specific situation depending on the interested scenario. The use of IMS platform enables to bridge telecommunication and Internet world, opening a huge amount of potential field of applications, which can be used by operators on field, with high flexibility and simplicity of access.

The platform and its relevant protocols are now in a prototype version already tested by simulation of different scenarios as the one previously described. Field trial applications will better validate the achieved results, verifying in real time conditions the effectiveness of the system under the applicative and communication perspective. From the project results it is evident that PICO platform solutions and applications can realistically give a big boost to the crisis scenario management, if the related infrastructure, as described in the present paper will be accordingly deployed.

Further developments of the system are possible both for improving the already existing protocols and integrate new protocols.

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EVACUATION DURING NATURAL DISASTERS IN JAPAN FROM VERTICAL EVACUATION TO COMPREHENSIVE EVACAUATION

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Keywords

Evacuation, Extreme Heavy Rain Fall, Human Causalities, Long-term Flooding

Abstract

Flooding by extreme rain fall in Sayo town in 2009 killed 18 people and two people are still missing. Nineteen of twenty sufferers died outside during evacuation or whilst driving a car. Japanese policy about flooding evacuation is that all the people of a possibly flooding area should evacuate to an evacuation centre based on “evacuation advice” and “evacuation order”. This evacuation policy was developed for the flooding from the large river. Though Japanese river is steep and short, it takes several hours before flooding after heavy rain fall. However, Japan recently suffered from extremely heavy rain such as 100mm/hour, which caused immediate flooding. And people move to evacuation centre during flooding, and were killed on the way going to evacuation centre like Sayo tragedy. Reflecting those issues, Japanese government started to discuss about the policy change about evacuation procedure. Flood hazard mapping has become key for decision making about evacuation. Flooding over 3m could flush away or destroy wooden structure housing, so those who live in those areas should evacuate immediately at the time of heavy rain or follow evacuation advice. However, at less than 3m flooding area, staying in the second floor of their house is much safer than moving to an evacuation centre using a flooding road. In addition to short time heavy rain fall, possible long term flooding at under sea level area is also a serious problem in Japan. This paper discusses a comprehensive framework for evacuation at the time of flooding based on survey results on flooding disasters.

Introduction

Flooding by extreme rain fall in Sayo town in 2009 killed 18 people and two people are still missing. Nineteen of twenty sufferers died outside during evacuation or whilst driving a car. Basic understanding about evacuation under natural disaster in Japan are as follows: 1) Moving to safer place on foot, 2) Evacuating to designated emergency shelter within community, 3) Evacuation Order Mayors' responsibility based on hazard information from JMA, and 4) Three criteria about evacuation order Mandatory>Advisory> Preparedness (New)

This evacuation policy was developed for the flooding from a large river. Though Japanese river is steep and short, it takes several hours before flooding after heavy rain fall. However, Japan recently suffered from extremely heavy rain such as 100mm/hour, it caused immediate flooding. People move to evacuation centre during flooding, and were killed on the way going to evacuation centre like Sayo tragedy. Reflecting those issues, Japanese government started to discuss about the policy change about

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evacuation procedure. This paper discusses a holistic evacuation framework based on research results on human casualties in recent flooding disasters in Japan.

Theory and Method

Data on human casualties about the 2004 Niigata flooding disaster, which killed 12 people, and the 2009 Sayo flooding disaster, which killed 20 people, were collected through field survey. Also data about inundation height of the location people were killed or missing was collected. Based on field survey data, the causes of people dying from the flooding disaster were analyzed, and the evacuation procedure targeting “not losing life” was proposed.

Why do people die from flooding disaster?

On July 13, 2004, the levee of Ikarashi and Kariya River was breached from heavy rain fall, and 12 people were killed. From the analysis of fatality causes, we found three types of human death from flooding disaster as shown in Figure 1.

The first case is those who stayed in home and were killed because their houses were flushed away from the levee breach. In the 2004 Niigata case, three people who lived near to the river levee were killed without evacuating from their house, and flushed away with their houses. In case of the 2009 Sayo flooding disaster, houses near to the river were flushed away due to bank failure. However, residents had been evacuated from the lessons in 2004 flooding, and no people lost their lives.

The second case is those who died outside. Those who started their evacuation to a designated evacuation centre after inundation starting, and those who drove a car and lost their lives. 19 human casualities of 20 occurred outside in the case of the 2009 Sayo flooding disaster. 11 people were killed during evacuation and 8 people during driving a car. This type of human casualties was highlighted in the 2009 Sayo flood disaster, and the same things happened in the 2004 Niigata flooding. In the Niigata case, five people lost their lives during evacuation, driving a car, and visiting their factory to check the damage.

The third case is about people with special needs, especially disabled single elderly people. They drowned in the first floor of their home. Because they could not move without help, and could not go to the second floor which was not inundated. In the case of the 2004 Niigata Flooding disaster, four disabled elderly people lost their life, though inundation of their homes starts 2-3 hours after bank breaking and there was enough time for evacuation. The 2004 Niigata Flooding disaster highlights the evacuation of people with special needs, and big policy change about evacuation of people with special needs by setting a new evacuation alert called “Evacuation Preparedness”.

The 2009 Sayo Flooding disaster raised public awareness about issues on human causalities during evacuation to designated evacuation centres, although the same things happened in the 2004 Niigata flooding disaster. From the lessons on the 2009 Sayo flooding disaster, the Japanese government set up a special committee setting polices for safer evacuation during natural disasters. In this committee, there is discussion that those who live in safer areas from flood disaster can stay in their home, being not recommended to evacuate to registered evacuation centres. It is a big policy change about evacuation in Japan because evacuation policy in Japan is that all the people should go to a designated evacuation centre such as a public school or public building when the evacuation alert is issued.

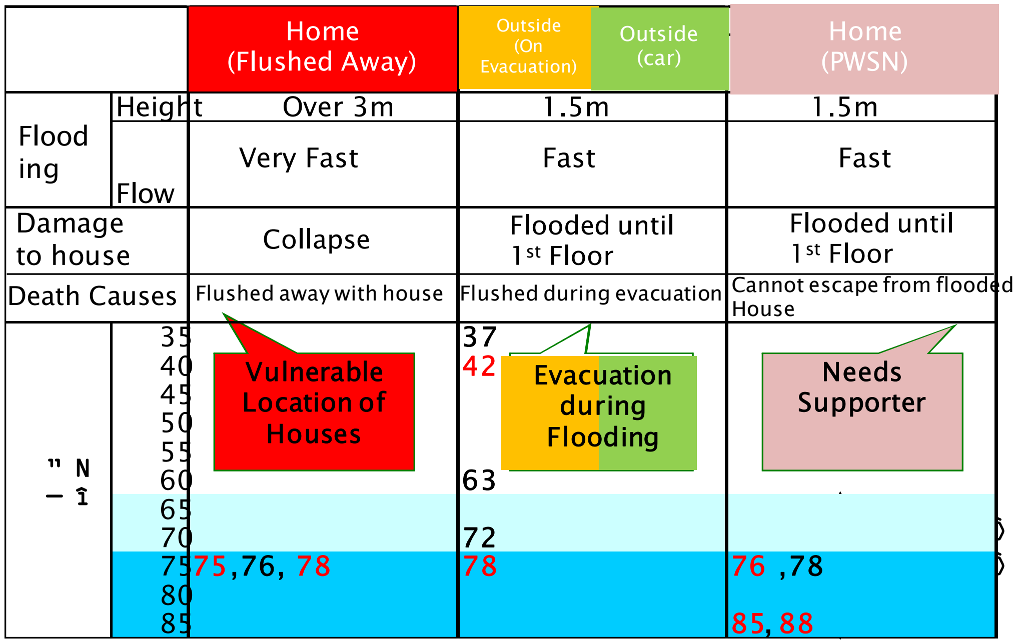


Fig.1 Causes of human causalities from flood disaster

Three Types of Flooding Disaster

Though Japan recently suffered from flooding for a short time in extreme rain falls, there are three types of flood disaster (Figure 2). The largest scale flood disaster is inundation from storm surge at under sea level area. The 2005 Hurricane Katrina in the US and the 1958 Ise Bay Typhoon in Japan corresponds to this type of flooding disaster. At the time of over 3m height flooding, water can reach the second floor and leaves no space for evacuation at their home, and also can flush houses away. And those who stay in their home could lose their lives. In the case of the 2005 Hurricane Katrina, those who did not evacuate to safer places in spite of a mandatory evacuation order issued one day before the hurricane landing, lost their lives because water came up to the top of their roof and they drowned. In addition to the life threat, it needs a long time for recovery from flooding in under sea level area. It is because water can not be drained without using pump. So those who lived in the inundation area must live in shelter for a long time. In case of the 1958 Ise Bay Typhoon, inundation continued for three months, and in the 2005 Hurricane Katrina, around 40 days. So evacuation is essential for those who live in under sea level area when the evacuation alert is issued. Although typhoons and hurricanes could cause large scale impacts, the course of typhoons and hurricanes can be predictable, and so the alert can be issued with enough intervals for evacuation.

The other type of flooding disaster is inundation from levee breach. River water enters a dwelling area, and houses near to the breaching point can suffer from serious damage. This type of flooding disaster is the flooding disaster which the evacuation procedure in Japan intends to accommodate. Large rivers could experience heavy rain fall for several hours, and there are several hours interval before levee breach. So that local governments can issue evacuation alert step by step such as 'evacuation preparedness', 'evacuation advisory', and 'evacuation order' with enough time for evacuation.

However, recent flooding disaster in Japan has been caused by a short term extreme rain fall such as over 100mm/h rain fall. Flooding starts not from rivers, but starts from the dwelling area because drainage cannot cope with extreme rain fall. Drainage in Japan usually is designed to cope with 60mm/h rain fall. And, inundation starts before the evacuation alert is issued. So that the standard operation procedures for the evacuation alert such as preparation, advisory and order does not work in this case. Frequency of extreme rain fall is increasing in Japan, and so it is necessary to revise evacuation policy for those situations.

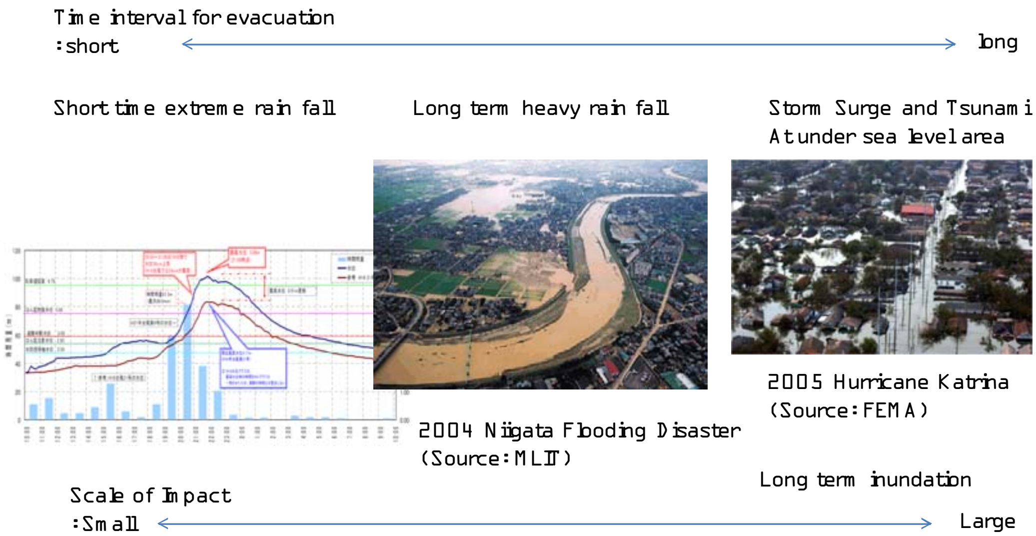


Figure 2 Three Types of Flooding Disaster

Four Types of Evacuation

Theoretically there are four types of evacuation such as ‘stay’, ‘vertical evacuation’, and ‘horizontal evacuation’ (Figure 3). In case of a chemical spill and nuclear plant failure, the best approach for evacuation is staying in the home. This type of evacuation is called ‘shelter in place’.

The second type of evacuation is ‘vertical evacuation’. In case of tsunami evacuation, tsunami tower or tsunami evacuation building are prepared in high tsunami risk areas. In case of evacuation at the time of river flooding, ‘vertical evacuation’ could also work well. If the building could not be flushed away, evacuation to the second floor is a good way to save a life. National Government Guideline for evacuation at the time of river flooding, which were issued after the 2004 Niigata Flooding Disaster reflecting the lessons from the event, recommends ‘vertical evacuation’ to save life. The guideline says that ‘people can evacuate to the second floor of own home or neighbours to save their lives at the time the route to designated evacuation centre are inundated’ (CAO, 2005). However, the concept of ‘vertical evacuation’ is not common, and many people lost their lives in the 2009 Sayo flooding disaster.

The third type of evacuation is ‘horizontal evacuation’. This is ‘the evacuation’ in Japan. However, there are two destinations for ‘horizontal evacuation’, designated evacuation centre and safer place. In February 2010, Japan was hit by a far distance tsunami caused by an M 8 class earthquake in Chile, and an evacuation alert was issued. National government conducted a questionnaire survey about evacuation for this disaster because the evacuation to designated evacuation centres was very small. This questionnaire survey found very interesting results about evacuation in that 37.5% people evacuated based on tsunami alert, and 59.8% of evacuated people went to non-designated safe places such as movie theatres or shopping centres located inland. This means that the larger proportion of people evacuated to non-designated evacuation centres.

The most important point of evacuation is survival from disaster. Going to designated evacuation centres is the most preferable, but various ways of evacuation exists as explained in this chapter. Appropriate ways for evacuation to save lives will be discussed in the next chapter.

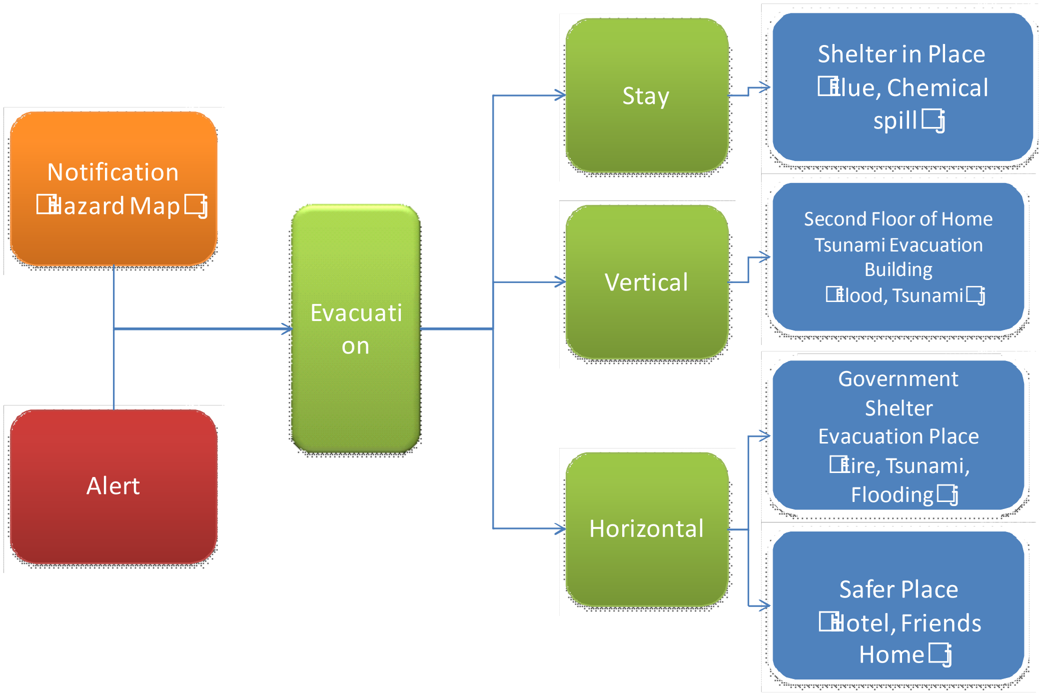


Figure 3 Holistic Framework of Evacuation

Discussions –Evacuation to save our lives-

We need two types of information for decision making about evacuation. One is information called 'notification' which notifies the hazardous area. Hazard map is usually used as an information tool for this. The other information is called 'alert' which informs the timing of evacuation. Without pre-education or 'notification' about whether the location people are living in is safe or not, people never evacuate only by alert information. Both 'alert' which tells the timing of evacuation and 'notification' which is educational information before the event are necessary for decision making about evacuation. Then how can we survive at the time of flooding using these two types of information?

Flushing away of buildings occurs at near levee and over 3m inundation areas. Figure 4 shows the fragility function curve developed real building damage at the time of the 2004 Niigata Flooding Disaster (Shingo Suzuki et al., 2005). So that those who live near levee and over 3m height inundation areas in Hazard Map should select 'horizontal evacuation' to survive from flooding disaster. On the other hand, those who live less than 3m inundation height area in hazard map need not evacuate even at the time of heavy rain fall or when the alert is issued. Hazard Map of Kyoto City (Figure 5) tells that "0.5m-3m: evacuate to the second floor" "under 0.5m: evacuation could raise the risk". But those who live in a single story house should evacuate to a designated evacuation centre or a house of more than two stories in neighbourhoods because those houses does not have space to evacuate.

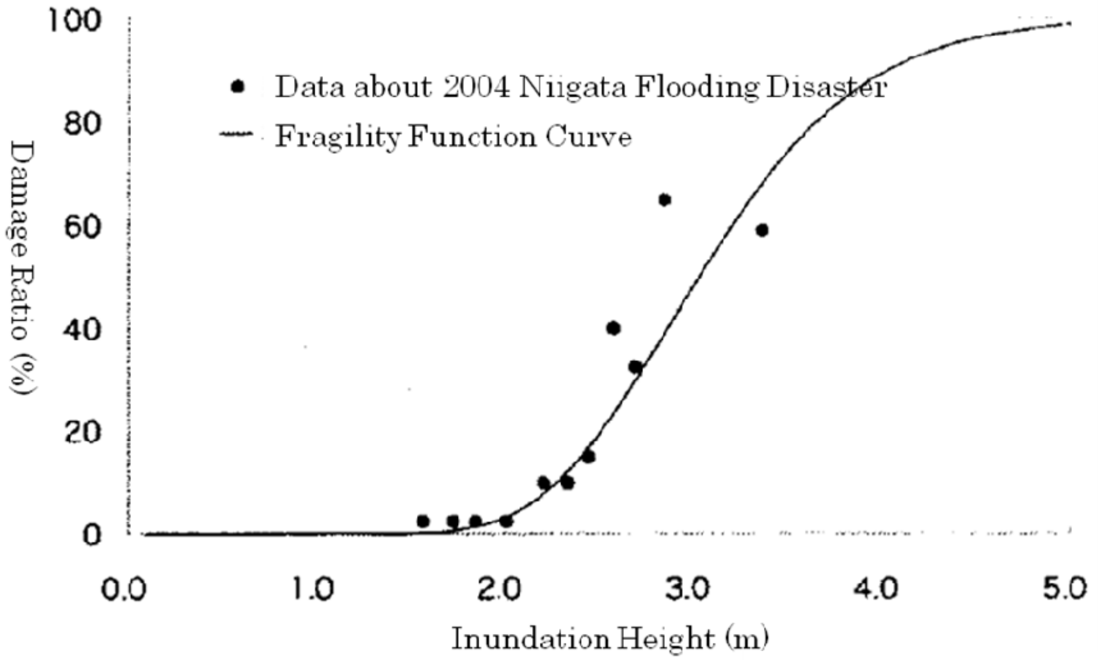
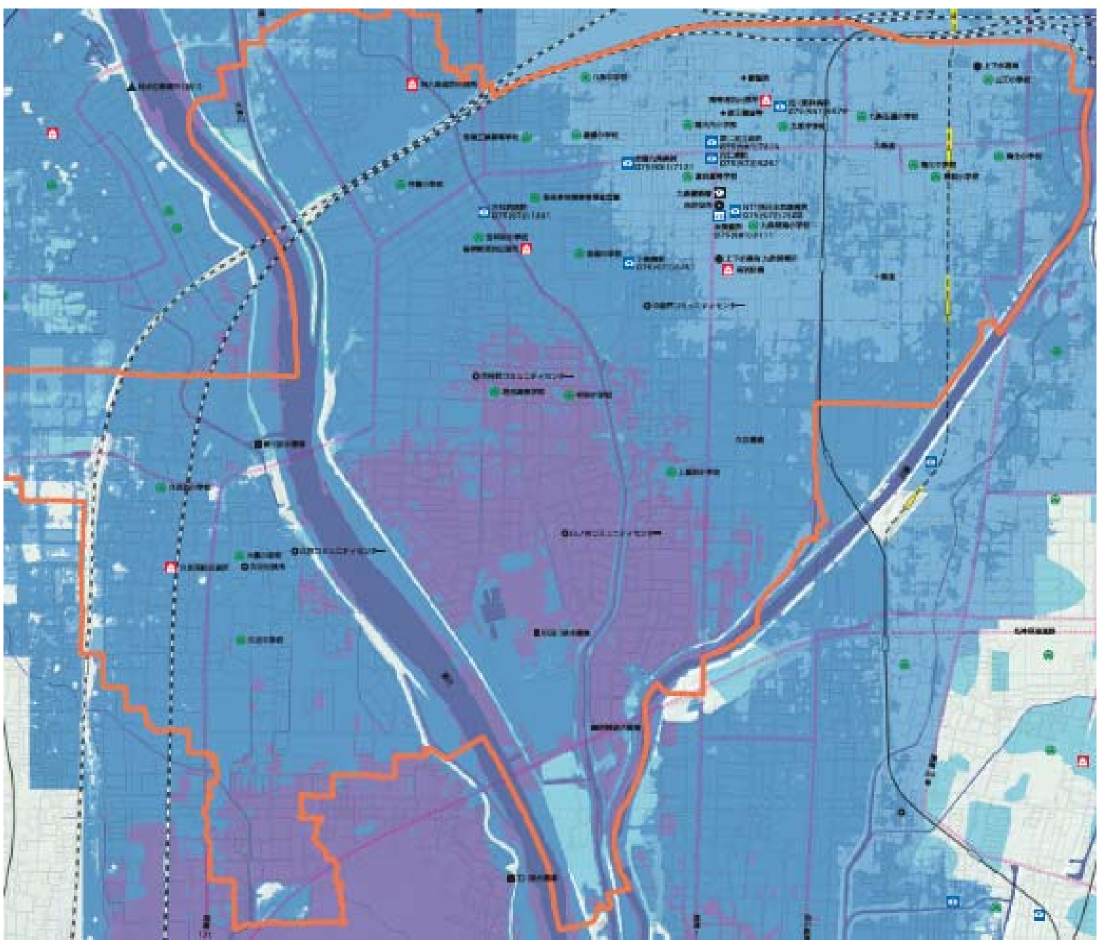


Figure 4 Fragility Function Curve for Flooding Disaster (Source: Suzuki et al., 2005)



(Violet: Over 3m, Dark Bule: 0.5-3m, Light Blue: less than 0.5m)

Figure 5 Flood Hazard Map in Kyoto City

Procedure of evacuation for a person with special needs (PWSN) was revised from the lessons of the 2004 Niigata Flooding Disaster. ‘Evacuation preparation alert’ is newly developed, and name lists of PWSN within communities are prepared. As a result, numbers of human casualties of PWSN were dramatically reduced in the 2009 Sayo Flooding Disaster. However, one elderly woman died at the inundated entrance of her home. Continuous efforts to save PWSN are necessary.

Verification of new evacuation procedure such as 1) Over 3m: Horizontal Evacuation, 2) 0.5-3m: Vertical Evacuation to the second floor and 3) Under 0.5m: Staying home was conducted using human casualties and inundation heights at the time of the 2009 Sayo flooding disaster. In the Sayo neighbourhood where inundation height was estimated to be 2m in hazard map, two people died during evacuation and one person died in her home. So in this area, vertical evacuation to the second floor was the right decision made about evacuation. In the Kuzaki neighbourhood where inundation height was estimated to be over 3m in hazard map, several houses were flushed away from levee breach. But all the people in this area evacuated to a safer place and no-one lost their lives. So early evacuation to a designated evacuation centre or safer place was the right decision in this area. In the Makuayma neighbourhood where inundation height was estimated to be 0m in hazard map, seven people died during evacuation. So staying in the home was the right decision in this area.

Decision-making about evacuation based on hazard map is useful. However, one remaining issue about saving life from flooding disasters is about human casualties whilst driving a car. Those who drive a car do not have information about possible inundation heights based on a hazard map. One possibility to distribute risk information to a car is using a car navigation system. We continue our research to reduce human casualties whilst driving a car.

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EVACUATION MANAGEMENT OF THE ERUPTIVE CRISIS OF MERAPI VOLCANO, INDONESIA

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Keywords

Crisis, evacuation, eruption, Merapi, disaster management

Abstract

The centennial eruption of Merapi volcano began in late October into November 2010. It created a failure of the evacuation and contingency plan that had been prepared by the local government to anticipate the crisis. The evacuation and contingency plan was able to handle the first phase of crisis situation. By November 3 2010, due to the large number of refugee, government could no longer use that evacuation and contingency planning. On November 5 at 1 A.M, due to the strong and persistent activity, the government decided to extend the safety zone to a radius of 20 kilometres. Therefore, the evacuation management was unplanned and haphazard. This paper aims at analyzing the difficulties and problems of the evacuation management of the latest eruptions of Merapi volcano. This study also examines the keys issues that must be overcome in the evacuation and contingency plan. Evacuation plans should be tailored to local discourse and consider the needs and resources of the region. A wide range of volcanic hazards studies accompanying different scales of eruption must be considered for contingency planning in Merapi. A multi scales and multi scenarios evacuation plan is needed in the area with a high volcanic risk such as Merapi's region.

Introduction

Almost 455 millions of world population in 1990 are estimated lived within 100 km of historically active volcano (Small & Naumann, 2001). Indonesia which has atleast 130 active volcanoes is one of the region with high volcanic risk. Since the volcanic soil is rich and fertile, people tend to inhabit on the volcanoes areas. The more human induces the hazard-prone area, the more probability of disaster will affect the human life (Mei, Sudibyakto, & Kingma, 2009). Merapi volcano (2965 m), located approximately 25 km north of Yogyakarta, a city with a population of more than 1 million (Fig.1), is known as the most active unique volcano in the world, because the period of repeated eruption is relatively short and frequently causes many disasters with many death and loss of the resources (Sutikno & Santosa, 2006).

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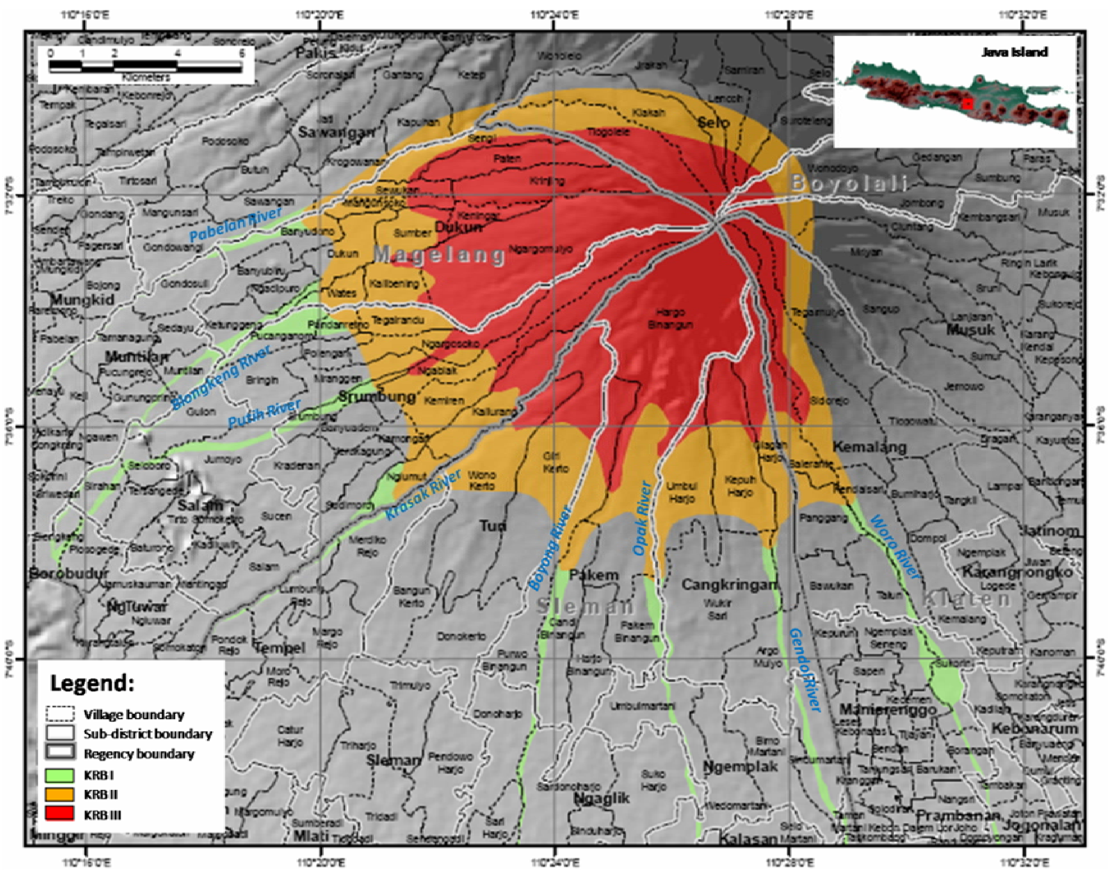


Fig. 1. *Merapi volcano* (Source: Hadisantoso, *et al.*, 2002)

The centennial eruption of Merapi volcano in 2010 began in late October into November 2010. This eruption was said by authorities to be the largest since the 1870s (Kompas, 2010). On September 20, the authority increased the level from level I (normally active) to level II (on guard). One month after, 21 October 2010, the Indonesian government raised the alert level III. On 25 October 2010, the alert was raised to its highest level (IV) and the government warned villagers in threatened areas to move to safer ground. People living within a 10 km zone were told to evacuate. The eruptions on started at 17:02, 4 lava flow seismic events and 6 pyroclastic flows were recorded in the 24 hours of 26 October. First fatalities occurred on this day. A gatekeeper of the volcano who refused to evacuate and 16 people in Kinahrejo village, died on 26 October. The gatekeeper, better known as Mbah Maridjan, was the spiritual guardian of the volcano. He was believed by local people to have a power to speak to the spirits of volcano. He also led annual sacrificial ceremonies, *labuhan*, dedicated to the mountain to hold back its lava flows. Local people saw him as a brave man, believing him over government officials and volcanologists when it came to determining Merapi's danger level.

By early morning of 30 Saturday October, the volcano erupted again, longer and more violent than the previous events. Ash from the eruptions on 30 October fell more than 30 kilometres away and pyroclastic flows headed toward Gendol River, Kuning River, Krasak River and Boyong River (Fig.1). On Wednesday, 3 November, authorities announced to move the shelters 15 kilometres away from the summit farther than a previous set up of 10 kilometres. The pyroclastic flows travelled up to 10 kilometres away from the summit. By 4 November Merapi had been erupting for 24 hours without stopping and around 11 P.M pyroclastic flows travelled up to 15 kilometres from the vent. The following day at 1 A.M, due to the strong and persistent activity, the government decided to extend the safety zone to a radius of 20 kilometres. The volcano continued to erupt until 30 November 2010 and by 3 December 2010, there were at least 320,000 people evacuated to emergency shelters and the death toll was over 353. On 3 December 2010 the official alert status was reduced to level 3 from level 4, as the eruptive activity had already waned.

Contingency planning has to wrap a forward management process to establish arrangements and procedures to respond to a potential crisis or emergency. This includes developing scenarios, determining the objectives of all actors involved in this situation, information process, and operational arrangements for specific actors at times of need and defining what will be needed to reach those objectives (Vidiarina, 2010). Planning for volcanic contingencies is a difficult task, requiring urgent attention in view of the results of volcano surveillance and historical eruption history, as mentioned by (Mckee, et al., 1985). A contingency plan might fail if the level of disaster bigger than the estimation, as happened in Merapi volcano.

The contingency plan of Merapi was created collectively in 2009 by the Merapi Volcano Observatory (MVO), Governments of Klaten, Boyolali, Magelang and Sleman Regency, UNICEF, and several non-governmental organisations. Unfortunately, this contingency plan was not adequate to overcome the crisis. The coverage area of the 2009 contingency plan was quite narrow compared to the areas to be evacuated during the 2010 eruptive crisis. For example, the contingency plan of Sleman Regency only covers seven villages located in the zone of 8 kilometres from the summit with 12660 refugees. In the 2010 eruptive crisis, the safe zone is extended to a radius of 20 kilometres with more than 800.000 people to be evacuated.

This study aims to analyse the difficulties and problems of evacuation management related to the 2010 centennial eruption of Merapi volcano. This article also examines the keys issues that must be overcome in the evacuation and contingency plan.

Theory and Method

Theory

In disaster management, several steps that must be prepared are prevention, mitigation, preparedness, emergency response, recovery and development (ADPC, 2005). The important aspect of the crisis period is the evacuation of residents. It is a strategic move aimed at protecting the residents. As noted by (Tobin & Witheford, 2002), through the development of monitoring and risk management of the volcano, evacuation of residents becomes increasingly common. The concept of evacuation itself is quite easy, moving people from prone area to a safer area. However, in reality, it is difficult to do evacuation, because it involves various aspects of human life. As mentioned by Woo (2008), evacuation is a very difficult decision in disaster management. It is because when there is a mass evacuation, the cost is big enough, but if evacuation is not accomplished then the amount of losses caused by disasters are also high. For any alert state, civil protection officials have to consider the pros and contras of evacuation before making a decision.

The effectiveness of evacuation practices is based on the decision to evacuate and dissemination of the warning message, the practical management of the evacuation, and the conditions of the place of refuge relative to previous domestic conditions (Tobin & Witheford, 2002). An example of evacuation is the evacuation of the eruption of Mount Pinatubo, the quick evacuation of tens of thousands of people who would have been killed in the numerous and large pyroclastic flows if they had postponed beyond a few more hours (Baxter, et al., 2008).

In Indonesia, governments have the principal responsibility for dealing with disasters and for considering the roles played by stake holders. The National Disaster Management Agency (NDMA or *BNPB* in Indonesian), initiated in 1966, is a non-departmental body with its membership extended up to 10 ministers and related governors. This agency functions are to formulate, stipulate disaster management, and coordinate disaster management activities, pre-disaster, emergency response, and post-disaster activities. To implement disaster management duties in Province and Regency/City regions, Regional Disaster Management Agency (*Satkorlak-Satlak*/*BPBD* in Indonesian) is established. The Center of Volcanology and Geological Hazard Mitigation of the Volcanological Survey of Indonesia (VSI) is responsible for assessing and monitoring volcanic hazards (Fig.2). Day-to-day conditions of the volcanic activity levels I-IV (*aktif normal, siaga, waspada, awas* -- normally active; on guard; prepared; and beware conditions) is broadcasted by using local radio. These four warning levels inform the community to get ready in the case of an order to evacuate (prepared and beware condition levels) (Fig.2).

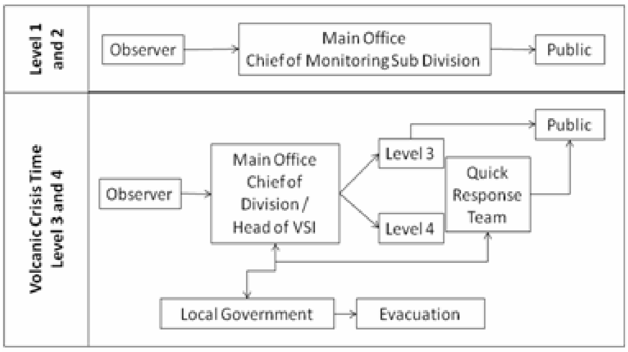


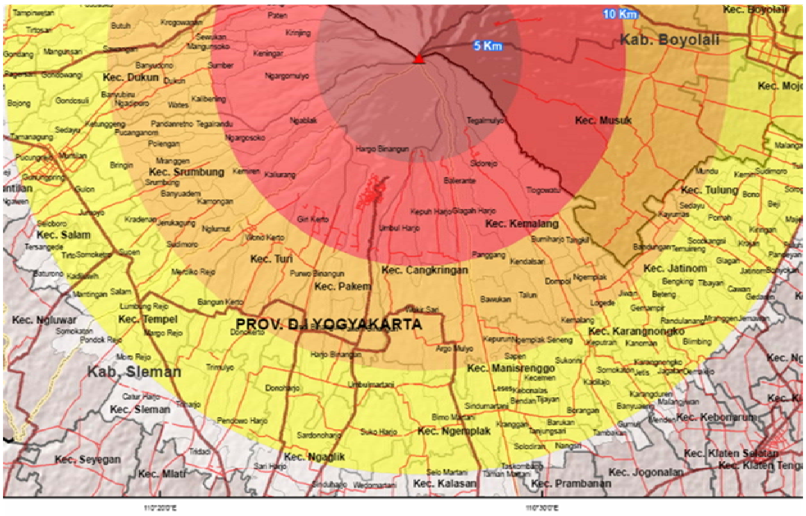
Fig. 2. *Schematic diagram of volcanic activity and dissemination of information*

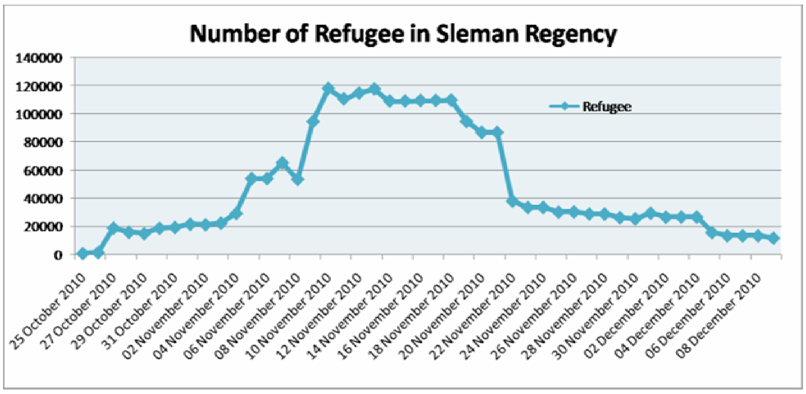
Method

Methods of data collection used in this study include secondary data regarding the 2010 eruption of Merapi volcano from local authorities, VSI, and questionnaire-based surveys with refugees living in the volcano-prone area. Field-based observation was conducted since late October 2010. Questionnaire-based survey and informal interviews with community leaders and residents took place from September 2010 to February 2011. Questionnaire-based survey with 387 respondents was done before the 4th November eruption in 5 evacuation shelters and 1582 questionnaires were done after the 4th November eruption in 28 evacuation shelters. Its goal was to study in depth the community's knowledge and individual perception of volcanic activity, experience in handling volcanic crisis, traditional coping strategies to prevent or minimize future volcanic eruptions. Interviews were conducted directly face to face and in local Javanese language. Quantitative methods such as statistical analysis of questionnaire responses are known to be highly effective in measuring the individual variables and successfully used in the domain of volcanic risk perception (Johnston, *et.al*, 1999; Dominey-Howes & Minos-Minupoulos, 2004; Gregg, *et.al.*, 2004; Barberi, *et.al.*, 2008; Bird, *et.al.*, 2010; Carlino, *et.al.*, 2008)

Results

In order to analyze the number of population to be evacuated, the number of registered refugees and its distribution, we take one example in Sleman Regency, as below (Fig. 3). The evacuation time before the biggest eruption on November 4 is not the same in each region. Only 3 % from the respondents who left their villages on October 25 before the eruption took place, but most of the refugees (81%) evacuated on October 26 when the first eruption happened. Trucks, motorbikes and cars are the main vehicles used for evacuations. However, several local resources such as tourism trains were also used to evacuate people from Kaliurang (a tourist site located in Merapi's flank). During evacuation period, people still go back to their villages, especially during the day. Before the 4th November eruption, people went back to their villages, in order to feed their cattle. But after the 4th November eruption, people went to their villages to see the condition of their house. Despite the highest volcanic activity levels of Merapi, several villagers, particularly youth and men, have the courage to go home to see the situation of their villages.





Regency	Number of people to be evacuated			
	5 km	10 km	15 km	20 km
Sleman	35708	58114	108154	359755

Figure: Safe zone of Merapi volcano
Graphic: Number of refugees
Table: Number of evacuated people
Source: BNPB (2010)

Fig. 3. *Population, refugees and safe zone of Merapi*

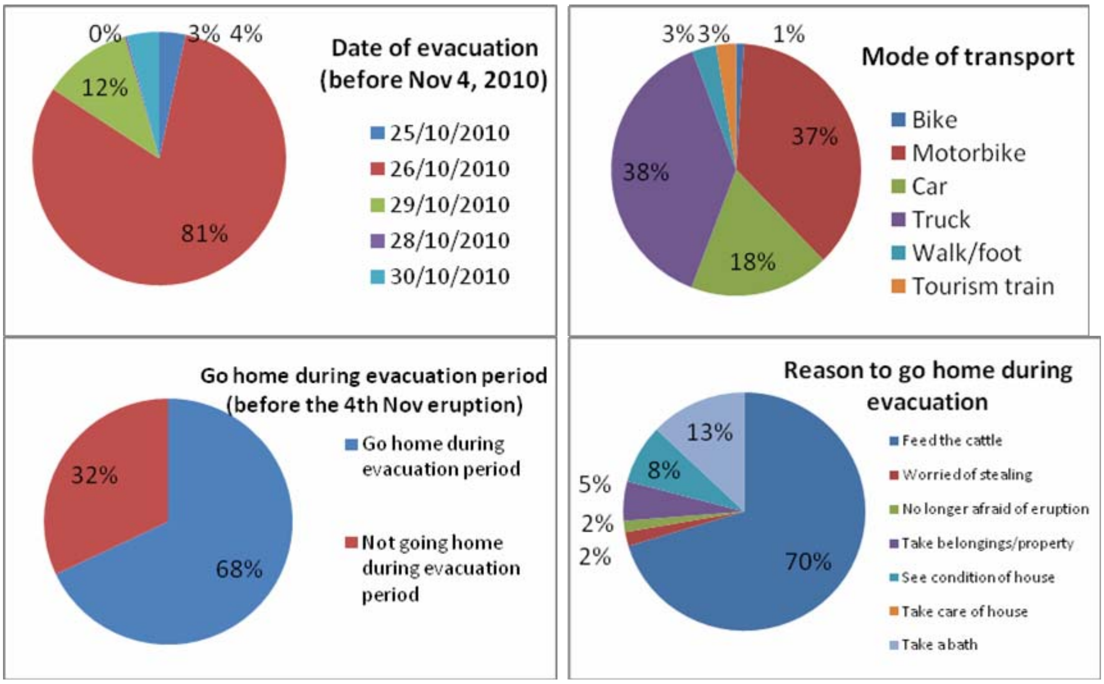


Fig. 4. *Results of questionnaires before November 4, 2010*

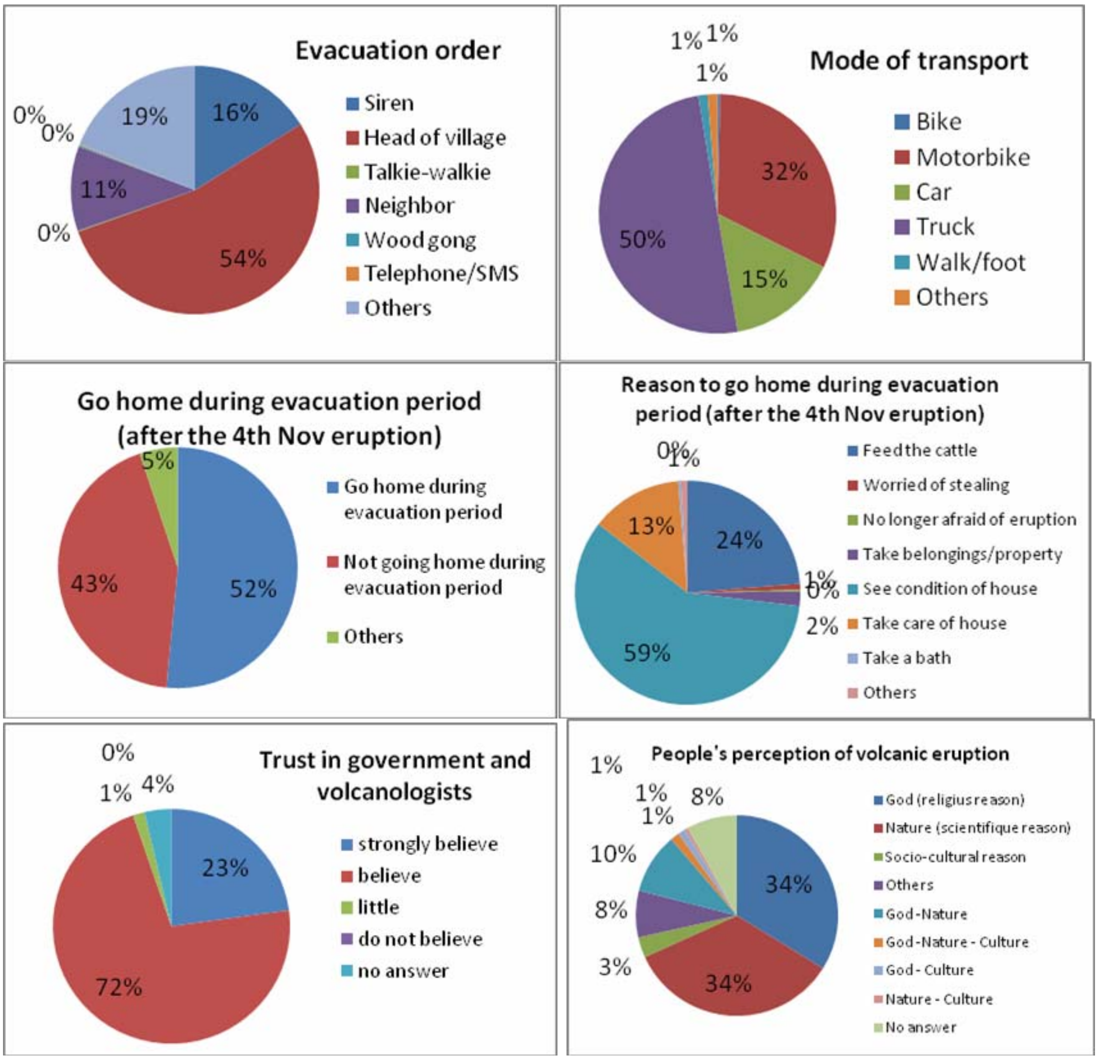


Fig. 5. *Results of questionnaires after November 4, 2010*

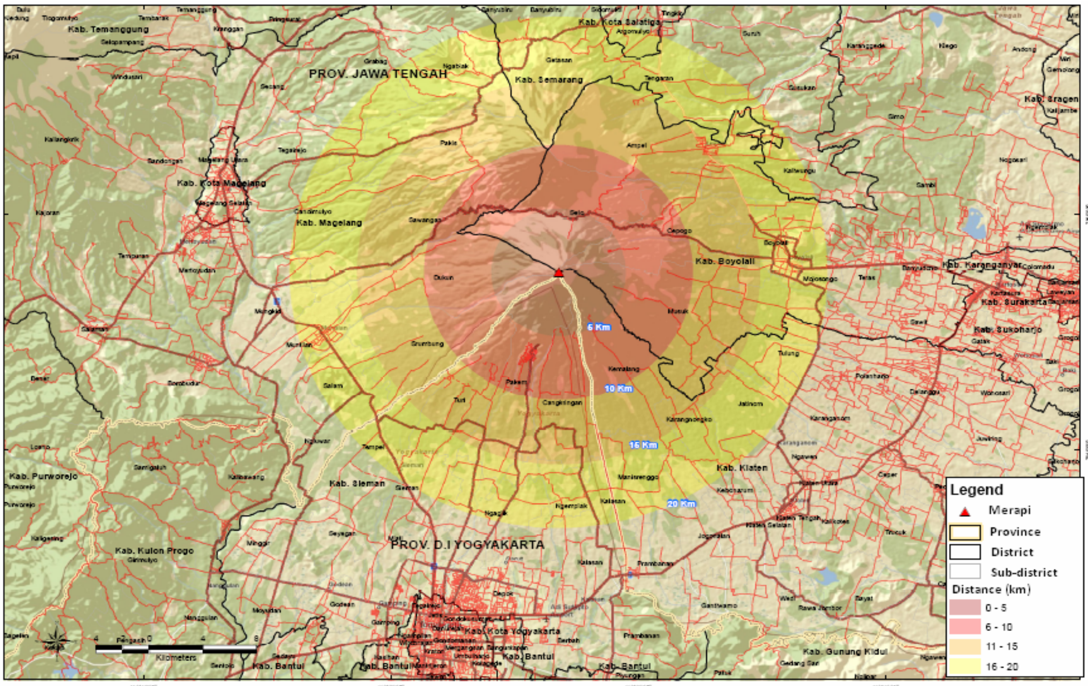


Fig. 6. *Safe zone of Merapi volcano* (Source: BNPB, 2010)

Discussion

The difficulties and problems of the evacuation management of the 2010 Merapi eruption are mostly related to the large scale of safe area and the large number of people to be evacuated. The local authorities were able to handle the first phase of eruptive crisis since October 25 to November 3, 2010. But after the raising of safe area on November 3, government faced several difficulties, for example lack of evacuation shelters due to large number of refugees. The major problems came on November 4, 2010, when the government decided to extend the safety zone to a radius of 20 kilometres in a very limited time. Most of the previous shelters were located in the radius less than 15 kilometres. Therefore, when people in radius 20 kilometres had to move away from the volcano, they did not know where they have to go, all they know is only to escape from Merapi. There is no evacuation shelter prepared to accommodate the refugees from radius 20 kilometres. Furthermore, the number of people to be evacuated in radius 20 kilometres is quite large, for example, in Sleman regency itself, for safety zone of 20 km, there were at least 359.755 (Fig.3). If we compare with the number of refugees in Sleman (Fig.7), there were 117.778 refugees in Sleman regency. Thus, there were at least 241977 people who evacuated in others regions or they did not evacuate.

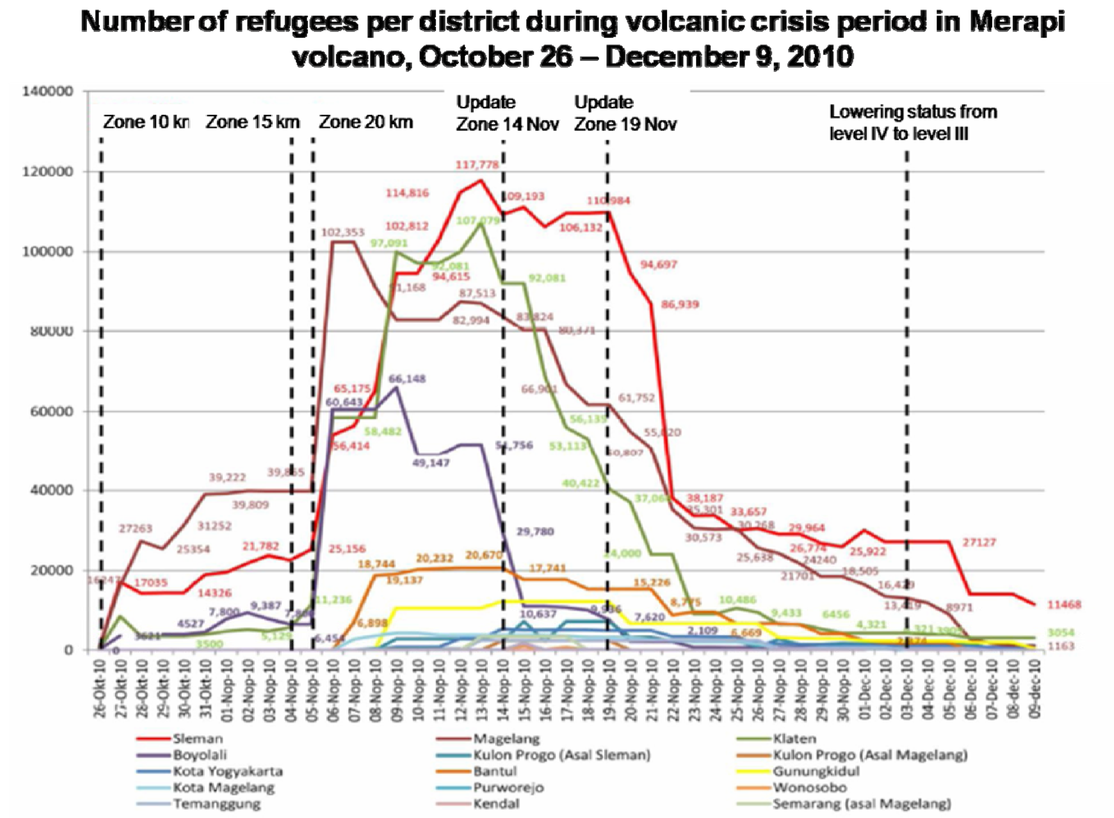


Fig. 7. *Number of refugees per district during volcanic crisis period in Merapi (BNPB, 2010)*

Based on the problems and difficulties found during the 2010 Merapi eruption, several keys issues that must be overcome in the evacuation and contingency plan are described below:

1. The importance of natural hazard study

The hazard map provided by VSI contains three danger zones ranked from 3 to 1 (KRB 3, KRB 2, KRB 1) judged unsafe for settlement (Fig.1). These maps are intended to support volcanologists in describing the pattern of past eruptions and estimate the areas likely to be affected by various hazards (Suryo & Clarke, 1985). The first danger zone map of Merapi with a scale of 1:100.000 was firstly published in 1978 by the VSI (Pardyanto, *et.al*, 1978). The most recent version of the hazard map was published in 2002. Unfortunately, the hazard map only provides the last 100 years of eruptions compare with Merapi's vast eruption history (Hadisantoso, et al., 2002). In order to improve the official hazard map, further volcanic hazard studies on Merapi should be completed. The hazard map should provide more than the last 100 years of eruptions. Thus, a wide range of volcanic hazards accompanying different scales of eruption must be considered for evacuation and contingency planning in Merapi.

2. The importance of planning and coordination

On emergency planning, evacuation planning has an exceptionally important role (Goldblatt, 2004). The hazard map is a basis for evacuation planning. By using the hazard map, we can identify the region and its population to be evacuated, analyse the demand (in vehicles) over the area to be evacuated and the voluntary. The plan needs to identify all resource requirements and detail how they are to be obtained for evacuation. All agencies involved in the evacuation management must also have a clear understanding of their roles and responsibilities. Main problem of the 4th November evacuation is the coverage area of evacuation plan in all regencies was quite narrow compared to the regions to be evacuated. Thus, evacuation plans should be tailored to local discourse and consider the needs and resources of the region. A multi scales and multi scenarios evacuation plan is needed in the area with a high volcanic risk such as Merapi's region.

3. Public involvement and outreach

Communities should be included in disaster management programs, in order for government and communities to play complementary roles in coping with volcanic disasters (Paton *et al*, 2008). Efforts have been made by the Sleman regency to enhance the evacuation management by constructing evacuation routes and signs, providing evacuation maps, evacuation vehicle and personnel needed on evacuation. Residents in the villages located close to the peak are already prepared to face Merapi eruption. Several risk reduction activities such as simulation of evacuation and programs on capacity building for disaster management have been undertaken by local governments, nongovernmental organizations and academic institutions. Unfortunately, there is a lack of community awareness and education for villages located more than 10 kilometres from summit of Merapi. After the increase of safe zone up to 20 kilometres from the peak in a very short time, the evacuation for people living in the zone of 10-20 kilometres were unplanned and haphazard. More than 80 % of the victims of the 4 November 2010 eruption are from villages located more than 10 kilometres from Merapi summit (Source: Riyanto, 2010). Lack of preparedness on evacuation also caused family and children separations. Therefore, in the future, community awareness and education should also be held not only in the villages near the summit but also all the villages located in the volcanic hazard prone area.

4. Evacuation refusal, case study in Merapi: cultural, health and socio-economic aspects

- Cultural:

Merapi has material and spiritual significance to the community. A volcano is one of the sacred places in Javanese people's perspective, because it is the source of life and its activity is controlled by divine power (Lavigne, et al., 2008). Based on traditional belief and knowledge, local people put their trust on the gatekeeper, Marijan, although they were exposed to the danger. In the 2010 eruption, Marijan refused to move out from his house prior to the eruption because he believed that his time to die in his place (village) has come. The eruption on 26 October 2010 devastated the village of Kaliadem and Kinahrejo and killed 25 people including the gatekeeper, his followers and some people who tried to pick up the gatekeeper for evacuation (Kristianti, 2010). However, Marijan's death affected people's perception of volcanic risk. The villagers increasingly believe in authorities and scientists (volcanologists) (Fig.5).

- Health:

Due to the lack of space and comfort in shelters, people tend to stay at home during the day and come back to evacuation shelter in the evening. The unhealthy condition of evacuation shelters caused some health problems, such as diarrhea and influenza. Many refugees were also sick because of volcanic dust that causes respiratory tract infections.

- Socio-economic:

The fact that people cannot bring all his belongings during evacuation period causes evacuation refusal. They are worried about their livestock and properties left at home will be stolen. In Merapi's flank, cattle are the main resource for most of the villagers. Considering the number of cattle in Merapi, on 1 November, local governments together with nongovernmental organization and academic institutions constructed several evacuation shelters for livestock.

5. Other important issues

- Condition of evacuation routes

Maintenance of evacuation facilities also becomes a major issue for post crisis management.

Following the volcanic eruptions, local government always tries to enhance the road quality by paving it with asphalt. But after several years, the condition of roads became worse due to trucks hauling volcanic-material. The attempt to maintain evacuation routes is not parallel in each region; government and society play an important role to this issue. For example, in west flank of Merapi volcano, Kemiren, Ngablak and

Ngargomulyo villages, people refuse to permit sand mining activity in their village because they are worried if the evacuation routes will be damaged by trucks. Contrast, people at Klaten and even government do not pay much attention to the condition of evacuation routes because sand mining is seen as a main sector of their economy. These examples illustrate that people awareness and government support to maintain infrastructure as mitigation tools are important.

- Role of media and risk communication

Differences in perception between local communities and scientists or emergency planners towards disaster management issues can provoke a disruption of crisis management plans (Johnston and Ronan, 2000). Panic gripped villagers of Merapi volcano on 7 November 2010, after a national television station broadcast a fake forecast that the eruption of Merapi could reach 60 kilometres from the summit. Consequently, the refugees from several areas in Merapi fled to others regions in Java and even to other islands in Indonesia. Foreign students who live in Yogyakarta city also left the city and even went back to their own countries. Mass communication is inextricably entwined with disasters (Rattien, 2005). The role of the media is very important in transmitting information to public. Therefore, the information should be accurate and reliable.

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REPATRIATION OF U.S. CITIZENS AND MASS-MIGRATION AFTER THE HAITI 2010 EARTHQUAKE
NEW CHALLENGES AND THEIR LESSONS

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Keywords

Repatriation, intergovernmental coordination, planning functionality, reimbursement

Abstract

This paper will focus on the lessons learned from Florida's management of the repatriation process of United States (US) citizens in and mass-migration from Haiti in the wake of the January 12th 2010 earthquake. The repatriation process consisting of personnel transportation, tracking, and medical assistance required intergovernmental coordination at the local, state, and federal levels. Analysis of this process offers major lessons related to coordination between federal and state agencies involved in repatriation; administrative difficulties in federal reimbursement of funds spent by Florida agencies in the process; and policy consequences of a legally mandated, but low-priority review of repatriation plans. The breakdowns in coordination between state and federal authorities led to several avoidable errors: The wrong airports were spontaneously designated to receive flights from Haiti; additional airport and state government staff had to be called up and transported to these new locations; local hospitals in Orlando and Miami, Florida were overburdened with individuals with severe injuries; and patients had to be stabilized and then quickly transported to hospitals hours away because local hospitals had reached maximum capacity.

Besides these logistical and coordination difficulties, Florida's lead agency for repatriation, the Department of Children and Families (DCF), had its own challenges that derived from a delayed review and the operational limitations of the repatriation annex. Updating the Florida Repatriation Annex is the responsibility of the Florida Division of Emergency Management (DEM) which had not done so since 2008. DCF attempted to use the annex, but had no standard operating procedures in place that effectively translate the plan into detailed action. Additionally, the plan does not explicitly outline who has responsibilities for elderly and disabled evacuees, part of Emergency Support Function #8—Public Health and Medical Services—a critical feature of the emergency management support structure that agencies reference when responding to an event. Meanwhile, several injured non-citizens and citizens were flown into Florida who will require permanent medical assistance for the rest of their

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lives (e.g. quadriplegics).

Despite breakdowns in coordination from the federal government to the state and lack of planning guidance, state employees improvised several actions that led to the overall success of the operation. The lessons learned from the event are relevant from emergency management and financial standpoints because they indicate improvements needed in Florida's and the nation's management of similar responses in the future.

Introduction

According to federal Department of Human and Health Services (HHS) Office of Refugee Resettlement (ORR) agreements with the States, states designated as port of entries will be asked to activate their state emergency repatriation plan and assist with the coordination and provision of temporary services to evacuated individuals. Indeed, Florida activated its repatriation annex and volunteered its assistance on January 13, 2010. [3] DCF was made the lead agency for repatriation-related activities as outlined in Florida's Comprehensive Emergency Management (CEM) plan. However, at the time, the Repatriation Annex of the plan had been overdue for review.

The July 2010 After Action Report from the Florida Division of Emergency Management (DEM) as well as initial interviews with public servants involved in the repatriation process from the Florida Department of Business and Professional Regulation (DBPR), and DCF indicate that state and federal authorities were unprepared for this scenario. Particularly, the lack of coordination between state and federal authorities led to avoidable errors.

The purpose of this report is to examine the recent repatriation within the context of Florida's current emergency management priorities, identify shortfalls, and propose policy alternatives to prevent future breakdowns in coordination during disaster events and response processes of a similar nature. The research will also address problems such as intergovernmental coordination, federal reimbursement processes, and impediments to the operational functionality of Florida's repatriation annex.

Literature, Theory and Method

Literature Review

Relevant literature discussed here addresses: emergency management in the US, disaster policy, statutory authority, intergovernmental coordination, federalism, and repatriation in Florida. These topics clarify the historical and current contexts of emergency management legislation and look at models of intergovernmental coordination to determine whether the difficulties in collaboration between federal agencies and Florida were unique or representative of common intergovernmental issues. Birkland's (2009) research on disaster policy and public perception of "failed disaster policies" highlights the exceptional status of repatriations. Despite US involvement in foreign disasters and a recent repatriation of citizens from Lebanon in 2006, there might be limited opportunities for repatriation-related policy change because the events which prompt them do not occur on US soil.

Schneider's (1995) research helps to explain the differences witnessed in prescribed government response actions and what actually occurs. This helps to clarify why governmental disaster response appears inconsistent at times. Farber et al (2006; 2010) describe relevant US statutory authorities as they relate to disaster policies, most notably the goals and limitations of federal involvement. Malloy (2009) demonstrates a current tendency towards top-down disaster management which reflects how the federal government manages

[3] http://www.floridadisaster.org/eoc/PressReleases/EOC%20ACTIVATION.pdf

repatriations, but might also indicate why there appears to be little regard for Florida local governments affected by repatriation.

O'Toole's (2007) models of intergovernmental coordination help to illuminate the extent of US intergovernmental coordination and the difficulties that result from a national government tendency to want to run disaster relief processes top-down since 9/11 when emergency management in the US is organized as a bottom-up process. While the domestic Hurricane Katrina and foreign Haiti 2010 scenarios do not exactly parallel each other, the commonality of lack of coordination between federal agencies and Florida suggests that minimal lessons may have been learned from Katrina. This would correspond with Birkland's (2009) findings that extra media coverage and public concern after large disasters do not necessarily translate to improved public policies that solve the problem.

Weiss (1966) outlines Florida's and the federal government's repatriation-related activities after the Cuban Revolution in the 1960s. His research demonstrates the importance of the state-federal financial relationship in repatriation, as well as how repatriation can influence legislation and affect the provision of local public services. In 1961, Section 1113 of the Social Security Act (1935) was newly added to address the financial hardships and medical conditions of US citizens returning from Cuba (and other countries). Miami, FL was the designated port of entry for the roughly 200,000 repatriates in the early 1960s, according to Weiss (1966, p.11). This influx of refugees led to problems in law enforcement, housing, emergency relief, health services and more as the City of Miami struggled to absorb and meet the needs of these individuals (p.13). Florida's management of these problems indicates a pattern of dependency on federal funding for repatriation assistance as demonstrated by the Florida Department of Public Welfare (1949-1964) in the 1960s and DCF in 2010.[4]

Finally, Mitchell (1994) brings to light the use of mass-migration as an effective political tool as demonstrated by the Cuban leader Fidel Castro in 1980. The communist Cuban government's ability to manipulate Cuban migration in that year demonstrates Florida's inherent mass-migration vulnerabilities due to its location in the Caribbean basin. Mitchell estimates the number of migrants to Florida in that year at approximately 125,000 Cubans including 20,000 former prisoners and mentally ill individuals.

Overall, the literature review displays the interdisciplinary qualities of emergency management processes and the political, financial and administrative issues at stake in repatriation. It demonstrates how studying Florida's repatriation-related interaction with the federal government and past management of large-scale repatriations might prove useful for similar operations in the future. The literature focuses this report on identifying shortfalls and finding policy options for DCF that reflect the realities of US emergency management and current disaster policy. Through careful methodology and evaluation, this report aims to contribute to the limited literature on costly repatriations in Florida by addressing shortfalls in repatriation-related activities and by identifying policy options that are useful.

Theory

The literature review helps to illuminate the public's reactions to the 2010 repatriation and repatriation-related governmental response processes. These include Schneider's bureaucratic norm-emergent norm theory and Birkland's (2009) proposition that disasters increase the attention paid to a policy problem. Schneider provides a framework within which to analyze governmental missteps in repatriation while Birkland's research highlights why there may be little public support for repatriation-related policy reform.

Schneider's (1995) theoretical framework for analyzing governmental response is helpful in analyzing Florida's management of the 2010 repatriation. Schneider posits that successful

[4] It is worth noting that, according to Florida archives, in1969, the Department of Public Welfare became the Division of Family Services under the Department of Health and Rehabilitative Services (HRS). Family services functions were later assumed by the newly formed DCF in a split from HRS in 1997.

governmental disaster response depends on the extent to which post-disaster human behavior corresponds with prior governmental expectations and planning. (p.6) According to Schneider, standard operating procedures, routine policies, and institutionalized behaviors constitute the "bureaucratic norms" which dictate a prescribed governmental response. However, the physical and emotional conditions that emerge in the aftermath of a disaster frequently generate new and spontaneous patterns of behavior which can differ greatly from the prescribed governmental response. Schneider terms these new behavioral patterns "emergent norms." The larger the difference between the two, the more likely the governmental response will be seen as a failure.

To an extent, Florida's shortfalls from the 2010 Haiti Repatriation can be analyzed from a bureaucratic norm-emergent norm perspective. These include institutional plans that were in place and not followed. This resulted in spontaneous decision-making that led to intergovernmental coordination problems, and delays in federal reimbursement because of a pre-existing political and administrative low-prioritization of high-impact repatriations in Florida. However, her theory hinges on widespread public knowledge and understanding of governmental response processes which may not be the case in repatriation. Floridians are less familiar with repatriation processes than they are with disaster response and recovery after a hurricane, for example, which aids in the public perception that Operation Haiti Relief was a complete success. However, state employees deeply familiar with the operation believe that more can be done to ensure an improved response and mitigate the impact of a future event on state agencies and budgets.

Birkland's (2009) research on disaster policy and public perception of "failed disaster policies" clarifies the lack of widespread interest in policy change after the earthquake. Media coverage of the event focused on the human suffering, the disaster relief aspects of the operation, and the inability of the Haitian government to mount a disaster response. The media did not focus on the resulting mass-migration, repatriation efforts, and the cost of both to the state of Florida. Thus, the disaster's non-American location, a lack of media scrutiny, and widespread unfamiliarity with the operation as well as the functionality of the repatriation plans translate to a lack of public pressure to improve policies and a non-opportunity for policy change. It appears that detailed knowledge of Operation Haiti Relief will remain limited to individual members of the public as well as state and federal actors involved in the medical assistance, transportation, mass care, and financial aspects of the operation.

Method

The following methods were used to collect information for this paper:

• Face-to-face Interviews (n=2) and e-mail contacts (n= 4) with the employees of the Department of Children and Families (DCF) as well as with an employee of the Department of Business and Professional Regulation

• Review of applicable statutes, policies, rules, Florida repatriation planning documents, and Florida emergency management plans

• Analysis of academic literature related to intergovernmental relationships, administration theory, federalism, emergency management, disaster law and more

• Analysis of popular media, especially established newspapers and news magazines

All of the individuals interviewed were involved with the delivery of services which constituted the repatriation process and have expert knowledge of the strengths and weaknesses of the process. The initial structured interviews with these key DCF and DBPR employees were essential to provide insights into the breakdowns that occurred during the repatriation process. Typically, the initial e-mail interviews consisted of a series of roughly 12-14 questions. The follow-up unstructured interviews (n=2) were done face-to-face with roughly 8-9 questions. The questions were mostly overlapping and were designed to record the perspectives of the interviewees. They took into account the different vantage points from which the interviewees work in government and from which they evaluated the strengths and weaknesses of the repatriation process. In some cases, the state employees provided data via electronic links or PowerPoints that had to be cleared with the Communication Departments of their agency.

It was necessary to review several legal documents concerning the statutes governing the repatriation process and the state and federal agencies involved. These documents helped to clarify the governing legislation and how the emergency management response processes are supposed to occur as well as what gaps might exist in the current legislation. Clarifying these issues meant understanding what made the Haiti 2010 repatriation a unique situation.

Finally, popular media helped to demonstrate the impact of the disaster and why US intervention in terms of disaster relief and repatriation was necessary to begin with. Articles in news magazines and newspapers illustrate the limitations of the Haitian government before and after the earthquake. The strength of the news articles is that they demonstrate the urgency of the humanitarian crisis and the need to go in and rescue US citizens.

Results

The research indicates three major problems with Florida's management of the repatriation process. These problems relate to intergovernmental coordination, federal reimbursement of the lead Florida agency, and the low-prioritization of repatriations in Florida as evidenced by the delayed review of Florida repatriation plans and non-existence of standard operating procedures that translate the repatriation annex into action steps for DCF.

State officials confirmed that the intergovernmental coordination during the post-disaster repatriation process was poor. In particular, coordination between federal and state agencies proved difficult from the beginning. A state official closely involved in the mass care aspects of the operation confirmed that "the state plan was not followed because the federal plan was not followed." (State Emergency Management Team Member, personal communication, November 30, 2010). According to this official, multiple federal agencies acted independently of each other, failing to effectively coordinate with each other and with Florida state agencies, or with the local governments they were affecting by their actions.

Second, administrative difficulties emerged when DCF officials tried to get reimbursed by the federal government for funds spent. According to DCF officials, the agency has several federally-funded programs and has a standard procedure for getting reimbursed by the federal government. However, these procedures do not necessarily apply in the repatriation process absent a declared US disaster. DCF was forced to act in "good faith" to service their fellow Americans as well as non-citizens transported en masse to Florida. Without a federal disaster declaration, payments practically come to a stop as DCF soon discovered. Eventually, DCF would get reimbursed for most of the funds spent, having recently received the majority of the money with some exceptions: As of December 3rd 2010, Florida had received $6 million in reimbursements from the federal government. Outstanding was $1 million for funds spent for medical assistance through Medicaid. The national Congress finally set money aside for this purpose in August of 2010. The last of the funds were finally released to the agency approximately one year later, according to DCF officials. But the administrative and statutory authority issues remain with regard to sending the funds through the proper spending authority channels at the federal level.

Lastly, the missed scheduled reviews of Florida repatriation plans and DCF's non-existent standard operating procedures proved to be major challenges. While repatriations are a low-priority for the Florida DEM, meeting the legally mandated review deadline should be a high one. A timely, predictable process by which the repatriation annex is reviewed, updated, and appropriately exercised would improve DCF's coordination and make the agency less susceptible to and dependent on improvisation during the next repatriation event.

DCF officials are contributing by word-of-mouth to DEM's current review of the plan. However, there is no formal discussion of drafting standard operating procedures to help guide employees in the next event, nor is a comprehensive, agency-wide DCF after-action report being conducted. This informal arrangement is problematic in terms of preserving institutional knowledge.

The informal nature of DCF's input in the review process and the agency's infrequent experience with emergency management functions make it difficult to adequately capture the lessons and gain the expertise necessary to write effective standard operating procedures for repatriations. Drafting after-action reports and standard operating procedures are part of the emergency management organizational culture within the United States, a culture that DCF does not traditionally belong to. Still, DCF officials interviewed recognize the value in having a permanent record of policy problems and solutions.

Florida's proximity to unstable democracies and disaster-prone regions in the Caribbean and Central America indicate the need to prepare for a similar repatriation scenario in the future. Given the reality of potential future repatriations and mass-migrations, it is worth studying impediments to the current process, so that improvements can be made. Any attempts to solve such issues will have to address the limitations of current disaster policies and statutes.

Strategies to improve intergovernmental interaction without compromising the deliberately fragmented design of US government must be addressed. In addition to finding mechanisms that work for a disaster response system of divided authorities, mechanisms must be found to streamline federal reimbursement of state agency partners in disaster management without decreasing the transparency of government spending nor increasing corruption.

Discussion

This paper theorizes that Florida's management of repatriation efforts can be rendered more efficient and effective by reviewing lessons learned from the 2010 Haiti repatriation and by taking actions to improve repatriation-related policy and coordination. Interviews done with key Florida officials and analysis of after-action reports confirm the need for improvements. However, there may be too little political pressure and public support to generate positive change, given that the disaster occurred on foreign soil and that Florida has been inconsistently affected by mass repatriations and migrations since the 1960s.

Florida has several policy options that would improve future response processes. First, DCF could lobby the national Congress to pass a reimbursement agreement between the federal government and state-level lead agencies to streamline reimbursement for future repatriation efforts. Second, DCF could adopt a written after-action report process to effectively capture important lessons before they are lost. Third, DCF officials must demonstrate an awareness of the assumptions in the Florida Repatriation Annex. Acknowledgement of these assumptions (e.g., the assumption that DCF standard operating plans for repatriation centers exist) would be the first step to eliminating them and improving the plan's functionality.

Fourth, Florida DEM officials should consider incentives that guarantee the annual review of the repatriation annex. DEM employees must be able to see the benefits to updating the mandatory plan to reflect new knowledge. Fifth, compatibility issues between the state and federal repatriation plans should be raised with authorities from the federal Department of Health and Human Services (HHS). The repatriation demonstrated that improvisation by federal officials who did not follow the federal plan led to improvisation by state authorities to accommodate federal mistakes. Lastly, DCF should lobby the national Congress to make the Federal Emergency Management Agency (FEMA) the lead federal agency for repatriations instead of HHS. While HHS currently has the legal authority to provide temporary services, repatriation-related assistance, and transportation to final destination to US citizens, the agency's inexperience as a lead agency and inability to delegate functions led to many of the coordination problems witnessed during the repatriation.[5]

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NEW ASPECTS OF EMERGENCY DECISION SUPPORT FOR SHIPS IN DISTRESS

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Keywords

DSS, emergency management, maritime accidents, human behaviour, GIS

Abstract

The paper describes an effort to capture and model human behaviour during emergency management, particularly in situations of ships in distress. This research is based on authors' previous work on the project for development of Decision Support System (DSS) for emergency management that supports decisions related to maritime crisis. Implemented DSS helps to structure and organize large quantity of information related to the emergency management in case of maritime accidents, especially spatial data, in order to make it available to decision makers in a comprehensible and user-friendly way. The continuation of the research resulted in recognition of four main problems: (1) huge number of potential Place of Refuge (PoR), (2) lot of selection criteria (3) there are usually lot of scenarios due to dynamic conditions, (4) end users are emergency operators, not experts. The task of operator is to suggest a solution for maritime crisis to upper authority levels. So, it could be concluded that even though implemented DSS covers all decision levels it still leaves lot of decisions to operators and thus puts lot of pressure on them. The main challenge is to support decision making process in order to eliminate those problems and make DSS as efficient and supportive as possible. Human intellect could be substituted with algorithms, memory with data bases, but what about human "will" to solve problems and act in emergency management situations. The "will" could be seen as composed of sensitive and intuitive part of decision maker's mind versus mental part (intellect and memory). If performed under pressure, intuitive decision making could lead to unexpected decisions with catastrophic consequences. This paper recognizes and models such sensitive/intuitive part of decision making and incorporates it into DSS, thus avoiding a possibility for making poor decisions during emergency support for ships in distress.

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Introduction

Directive of the European Community 2002/59/EC is binding on all member states of the EU to establish (and communicate to the European Community) the Places of Refuge (PoR) for ships in need of assistance off their coasts, or to develop techniques for providing assistance to such ships [1]. Consequently, the Croatian Ministry of the Sea, Tourism, Transport and Development has initiated the procedure of harmonizing its working procedures and the respective executive organization to meet the requirements provided for in the Directive. In November 2003, the International Maritime Organization (IMO) Asembly adopted two resolutions (guidelines) addressing the issue of places of refuge for ships in distress - an important step in assisting those involved in incidents that may lead to the need for a place of refuge to make the right decisions at the right time. When a ship has suffered an incident, the best way of preventing damage or pollution from its progressive deterioration is to transfer its cargo and bunkers, and to repair the casualty. Such an operation is best carried out in a place of refuge.

Croatian coast is very indented with more than 1000 islands and, at the same time, Adriatic Sea hosts lot of tankers. This situation brought out a need for efficient system for granting access to a place of refuge could involve a political decision which can only be taken on a case-by-case basis with due consideration about all possible consequences. In so doing, consideration would need to be given to balancing the interests of the affected ship with those of the environment.

First-year research on the project resulted in a study treating the issue of places of refuge in a both scientific and professional manner. The GIS (Geographical Information System) application is developed containing integrated data about the 380 potential locations for PoR designated in the official navigational pilot book (Figure 1).

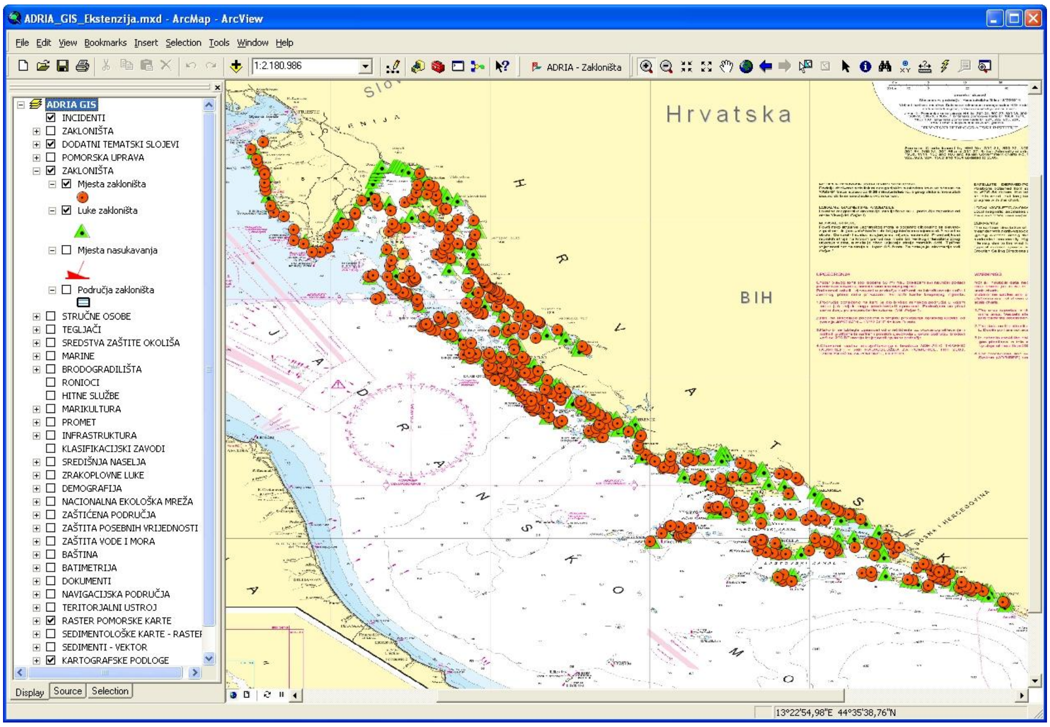

Figure 1: Layout of GIS application containing data about 380 PoR

The research within the project scope involves evaluation of natural, socio-economic and bio-ecological characteristics, maritime traffic situation and analysis of possible threats to the environment, and finally the principle of preliminary selection of places of refuge and their description. Relevant characteristics have been included in the GIS application called „GIS-ADRIA“. An additional result achieved by this project is the drafting of the concept of a Decision Support System (DSS) for defining the places of refuge and for protection of environment. Such DSS contains all relevant data necessary for environmentally and socially sound risk assessment.

The main goal of the research is to significantly improve the decision-making processes in emergency situations at sea. Two modules were conceived and built in the first stage of the project:

- GIS support with problem-oriented extensions, and over 30 thematic layers for subordinating characteristics of places of refuge, and
- MCA (Multicriteria Analysis) for valuation of each potential shelter (PoR) according to the relevant criteria with direct interface towards GIS application.

Following the implementation of the first phase, new problems were recognised. The main difficulty arose from the fact that end end-users are not experts but emergency operators who face huge pressure when deciding about interventions. The next step in the research was to analyse above mention problems and to improve DSS accordingly. The ultimate goal was to achieve continuous development of the DSS in accordance with RDIE principles (Figure 2).

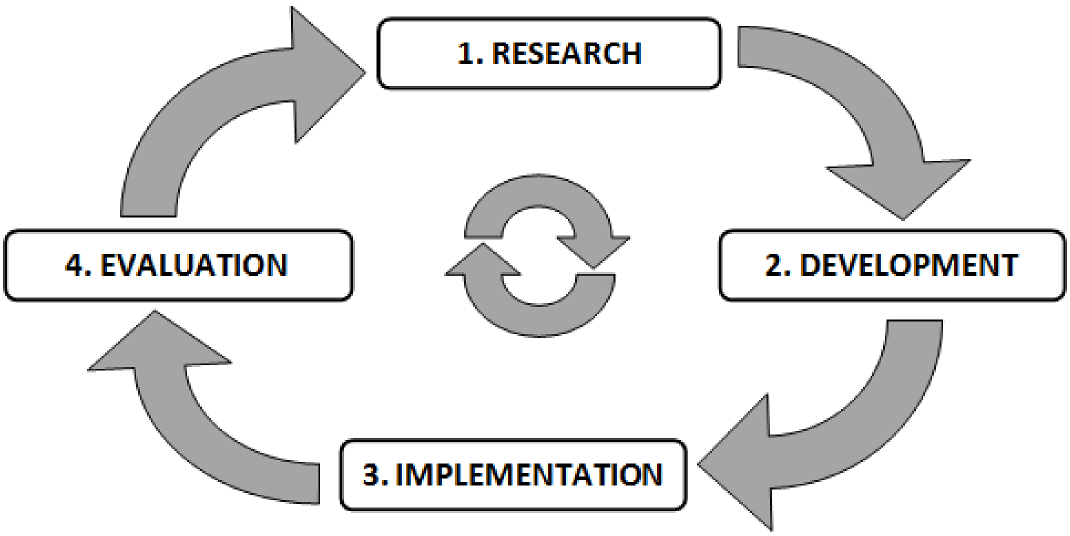

Figure 2: Research, Development, Implementation and Evaluation (RDIE) cycle for continuous improvement of the systems

By each RDIE development cycle DSS continuously becomes more efficient and efficacious. A new development cycle for this particular DSS should provide a solution on how to prevent the emergency operators form making wrong decisions. This would obviously make decision making process more relaxed, so the emergency operators could concentrate on the rescue procedure.

Methodology

To find out the behavior of emergency operators this research looks for an answer in Christian philosophy [2] recognizing three main parts of human mind: mental, sensitive and intuitive. Those parts generate different human functions. The most important are intellect, will and memory which categorize and analyze all information humans receive through sensors. According to this perception a model of human behavior could be represent by schema on

Figure 3. The other human functions are found to be irrelevant for modeling of decision making process.

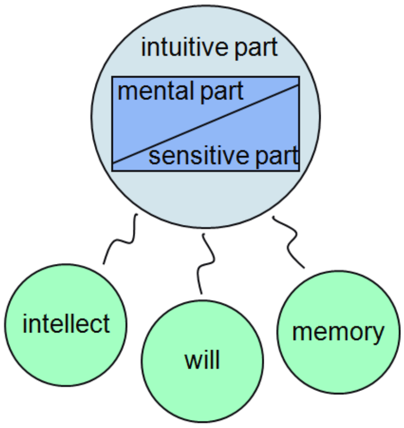

Figure 3: Model of human according to Christian philosophy

Decision Support System paradigm is based on IT support as well as on artificial intelligence where needed. The crucial question is if it is possible to fully replace emergency operators with artificial intelligence and, consequently, is it possible to build DSS where decision-making process is completely replaced with artificial intelligence? The answer is apparent because such systems are decision making systems (DMS) not decision support ones. Still, it is doubtable if these systems could entirely replace human behavior and thinking especially for ill-defined problems.

The three human functions presented on Figure 3 (intellect, will and memory) are not subdivisions of the human parts (intuitive, mental and sensitive). They are creation of human behaviour represented through these parts. The similarity could be found in IT world by thinking of software and its output as creation "passed" through hardware. Therefore, the human parts could be mapped to hardware and human functions to software, respectively. In that sense, Figure 4 shows the model of artificial intelligence that could replace humans.

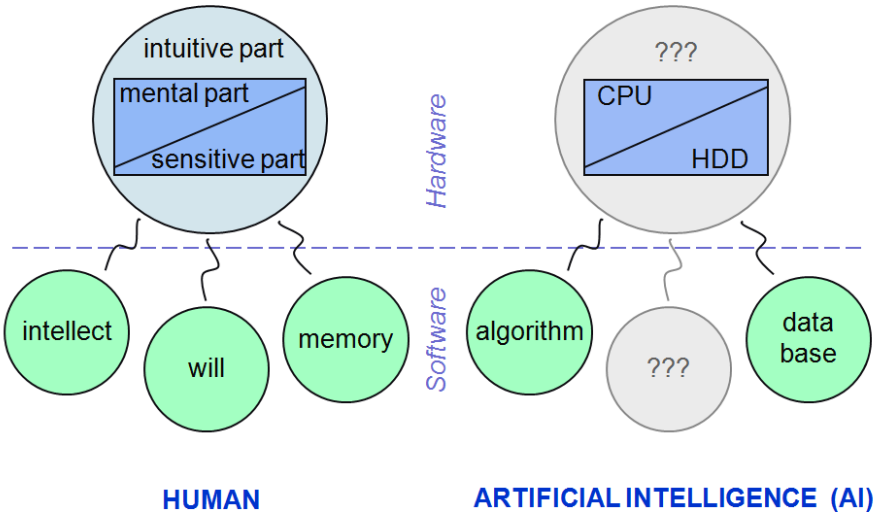

Figure 4: Model of artificial intelligence that could replace humans

The model shows that some parts of a human model cannot be mapped to artificial intelligence model. The human will and intuition could not be modeled and mapped into software. Regarding hardware, Central Processing Unit (CPU) could be recognized as mental part and Hard Disk Drive (HDD) could be sensitive part. Concerning software various algorithms correspond to intellect and data base to memory.

A decision is a product of human mind's three parts: mental, sensitive and intuitive. Intuitive part carries out the decision process and primarily represents human will, while sensitive and mental parts influence a final decision. Since it is not possible to map human intuitive part to artificial intelligence model the decision making process in uncertain and poorly defined environment is exclusively mandated to human and his/her intuitive part. The question herein is not about whether decision is right or wrong, but about who carries out the decision process. Figure 5 shows human decision making process.

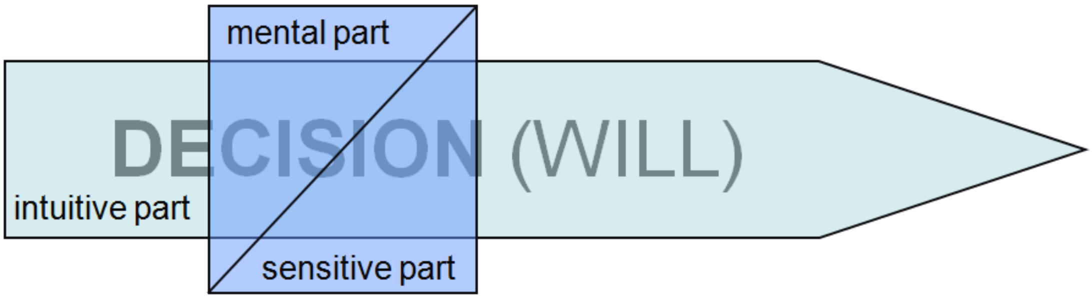

Figure 5: Human decision making process

As already mentioned the role of Decision Support Systems is to support not to replace human decision making process. Therefore, an artificial intelligence could be solely an artificial support as DSS (Figure 6).

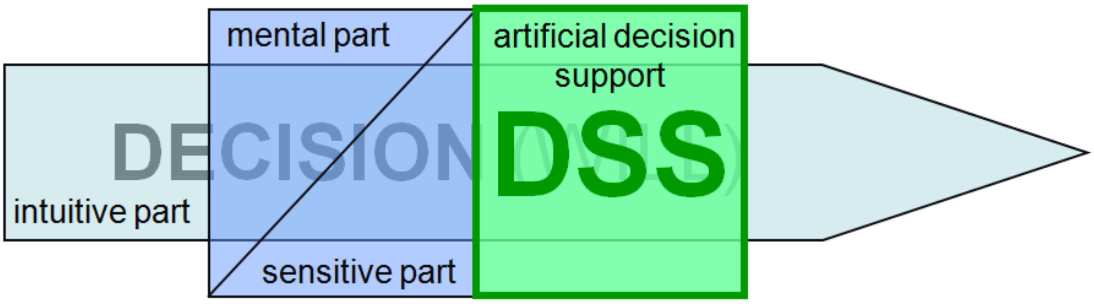

Figure 6: Human decision making process supported with DSS

The focus of this paper is on consequences that follows wrong decisions. For example, a wrong decision during rescue procedure of a tanker could lead to oil spill and enormous ecological catastrophe and fatalities. The responsibility is on emergency operator to propose proper solution and adequate shelter for ship in distress. Therefore, a DSS should prevent the operator to make wrong decision and at the same time helps him to make a right one (Figure 7).

The proposed decision support concept basically relies on Multicriteria Analysis (MCA) decision model and the whole process is supported by visual management and Geographical Information System (GIS). As mentioned above, the goal of the DSS is twofold, to support making right shelter selection as well as to prevent wrong decisions with catastrophic consequences.

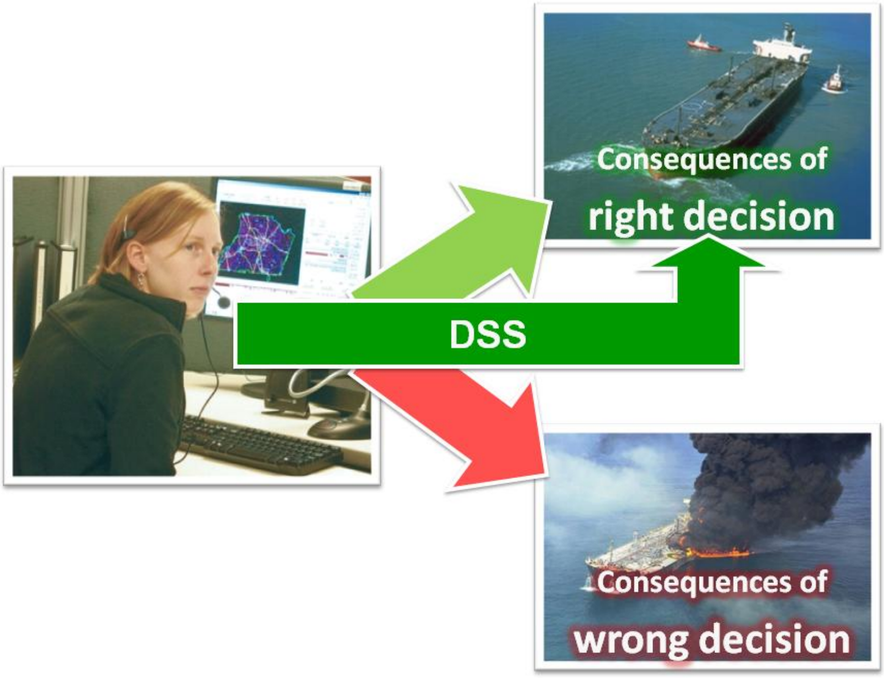

Figure 7: The role of DSS

The idea that combines GIS with decision-making procedures is not new because a significant number of problems from many fields can be characterized as spatial at the same time. Therefore, many authors have tried to combine decision-making process with GIS to help the involvement of many stakeholders in solving spatial decision problems (Jankowski et al [3]). Interesting research (Jankowski et al [4]) is an introduction of a new prototype of SDSS emphasizing the need for the improvement of the typically limited role of maps as support tool, to move toward the use of maps as a source of structuring in multiple criteria spatial decision-making. However, each viewpoint of combining decision-making processes and GIS, such as emergency management, has its own particular characteristics and problems.

Based on the authors' experience, in this research, among various multicriteria methods (Guitouni and Martel [5]), the method PROMETHEE II is chosen (Brans and Mareschal [6]) and connected with GIS. PROMETHEE II method is well accepted by decision makers because it is comprehensive and has the ability to present visualized results as it is proven in the application of this method in other engineering problems (Mladineo et al. [7], [8], [9], [10], Vuk et al. [12], Knezic and Mladineo [12]).

For the purpose of this project GIS was implemented in ESRI software (ArcGIS) and linked with output of PROMETHEE method. There is already an effort in literature (Marinoni [13]) to integrate PROMETHEE in a GIS showing how the combination of a decision-support methodology with powerful spatial analysis and visualization capabilities can be applied to evaluating decision alternatives.

Results

Analysis of the current DSS and applied methodology resulted in an entirely new DSS application that integrates GIS and MCA with an emphasis on the more user-friendly interface and visual management. The developed application primarily has a very simple interface: the menus and tools are presented using icons, overall presentation of GIS has been simplified with emphasis on layers related to emergency management and there are no unnecessary tools and functions. The following figures represent new DSS application and its features (Figure 8, 9, 10 and 11).

Figure 8: Adding a ship position with a single mouse click

After positioning of a ship (Figure 8) distance buffers are generated automatically and MCA is done on potential places of refuge (PoR) in area covered with distance buffers (Figure 9).

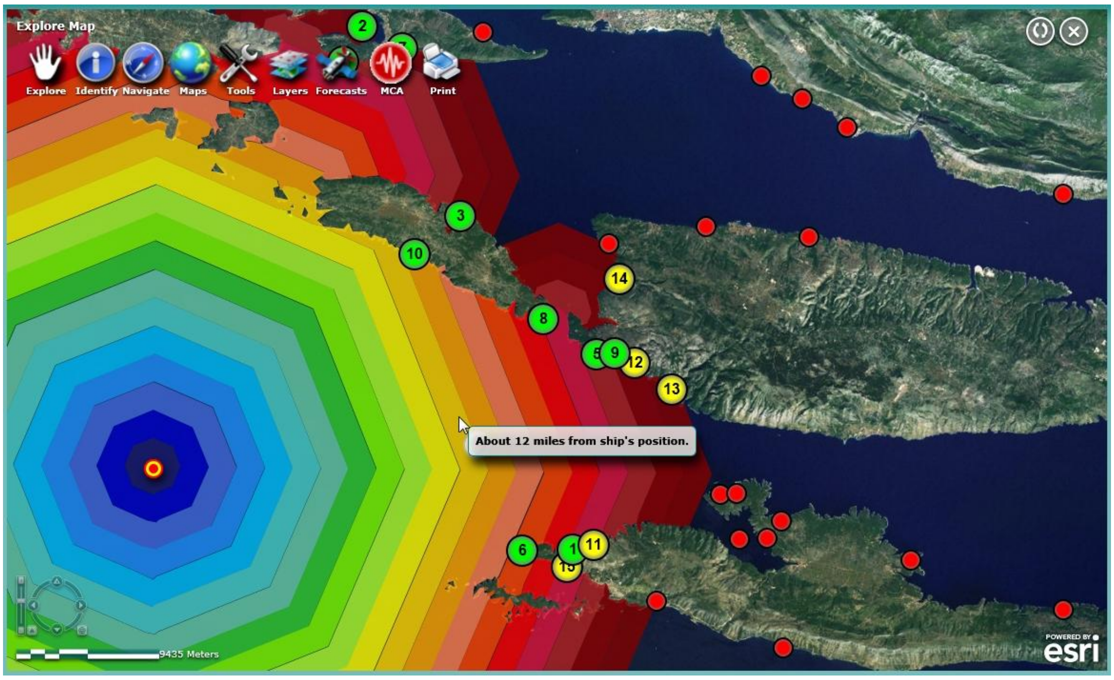

Figure 9: The distance buffers are generating automatically

The results of Multicriteria Analysis (MCA) are displayed in multiple ways (Figure 10): on a chart that represents PROMETHEE II output, on a map by placing a rank number on each PoR, and on a PoR's "map tip" with details about each PoR's rank (Figure 11).

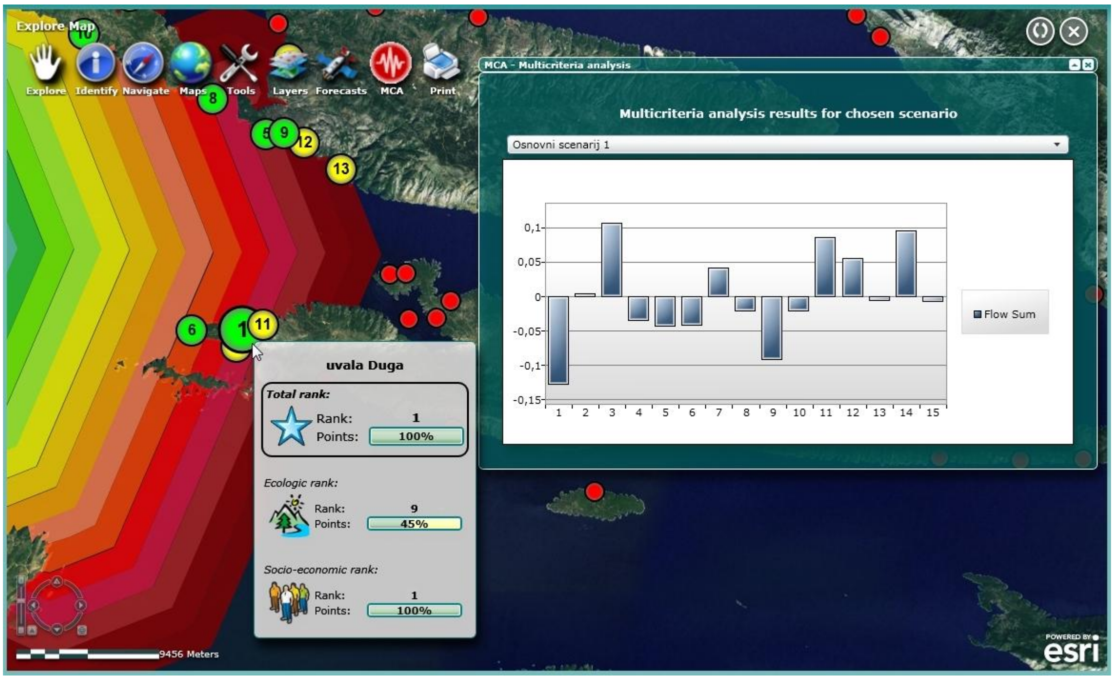

Figure 10: Display of results of Multicriteria Analysis (MCA)

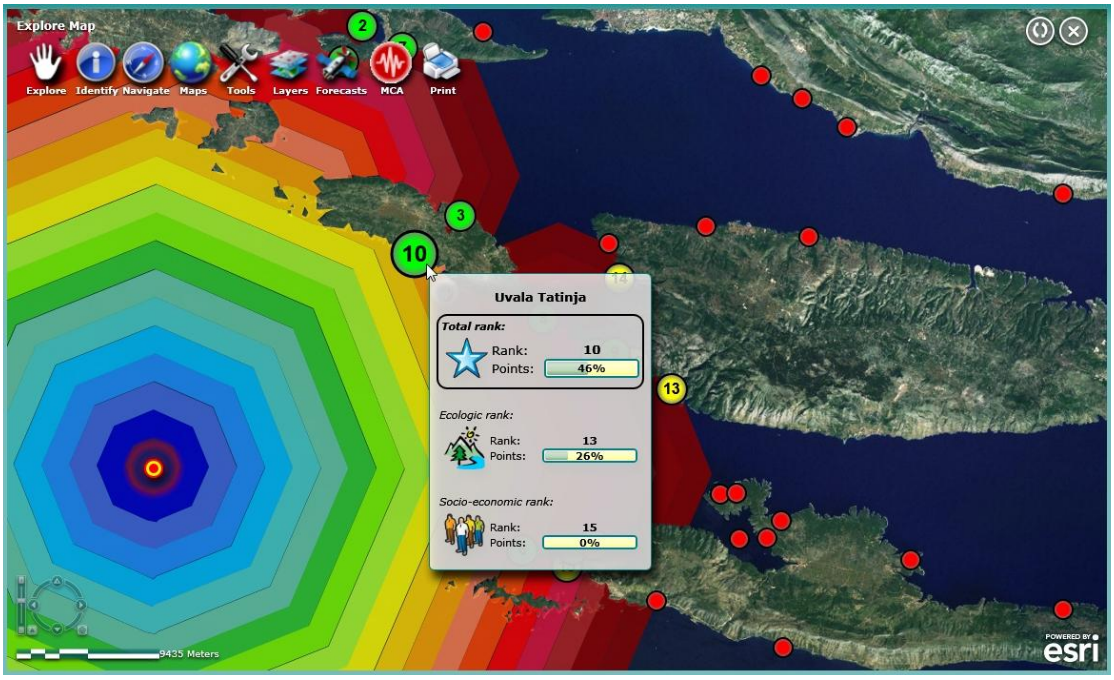

Figure 11: "Map tip" with details about PoR's rank

To ensure minimal possibilities that wrong decision is made, three MCAs are made each time: main MCA which results with total rank of PoR and two additional MCAs which result only with ecological and socio-economic ranks.

Different scenarios represent different situation on sea. Scenarios are represented in MCA using different weighting factors for criteria. So every time, regardless which scenario is chosen, the ecology and socio-economic ranks of PoR are showed. This ensures two most important impacts: the ecology and socio-economic ones are always observed.

On Figure 10 it can be seen that PoR with 1st rank has very low ecologic rank (9th) which means that chosen scenario is not an ecologic one.

However, on Figure 11 it can be seen that PoR with 10th rank has lowest socio-economic rank, because of tourist zone which is nearby. So that PoR cannot be chosen as a refuge for a ship that will endanger tourist zone. Although that PoR is closest to the ship, although its 10th rank is not bad, it cannot be chosen for a ship that will endanger tourist zone. And used visual management clearly "says" that to the emergency operator. That is the essence of visual management.

Discussion

Paper proposes special DSS concept which helps to establish efficient emergency management using GIS and its spatial analysis tools. Using visual management combined with powerful Multicriteria Analysis (MCA) the possibilities that wrong decision is made are minimal. Hence, the new DSS concept is about to be implemented and evaluated. When evaluation is finished, the one cycle of Research, Development, Implementation and Evaluation (RDIE) cycle is completed, and new researches can be done. The new research should be followed by new development, new implementation and new evaluation, so the continuous improvement of DSS can be ensured.

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FULL TEXT OF THE PAPER INTENDED TO BE PRESENTED AT THE 'TIEMS' CONFERENCE, BUCHAREST : JUNE 2011

"KNOWLEDGE AND EXPIERENCE SHARING AMONG MILITARY FORCES FOR DISASTER MANAGEMENT : LEARNING FROM EACH OTHER"

BY

COL AMARDEEP BHARDWAJ (INDIA)

PART – 1 : FORGING SYNERGY AND BRINGING IN TRANSFORMATION

1. **Introduction**. Militaries all over the world invariably get involved in Disaster Management, especially if the scale of the disaster is large. They have been combating disasters for many years now and within each nations' military lies a reservoir of knowledge, experience and valuable insights – a veritable treasure trove - on how best to tackle disasters. Yet we continue to work in isolation, oblivious of our own shortcomings and the strong points of others. My talk is based on the simple idea of **pooling these individual knowledge 'reservoirs' to share information, expertise and specialized knowledge of disaster management for the universal good.** By doing so we stand to lose nothing at all, yet gain exponential efficiency in managing disasters more effectively.

Expanding The Idea Of 'Pooling'

2. If we were to take a global overview of how various countries use their uniformed forces to manage disasters it will at once become apparent to us that the problems confronting us today are, more or less, similar if not exactly the same. Can each one of us not make a listing of 'potentially instructive' wisdom from others for our own good ? Can we all not learn from each other ? This, precisely, is the focal point of my lecture.

3. May I however, at the very outset, add a word of caution : there is no need to blindly copy the organizational structures, systems, mechanisms and procedures of others. That is not the idea at all. The basic premise on which to work is that each country must necessarily strive to evolve disaster management solutions that are essentially **indigenous** in concept, content and execution. At the same time, we must not hesitate in incorporating the good points of others. This can only come about by institutionalizing **a 'Global Information / Knowledge Exchange' on Disaster Management (DM) issues.** As a fore-runner to this perhaps the militaries of the world, known for their leadership, can show the way by setting up an **'International Military DM Exchange'.** I put forth this innovative proposal at this conference because such an idea can only be examined at an international forum such as TIEMS, it will serve no purpose within the confines of national boundaries.

4. While we are at this conference we can examine this – and other - path-breaking ideas, analyze them at length and see if we can indeed start the move towards implementing some of them. None of this will however be possible if we do not, first and foremost, abandon our narrow, 'my country only' mind-sets. I urge you all to start thinking like global citizens, at least for the duration of this conference. Only then can the realization truly dawn that **networking, information exchange and knowledge sharing have the potential to become future drivers of powerful transformational change, leading to betterment of the entire 'community of nations'.** It **can** be a win-win situation for everyone ! Do you want to give it a try ?

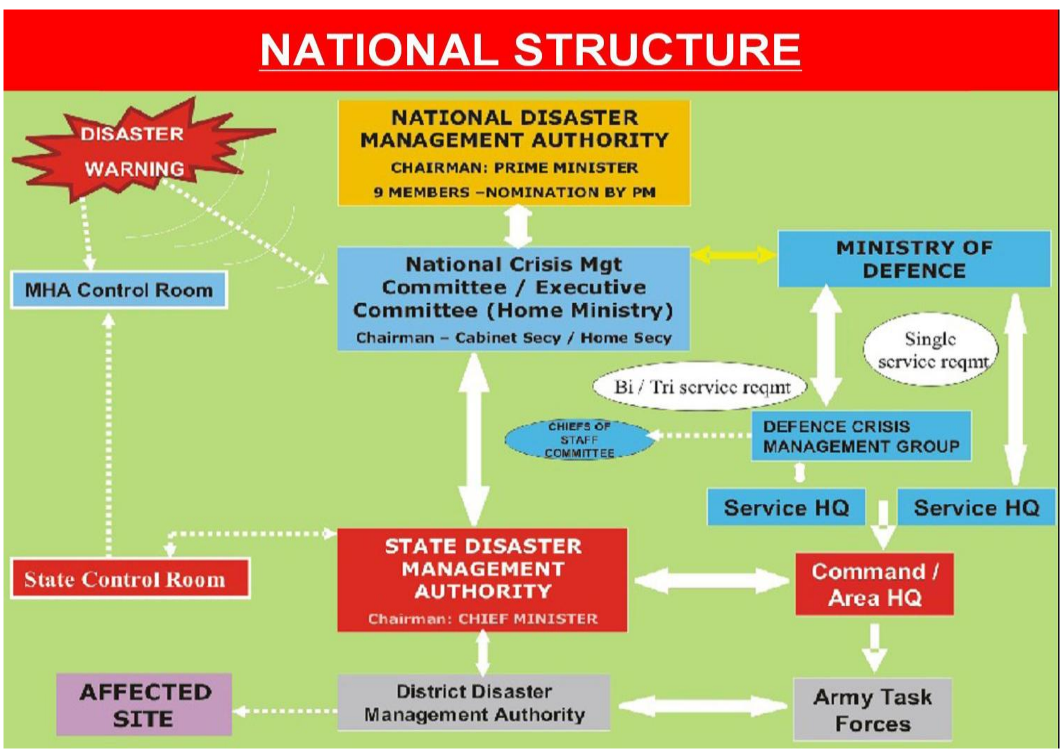
5. So far I have only talked about pooling information and knowledge. But that is not all. **Even resources can be pooled** : manpower, equipment, specialist machinery and all the infrastructure that goes in to managing disasters. Moreover, such aggregation need not be confined to the military only ; **even para-military, police, civil and NGO resources can be pooled internationally for the common good.** What we need to figure out, collectively, is how best to do so. My advice would be to take one step at a time, it being more important to

'walk in step' rather than 'walk fast'. If you reflect on this it will not take you long to realize that **it is only in our mutual synergy that our individual deliverance (from disasters) lies.**

6. When it comes to the employment of disaster response forces, the main issues facing all nations are, more or less, the same : forging civil-military synergy, precise definition of DM duties for the Armed Forces, establishing a dynamic and effective command and control module at the apex level, working out the modalities of coordination at the field level, etc. Studying the manner in which some of the successful disaster response mechanisms (both civil and military) function and how some of the countries have taken a lead over others in applying themselves to solving disaster related problems. Since the challenges are similar there is tremendous potential to learn from each other and thereby speed-up the process of solution finding. In other words, the DM concepts, techniques and methods adopted by certain countries can prove to be highly instructive for many others. I shall attempt to give you a brief insight in to this by quoting specific examples.

PART – 2 : INSTRUCTIVE WISDOM FROM OTHER MILITARIES

7. **COUNTRY SAMPLE 1 : INDIA.** [1] In recent years India has taken giant strides in transforming its entire DM apparatus. The military, para-military and police forces have been given added DM responsibilities and now constitute an integral part of the DM apparatus. This can be readily seen from the diagram below : --



Among the many new ideas introduced is the establishment of highly efficient response mechanisms to combat disasters. I have selected three which hold excellent promise for the rest of the global community. I shall briefly describe these.

(a) **Initiative 1 : Setting-Up Of Specialist 'Disaster Response Forces' At The National, State and District Levels.**

(i) **The Concept.** [2] Based on past experience it was felt that Specialist Response Forces are essential to combat disaster situations. Accordingly, three such forces are being raised : the National Disaster Response Force **(NDRF) at the National level, the SDRFs at the State level and the DDRFs at the District level.** The NDRF is already ten battalion strong, comprising a total of 10,000 para-military and police personnel. It is equipped with state-of-the-art equipment for combating disasters. It functions directly under the National Disaster

[1] *Annual Report 2009-10*, Ministry of Home Affairs, Govt of India.
[2] *The Disaster Management Act, 2005* No. 53 Of 2005 [23rd December, 2005.]

Management Authority (NDMA). It is a multi-disciplinary, multi-skilled, high-tech force for all types of disasters and can be inserted in to disaster zones by air, sea and land. At the State or Provincial level **SDRFs** are being formed and further down the line, at the District level, **DDRFs** are in the process of being raised.

(ii) **Present Organization.** [3] Presently the NDRF is constituted of ten para-military / police battalions, each having 1000 trained personnel. Each battalion can provide 18 self-contained specialist Search and Rescue (SAR) teams of 45 personnel each including engineers, technicians, electricians, dog squads and medical/paramedics. All the ten battalions have been equipped and trained for **all** natural disasters but 50% of the force is also trained in combating NBC disasters. This force is capable of operating in all types of terrain in almost all the visualized contingencies.

(iii) **Deployment.** These NDRF battalions are located at ten different locations in the country based on scientifically evolved 'vulnerability profiles' of various regions drawn up after a detailed process called '**Hazard Zonation And Risk Analysis**'. Their locations have been carefully chosen so as to cut down the response time for their deployment. During the preparedness period or in an impending disaster situation, proactive deployment of these forces will be carried out by the respective authority controlling these forces, that is the NDMA/SDMA/DDMA, as appropriate.

(iv) **Functional Parameters.** These Disaster Response Forces carry out regular training, familiarization with the area of responsibility, mock drills and joint exercises with the various stakeholders in DM. At the National level, four training centres are being set up to train these personnel. The NDRF units, being the most specialized, in turn impart basic training to the SDRFs. In addition, two national-level Disaster Management Academies - the NIDM at New Delhi and the NCDC at Nagpur - have been set up to provide training and to meet other national and international commitments.

(v) NDRF units maintain close liaison with the designated State Govts and, in the event of any serious threatening disaster situation, are made available to them in the shortest possible time, thus avoiding long procedural delays in deployment. An entire response strategy has been drawn up and manuals prepared on Standard Operating Procedures (SOPs) [4] for responding to various kinds of disasters. These SOPs lay down the sequence of actions to be taken by different agencies in the event of a disaster.

(vi) **Specialised Forces and Teams at States Level**. Each States has been advised to set up its own 'Composite Task Forces' (CTFs), 'Specialist Teams', 'Search and Rescue Teams', etc for responding to disasters. Each CTF is to include a company each of armed police, engineers and required medical staff.

(b) **Initiative 2 : Setting-Up Of 'National Disaster Mitigation Resource Centres' (NDMRCs) and 'National Emergent Reserves'.** [5] The concept of NDMRCs has been evolved to facilitate rendering of central assistance to the States. The NDMRCs are co-located with the NDRF battalions and serve as outstations of the Central Govt. Besides assisting the Centre in running mock drills and capacity development they are designed to act as additional links to the Central Govt during disasters. Most importantly, they act as repositories or warehouses for **'NDMR Bricks'** in each of the ten locations. A 'Brick' is defined as a composite package of such materials for a given number of people, generally worked at 25,000. There are many types of Bricks in use, namely :--

- Immediate Rescue & Relief Bricks.
- Follow up Bricks.
- Restoration Bricks.
- These 'bricks' can be complemented by 'incremental bricks' for each type of disaster i.e., cyclone, floods, tsunami, chemical / biological contamination.

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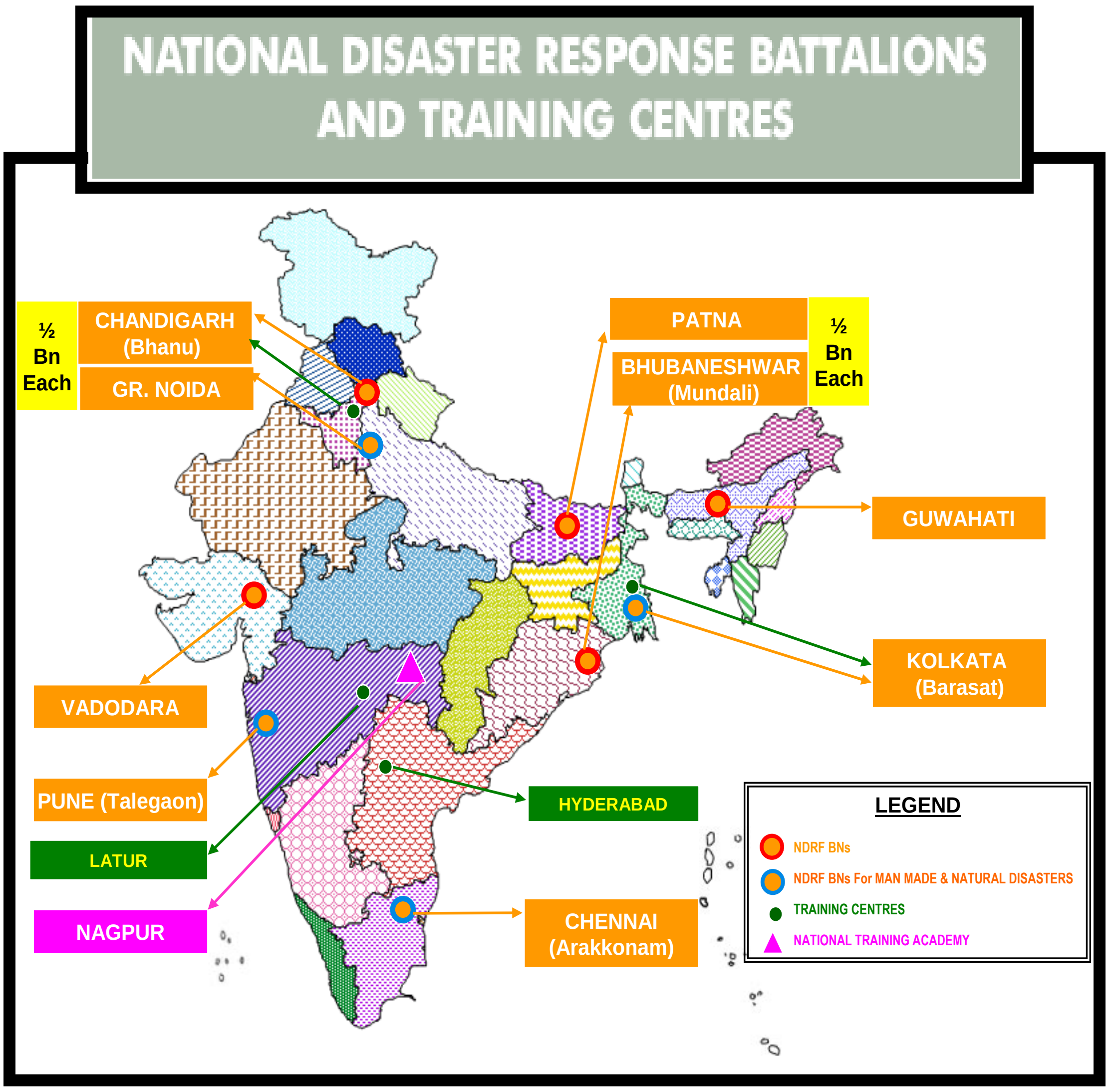
[3] Excerpts From ndma.gov.in

[4] *Standard Operating Procedure For Responding To Natural Disasters – 2010,* issued by Disaster Management Division, Ministry of Home Affairs, Govt of India.

[5] *National Policy On Disaster Management*, Govt of India, MHA.

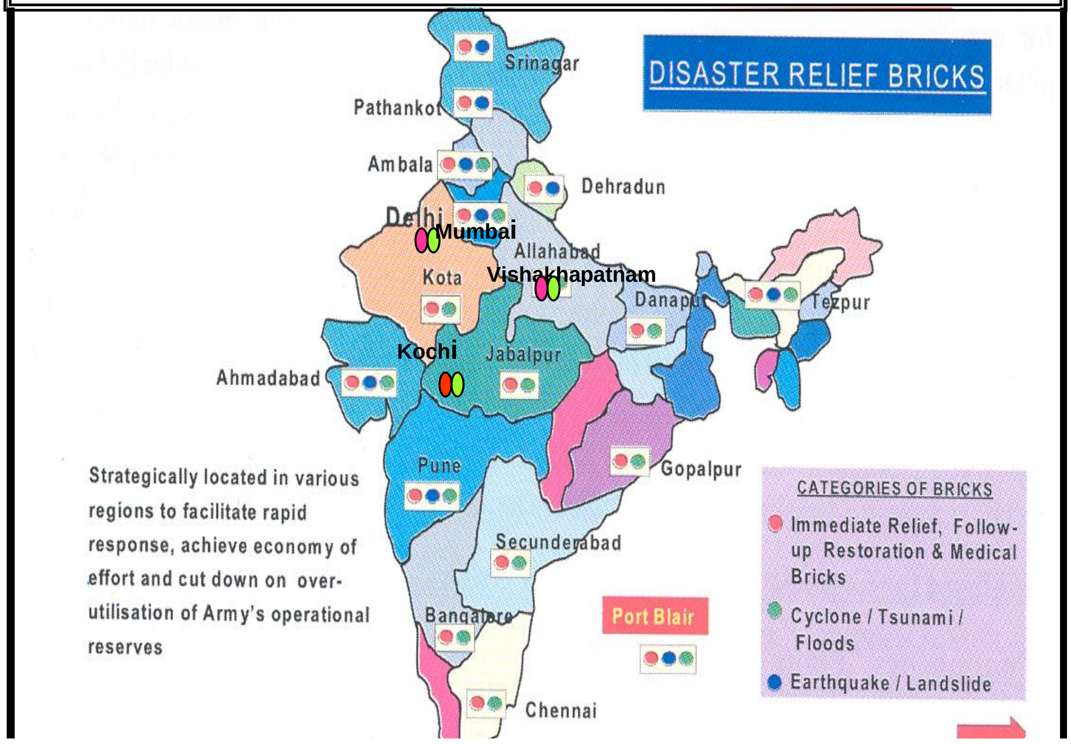


- Another idea that is gaining currency is to categorize them as 'Medical Relief Bricks, Engineer Plant Bricks, Hygiene and Sanitation Bricks', etc.
- Based on vulnerability of each region to a specific type of disaster, these bricks are being strategically located in varying combinations to facilitate timely movement and deployment.

(i) The list of relief stores has been carefully chosen and these cater to the emergent requirements especially for the first 72-96 hours. Additional bricks of stores for 50,000 people each have been especially kept for mountainous and high altitude areas. It needs to be noted that all these relief stores are being provided by the Central Govt to supplement the reserves already maintained by the respective States / Provinces. In the manner described above National Disaster Response Reserves of essential relief stores for 4,00,000 people are being located, country wide, near the existing locations of NDRF Battalions. These reserves are being stored with the Mitigation Resource Centres. It is hoped that operationalization of this system will reduce the high dependence of the civil administration on Armed Forces equipment and stores.

(ii) **<u>Military Disaster Relief Bricks</u>.** Over and above the **C**entral / Federal Disaster Relief Bricks, the military is in the process of setting up its own reserves of relief materials and stores, albeit at a much smaller scale. The Military Bricks are designed to ensure that specialist equipment and reserve stocks are made available to the troops, when called out for DM duties, in the right quantity, at the right place and at the right time. The idea is to pre-position appropriate disaster relief materials at suitably selected locations across the country so as to make the disaster response of the Military more effective.

DISASTER RELIEF BRICKS

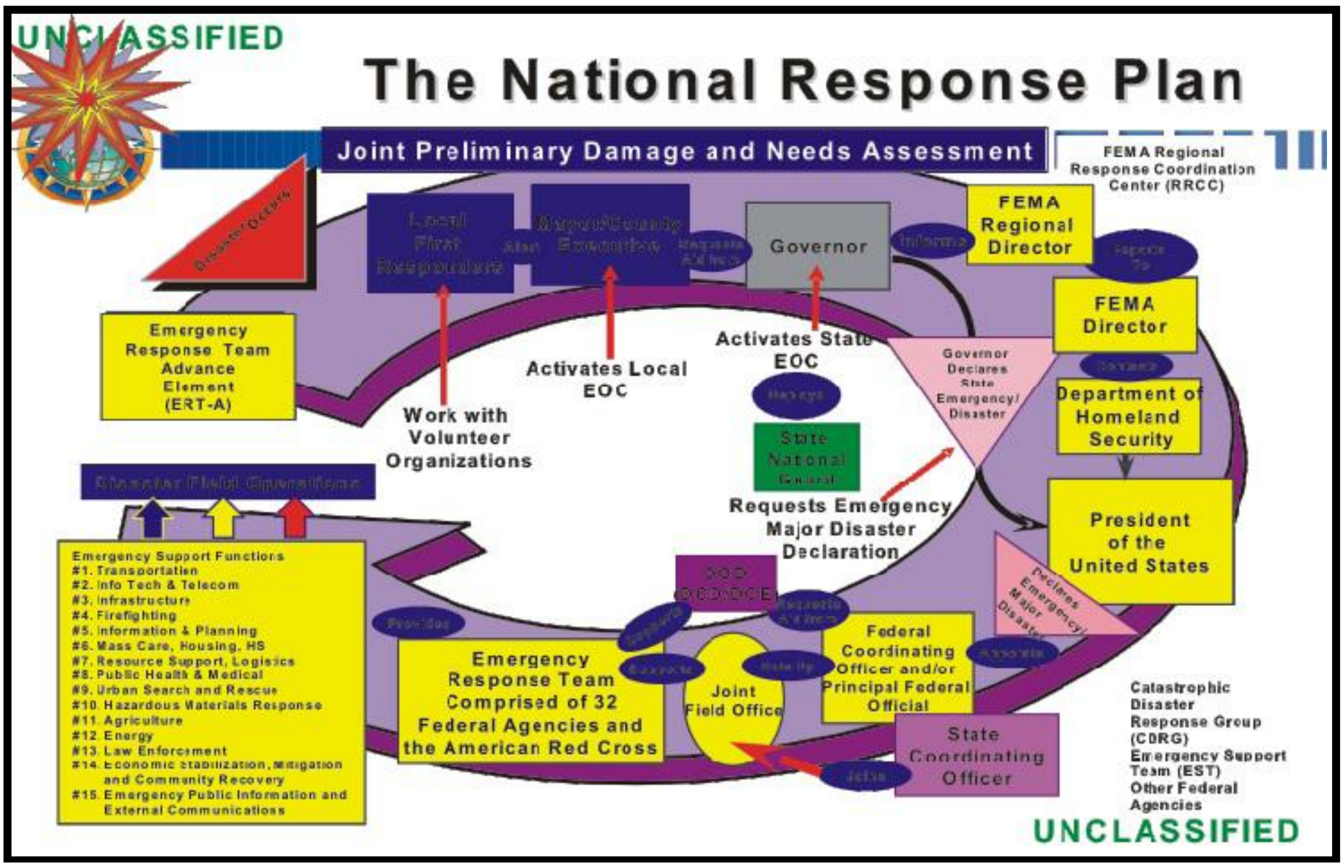


(c) **Initiative 3 : National Network of Emergency Operation Centres (NNEOCs).** The Central Govt is setting up **Emergency Operations Centres (EOCs) at National, State and District levels.** These are intended to be of multi-hazard resistant construction and have communication system linkages. A certain percentage are to be made **Mobile EOCs** for on-site DM. These are being set up at selected sites in various States and Districts with **Stand-By EOCs** at alternate locations. The equipment being placed at each National Level EOC comprises computers with VSAT communication terminals, GPS and satellite phones, large video screens, maps / bulletin boards, charts, risk vulnerability maps and a 15 day stockpile of essential commodities / consumables. It is intended to place a multi-disciplinary team, trained in the usage of all this equipment, at each EOC. At the State Level, **each State will have a state-of-the art EOC at the State HQ and mobile EOCs with the State nodal agency**. Similarly the **District EOCs** will have communication links with all revenue, police and block offices in the form of HF and VHF networks. Besides, they will promote local HAM clubs and use of electronic and print media for disaster information dissemination.

8. **COUNTRY SAMPLE 2 : USA.** [6] What I find particularly interesting, and instructive, in the US Model is that the employment of f**ederal military forces for DM requires special authority from the highest executive in the country, the US President himself.** Of course, it helps that the President is also the Commander-in-Chief of the Military. In this model, any military assets designated for use in assisting the civil authorities for DM tasks must be cleared by the Pentagon which then allows the Secretary of Defence (parallel to the Defence Minister in other countries) to maintain operational situational awareness. Thus a very important safeguard has been built-in to the military DM mechanism in that **the Defence Ministry must assume full responsibility for the operational consequences of tasking a military unit or formation on DM duties.** I feel that many of us can borrow this feature from the American model wherein the Defence Minister may direct the military to provide DM assistance to the civil authorities **only after having satisfied the highest authority of the land that proper arrangements have indeed been made to offset the resultant operational fallout.** In the US Model, the National Guard (a para-military organization) shoulders bulk of the DM responsibility and functions under the State Governor. However, if State resources are overwhelmed and there is a need to call in the Military, the Governor requests federal support

[6] Excerpts From *Federal, State And Local Disaster Management Within The US And US – PACOM Plan For Foreign Disaster Relief* By Lt Col Clay Sutton, ADF, US Pacific Command, Hawaii. Seminar Report, International Seminar On Disaster Management, Dec 2005, New Delhi.

through the President. Once the President gives his nod a Presidential Emergency Declaration is issued and federal funds are released to the State. The Federal Emergency Management Agency (FEMA), as part of the Department of Homeland Security, is the Primary Federal Agency nominated to coordinate the federal emergency response across all departments. It should however be noted that the **State Governor remains in charge.**



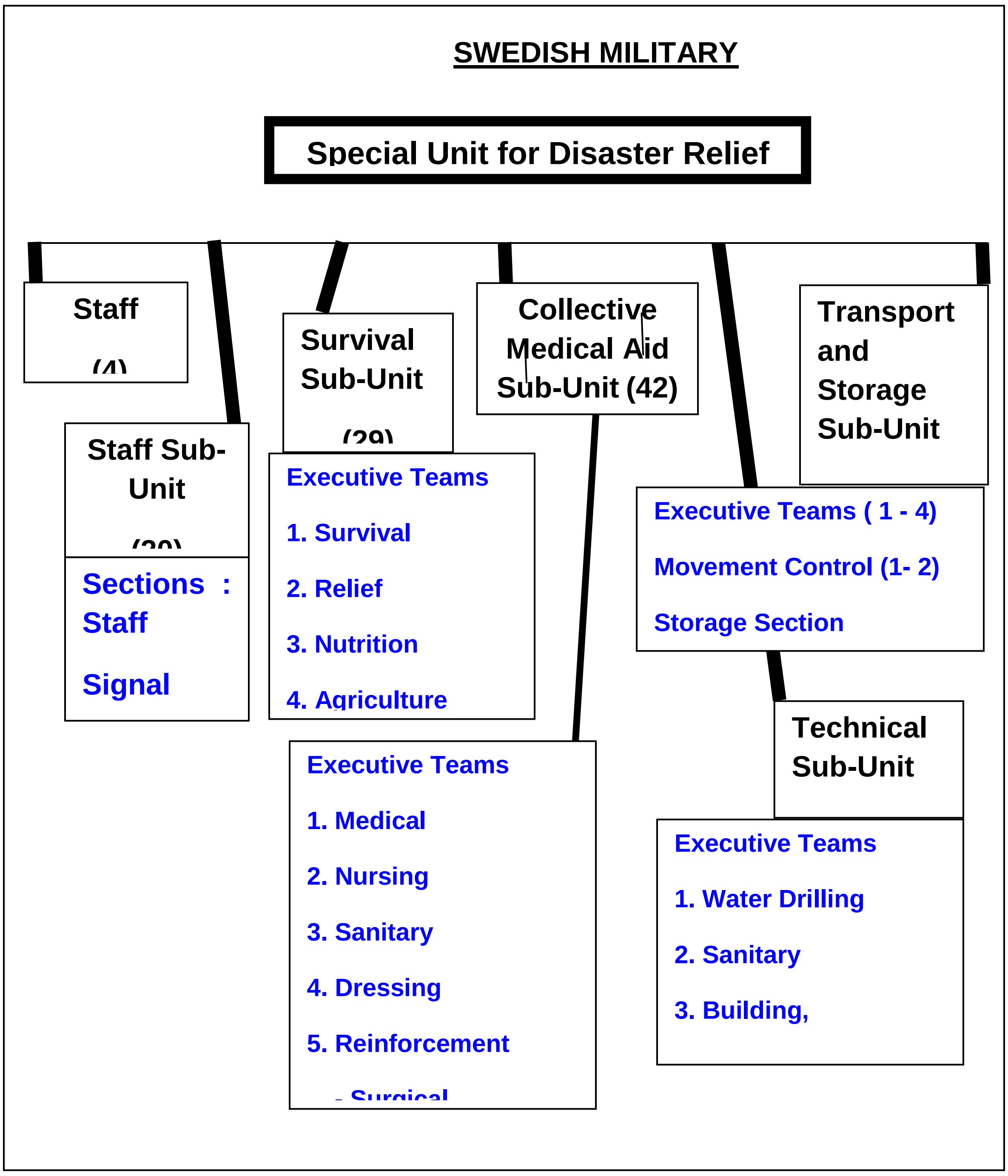
9. **COUNTRY SAMPLE 3 : SWEDEN.**[7] A striking feature of the Swedish DM apparatus is that institutional arrangements have been made for the provision of **specialized units for disaster relief.** A total number of 160 officers and men are formed into the administrative and operational structure of such a unit which comprises **Executive Sub-Units** and four **Direct Relief Sub-Units** responsible for Survival, Health, Technical Assistance and Transport and Storage. The organization of such a specialized unit is shown in the diagram on the next page. Highlights of this organization are as follows : --

(i) The unit relies on small specialized teams, each averaging four technically trained personnel.

(ii) The teams are equipped to operate independently.

(iii) The flexible structure of the special units allows the relative size of an operation to vary from that of an individual to the combined efforts of one or more relief units, depending on the nature and extent of the disaster.

[7] Excerpts from *Disaster Management, Societal Vulnerability to Natural Calamities and Man-Made Disasters : Preparedness and Response (Indian Scene)* by Dr Indu Prakash, Rashtra Prahari Prakashan, June 1994.

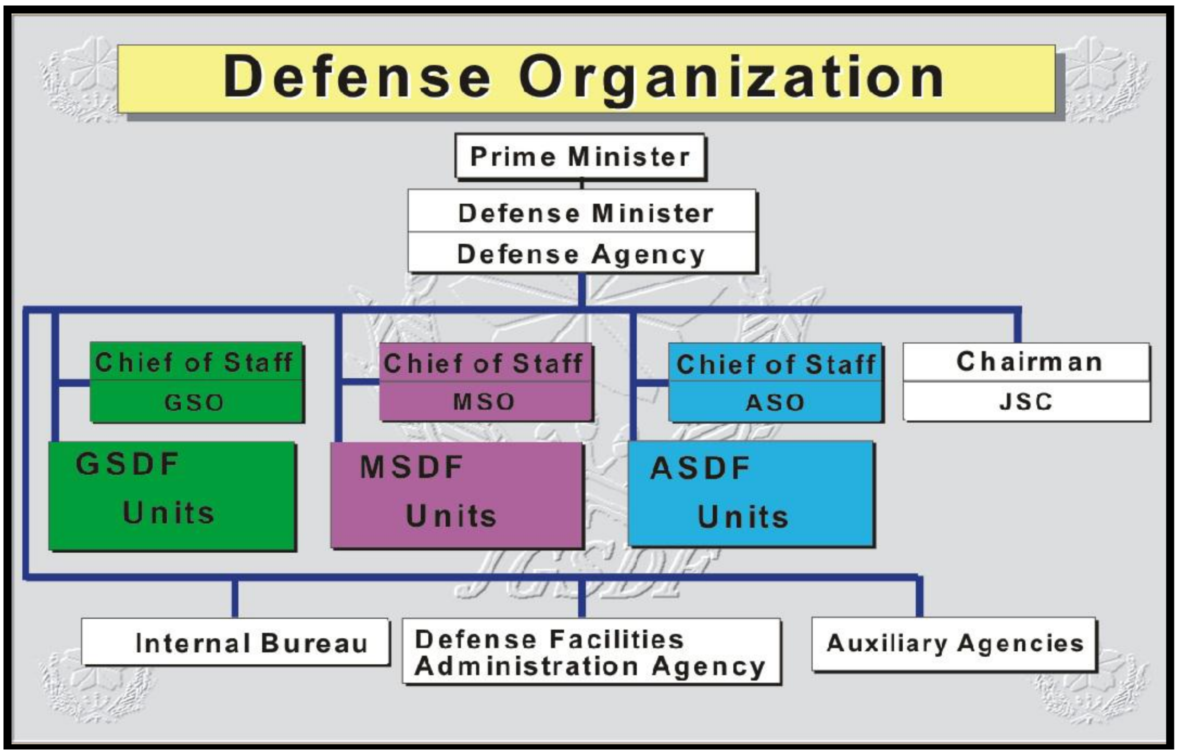


10. **COUNTRY SAMPLE 4 : JAPAN**.[8] The Japanese Defence Forces have a wealth of experience and insight in to DM which is unmatched by any other country. Since its inception in 1951, the Japanese Ground Self-Defense Force (JGSDF) has conducted over 16,500 disaster relief operations involving 6.6 million soldiers. Based on such extensive experiential wisdom they have evolved an excellent DM mechanism from which we can learn a lot. I will focus on three main aspects of their system which are relevant to us at the military level.

(a) **Feature 1 : Disaster Response Of The JGSDF**. DM in Japan has been duly catered for by law which also defines the role of Armed Forces in crisis situations. While the **onus is on the Autonomies (govts at district level)** for relief measures, **the Armed Forces constitute the most important and effective instrument of the National Government's response.** They are organized and structured as shown in the diagram on the next page.

(b) **The Primary Mission of the JGSDF is "to defend the country against direct and indirect aggression" while the Secondary Mission is "to take charge of and to maintain public order"**. Disaster relief operations are included in the secondary mission and assume considerable importance during peace time.

[8] Excerpts From *Japanese Structure For Regional Response In Disaster Management* By Col Ryuta Ando, JGSDF. Seminar Report, International Seminar On Disaster Management, Dec 2005, New Delhi.



The Local Authorities have the principal responsibility of protecting the lives and livelihoods of Japanese citizens. In a striking variation from the US Model, JGSDF units can be despatched for DM duties directly on request from the regional Governor or equivalent. **Even a Garrison Commander (a Colonel) can deploy a unit in peace time to conduct relief operations as soon as possible**. The most significant feature of this arrangement is that **in emergencies, requests can be made directly to JGSDF commanders by the local Mayors and the military commanders are empowered to mobilize troops to accede to such requests**.

(c) **Feature 2 : The Quick Response Force.** To promptly answer such requests **the JDSDF maintains an initial standby force comprising of 2700 personnel and 27 helicopters throughout Japan for dispatch within one hour**. This capability enables the JGSDF to deal with a wide range of disasters, such as earthquakes, forest fires, floods, volcanic eruptions and special disasters including nuclear and industrial accidents, very promptly and efficiently. This is an important asset which I feel many countries must consider building to enhance the effectiveness of their disaster response. Such a mechanism will go a long way in giving immediate succor to the affected populations.

(d) **Feature 3 : International DM Response.** Perhaps the most outstanding feature of the Japanese Model is the unmatched efficiency of their International DM Assistance. On receipt of a request from a foreign Govt of a disaster hit country or international organization, Japan undertakes **international relief activities based on the three 'pillars' of Financial Support, Material Support and Disaster Relief Operations On The Spot**. Financial help is provided through the Ministry of Foreign Affairs (MoFA), the material support is provided by MoFA through the Japan International Cooperation Agency (JICA), while the **actual disaster relief operations 'on the spot' are conducted by the Defence Agency in concert with other concerned ministries & agencies. MoFA coordinates all help. For this the GSDF maintains 'Quick Response Postures' with 260 troops. The advance party can depart from Japan within 48 hours of issuance of orders and the main body within 5 days. These stand-by troops can operate, self-contained, for 3 weeks. At the disaster site, Coordination Teams of the local Japanese Embassy are in charge of coordination and control of Japanese disaster relief activities. In this way, Japan has managed to link its embassies worldwide in the DM apparatus and bring in much needed synergy between foreign policy and international disaster relief.** I am convinced that such highly effective mechanisms are instructive for most countries who must also take steps to build such assets.

PART – 3 : LEARNING FROM THE UNITED NATIONS

11. In the field of DM, while searching for 'models of excellence' we simply cannot afford to ignore the United Nations. The vast amount of knowledge and expertise available within the United Nations system in combating disasters provides us a veritable treasure trove of 'distilled wisdom' on the subject. There is a need to weave together all these valuable insights with our country-specific knowledge bases and tie them up neatly in to one whole, inter-linking the numerous diverse aspects. Doing so will accrue exponential gains in terms of efficient structures, techniques and mechanisms to combat disasters. Here, I propose to acquaint you with four selected innovative ideas successfully introduced by the United Nations in to their DM apparatus. The very fact that these initiatives are proving to be highly effective points to their suitability as role-models for many of our military forces.

12. **LEARNING POINT 1 : FUNCTIONING OF OCHA.** [9] OCHA, headquartered at Geneva, stands for 'Office for the Coordination of Humanitarian Affairs' and is a part of the United Nations International Humanitarian Coordination Structure to combat disasters. It's main goal, besides saving lives, is to harmonise and synergise DM activities amongst all the responders, avoiding competition and eliminating discord. It is a complex task as everyone wants to coordinate but nobody wants to be coordinated. "However", explains Ms Ingrid Nordstrom-Ho, Chief of the Civil–Military Coordination Section, OCHA, Geneva, "experience has shown that **in a natural, technological or environmental disaster, the use of military and civil defence assets, and cooperation with the military, is usually accepted by all actors**, allowing coordination to focus on improving the effectiveness and efficiency of the combined efforts …… **The key elements, in our understanding of civil-military coordination, are : information sharing, division of tasks and planning**."

(a) **Civil-Military Relationships.** Since many stake-holders respond to humanitarian emergencies, there is a need to divide them into **Military** and **Civilian.** The civilian and military actors can be further sub-divided into **International** and **Domestic**. This results in four sets of civil-military relationships which need to be harmonized. These are : --

- Domestic Civil – Domestic Military.
- Domestic Civil - International Military.
- International Civil - Domestic Military.
- International Civil - International Military.

(b) **Guidance Documents**. OCHA draws its direction from numerous 'guidance documents' which it has drawn-up in partnership with the international community. These include the 'Oslo Guidelines, 1994', the 'Guidelines on Civil-Military Relationship in Complex Emergencies' and the 'Guidelines On The Use Of MCDA In Support Of Humanitarian Activities In Complex Emergencies'. **These provide guidance on when 'Military and Civil Defence Assets' (MCDA) can be used, how they should be employed and how UN agencies should interface, organize and coordinate with international and domestic military forces. I strongly recommend a thorough study of these 'guidance documents' by all militaries so as to refine our individual DM policies, concepts and responses.**

(c) **Humanitarian Tasks.** The MCDA Guidelines delineate three main categories of humanitarian tasks. These are : --

- **Direct Assistance**. Handing out aid to the people in need. It involves no intermediary and there is direct contact between the aid-giver and the aid-receiver.
- **Indirect Assistance.** This is removed at least one step from the beneficiaries wherein the aid could be transported from one location to another but does not involve actual distribution to the needy.
- **Infrastructure Support**. The repair of the roads, bridges, etc so that the transport carrying humanitarian aid can reach the desired locations.

[9] Excerpts From *UN And The International Humanitarian System* By Mr Markus Werne, OCHA Asia – Pacific, Bangkok. Seminar Report *International Seminar On Disaster Management, New Delhi, December 2005.*

(d) **Role Of MCDU**.[10] OCHA can mobilize and coordinate the deployment of MCDA from a number of countries and multinational organizations. **These assets include specialized personnel and equipment required for disaster relief operations (eg. Aircraft, helicopters, ships, NBC decontamination facilities, field hospitals, water purification units etc). The Military and Civil Defence Unit (MCDU) is the focal point for the use of military and civil defence resources in all types of humanitarian emergencies.**

(e) **Central Register of Disaster Management Capacities.** OCHA has established a **Central Register of Disaster Management Capacities (CRDMC)** as an operational tool to support, in conjunction with other measures, the UN system and the international community as a whole in their efforts to ensure expeditious delivery of the required humanitarian emergency assistance. The CRDMC contains 5 directories specific to DM : --

- SAR (Search and Rescue) Directory.
- MCDA (Military and Civil Defence Assets) Directory.
- Emergency Stockpiles of Disaster Relief Items.
- Rosters of Disaster Management Expertise.
- ATDR (Advanced Technologies for Disaster Response) Directory.

(f) There is much to learn from the functioning of OCHA. Such a study will yield valuable insights that can readily be incorporated by many countries / militaries in to their individual DM plans so as to significantly enhance the efficiency of their current DM response.

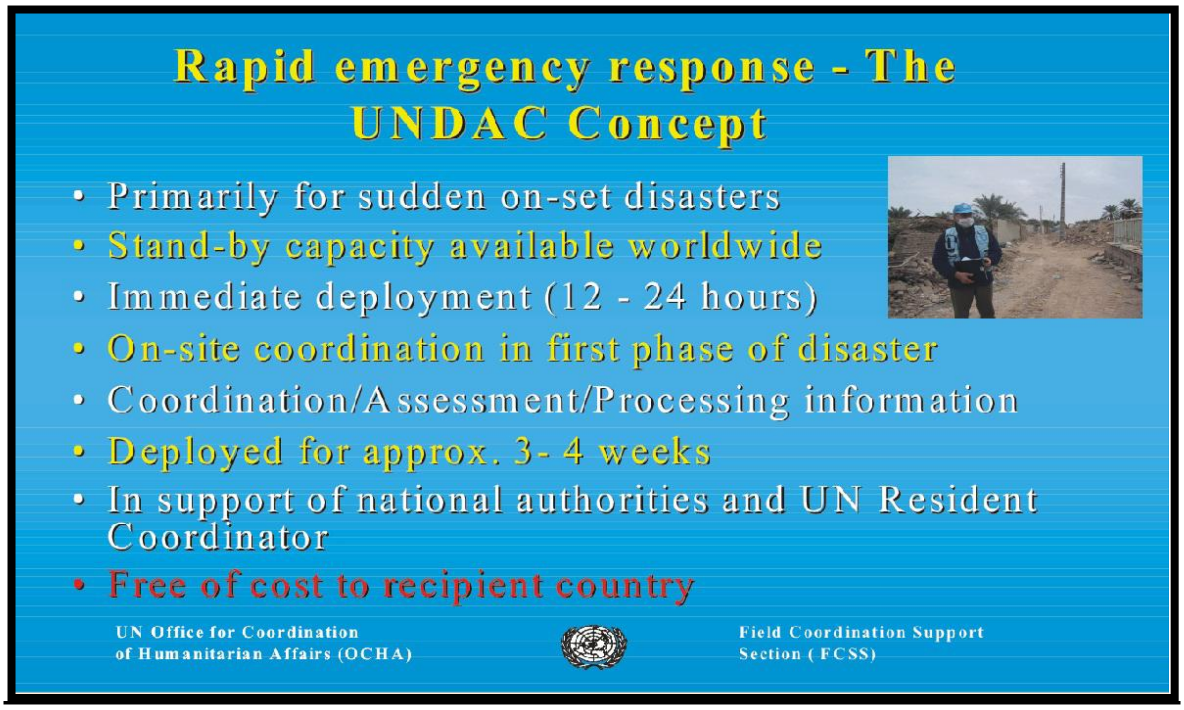
13. **LEARNING POINT 2 : FUNCTIONING OF THE UNDAC.**[11] UNDAC stands for UN Disaster Assessment and Coordination Team. It is the primary instrument used by the UN for coordination of the international DM response. These teams are primarily used for sudden onset of disasters and, at times, for complex emergencies. **They constitute a standing capacity for quick employment worldwide and are capable of deploying anywhere in the world within 24 hours**. They do so, on an average, more than once a month. The UNDAC Teams have three primary functions: Coordination, Assessment and Processing of Information. Of these, the last two assume greater significance. UNDAC teams work in support of the host national government and the UN Resident Coordinator is the facilitator for their employment. Their deployment is generally for 3 to 4 weeks and is free of cost to the recipient country.

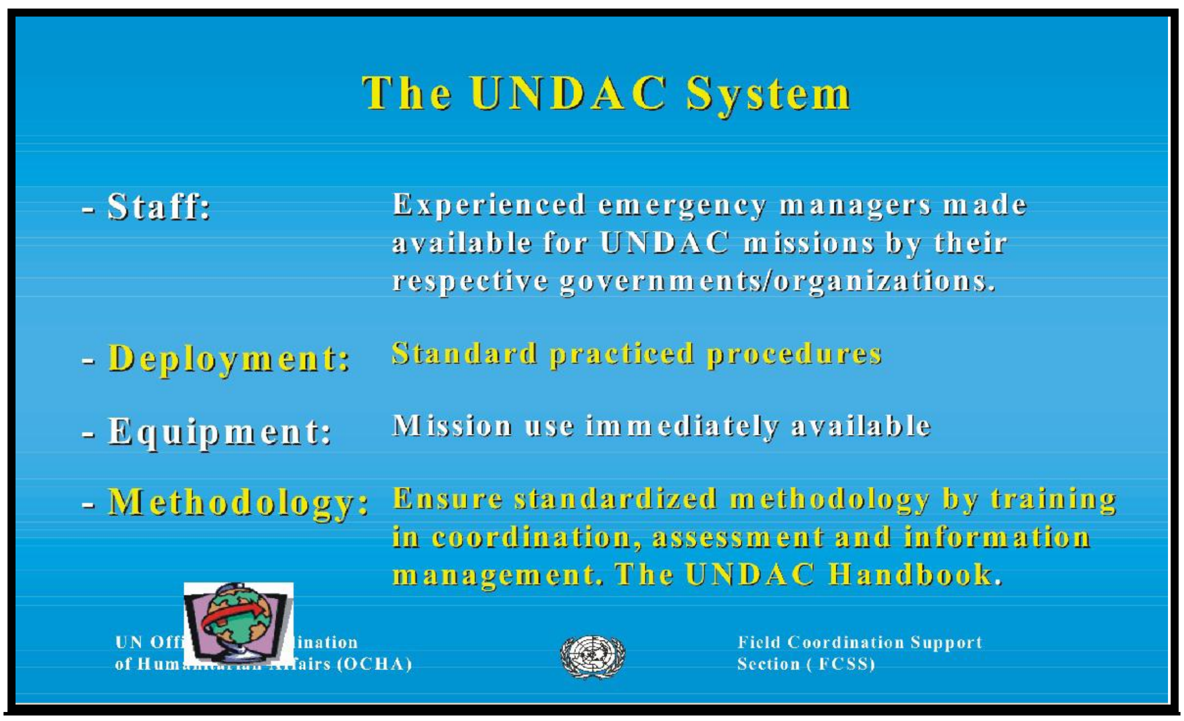
(a) **Staff.** The UNDAC system comprises of staff who are experienced emergency managers, made available by their respective governments/organizations. They could be doctors, public health specialists, foreign ministry people or architects, having experience as emergency managers. They are therefore not akin to a standing army and are hired for UN employment at a princely sum of one dollar a year. There are standard deployment procedures for their employment that ensures standardization. Each country has a mobilizing centre which is manned 24 x 7 and has a FAX machine.

(b) **Mobilization.** On occurrence of a disaster warranting international assistance, an alert message is sent to the **National Mobilizing Centre (NMC)** of member countries which specifies the nature of disaster, the likely duration of the mission and any special requirements (like proficiency in a language), etc. The NMC sends the message to half a dozen UNDAC members in their country and these members communicate their availability directly to the UN. Based upon their availability, **the UN selects a team based on the skills required**. Air tickets are dispatched to the **Marshalling Airfields**. The teams members collect at designated air fields like Singapore, Frankfurt, Panama and then the team proceeds to the disaster site. **Such is the promptness of the system that the general initial response time available to UNDAC members is about 20 minutes only, particularly in Europe.**

[10] Excerpts From *Humanitarian Military Coordination Structure In The UN B*y Ms Ingrid Nordstrom-Ho, Chief Civil-Military Coordination Section, OCHA, Geneva. Seminar Report *International Seminar On Disaster Management, New Delhi, December 2005.*

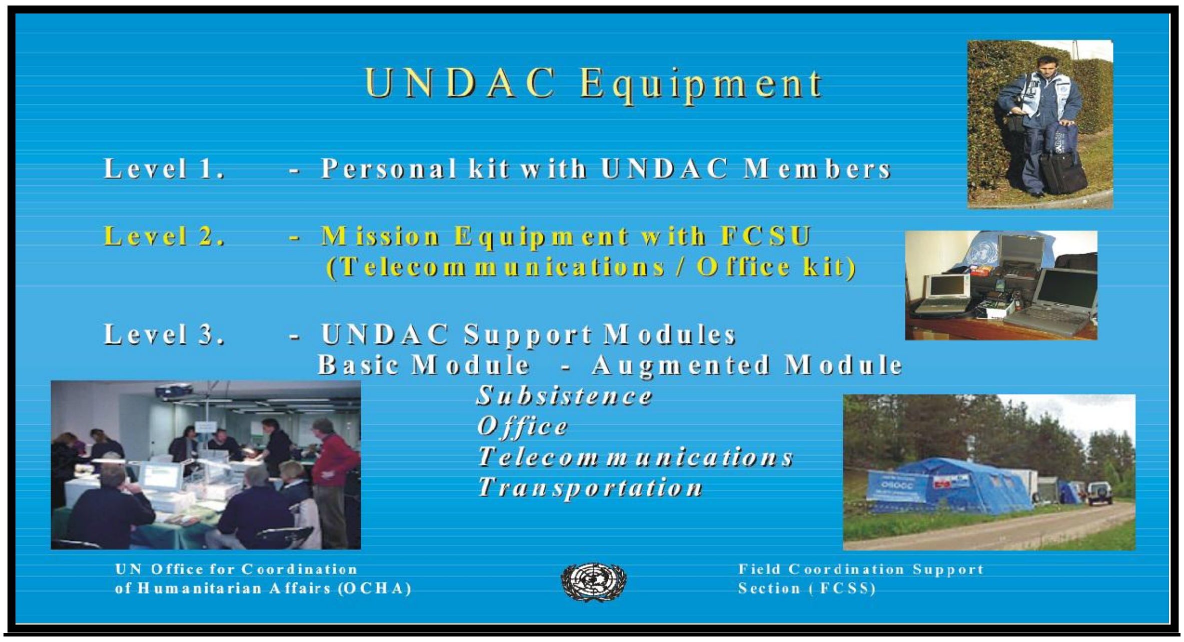
[11] Excerpts From *International Humanitarian Coordination Structures In The Field For Natural Disasters* By Mr Arjun Katoch, Chief of The Field Coordination Support Section, OCHA. Seminar Report *International Seminar On Disaster Management, New Delhi, December 2005.*





(c) **Equipment.** This is divided in to three levels. **Level-1** comprises a personal kit (sleeping mats, sleeping bags, water proof gear, etc) and is issued to the members to be kept handy at all times. **Level-2** equipment is in two roller bags and hand luggage bags, kept in packed condition at all times. Each set contains 2 satellite phones, 2 computers, 2 printers, GPS stationery and other items required to run a small office for 5 to 6 people for upto three weeks. Such packs are available in Geneva, Bangkok, Fiji, Panama and Nairobi. **Level-3** equipment has **Basic, Support and Augmented Modules** which are required for a large number of teams or at places where there is little or no infrastructure (like East Timor, Afghanistan, etc).

(d) There is much to learn from the UNDAC system and I feel borrowing from it can prove to be particularly useful for most militaries to sharpen and invigorate their individual DM response.



14. **LEARNING POINT 3 : INSARAG.** To respond specifically to structural collapses, irrespective of their causes, the International Search and Rescue Advisory Group (INSARAG) was formed. It has a **Steering Committee** located in Switzerland with UN-OCHA, Geneva as their Secretariat. Its organizational structure and three regional coordination groupings are shown in the two diagrams below : --

(a) **Operational Aspects**. **Operating Guidelines** have been evolved and are now accepted internationally. The **Urban Search And Rescue Teams** are classified as **Light, Medium And Heavy** based upon their operational capability. Internationally, the requirement is for medium and heavy teams. The guidelines include a system for marking and identifying buildings. These have been translated into numerous languages.

(b) **An INSARAG Team** comprises 40 to 60 people with 30 to 40 tons of equipment i.e. an aircraft load of a C-5A Galaxy size transport aircraft. The induction process would entail the move of this component (along with stores, dogs and medicines), negotiating Customs and Immigration and then integrating the team(s) with the local National Disaster response.

15. **LEARNING POINT 4 : OSOCC.** This organization was raised to achieve the following objectives :--

- To provide an interface for national authorities to coordinate international assistance on site (urban SAR teams).

- To facilitate information exchange between international and national relief actors (update lists, prepare reports and arrange meetings).

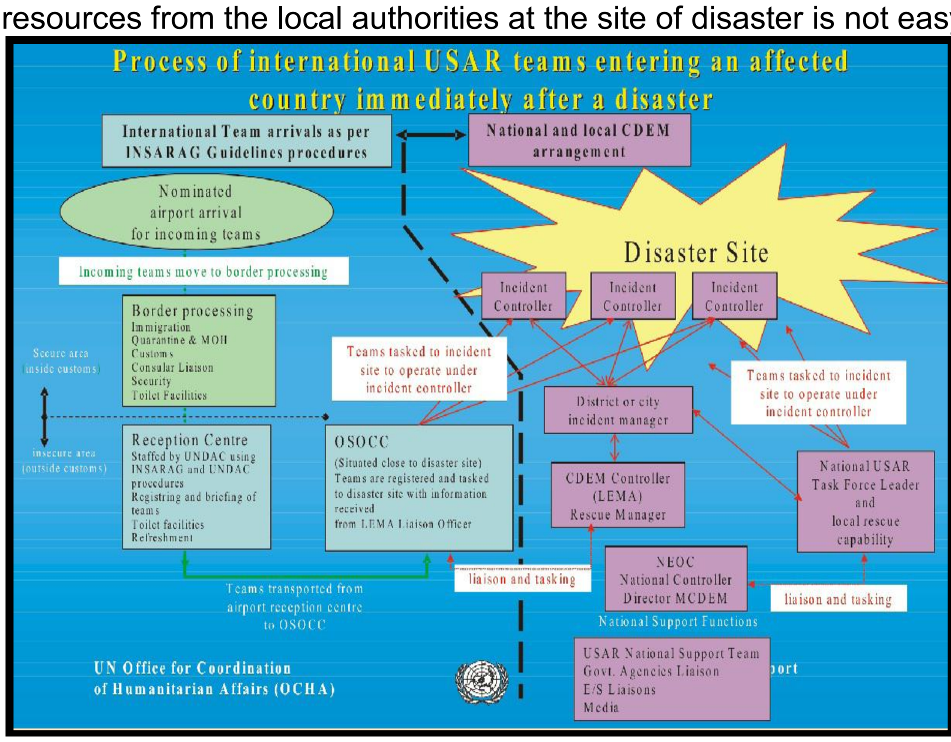
- To provide a platform for operations planning of international relief on site.

- To establish **Sub–OSOCCs** and **Reception and Departure Centres** for International USAR teams, when needed.

- To facilitate logistics support in cooperation with national authorities.

(a) **Activation.** Once an alert is sounded, along with the deployment of the teams, the 'virtual on-site' **Operations Coordination Centre (Virtual OSOCC)** is activated. This is a password protected web with about 2500 emergency managers across the world having access to it. This site is programmed to send out an alert whenever an earthquake of magnitude above 6 occurs. The virtual OSOCC has a separate topic for each emergency. Each emergency manager can access the site and type-in his actions. This ensures that the latest details are made available without making telephone calls.

(b) **Induction**. It is desirable that the UNDAC team reaches the disaster site before or at least with the first Urban Search And Rescue (USAR) team. This is often, not easy, as the USAR teams move in a dedicated aircraft while the UNDAC team uses the civil flights. Recently, **Switzerland has made available a dedicated aircraft to be used within a radius of 10,000 Kms**. This was used for the first time during the earthquake in Pakistan. It entails a lot of coordination at the airport to ensure the smooth induction of the teams. For their movement, 20 to 25 vehicles or 3 to 4 helicopter-lifts would be required. To muster such resources from the local authorities at the site of disaster is not easy.



(c) **Field Coordination.** This is done through INSARAG for OSOCC since OSOCC is not a Command Centre but a coordination platform and plays an important part in coordination which is done, largely, by mutual consensus. The following activities take place at OSOCC :--

- General and Sectoral Coordination meetings.
- Coordination of Needs Assessments.
- USAR Coordination.
- Information display, maps, telecommunication facilities.
- Coordination with National Government.
- Briefing of newly arrived entities.
- Press information and briefing.

(d) The manner in which OSOCC functions is not very different from that of most militaries, once mobilized for operational tasks. The important difference here is that an extremely high level of coordination is readily achievable in a short span of time by virtue of the streamlined procedures and efficient response mechanisms. It is my conviction that most of us can incorporate many good points of OSOCC in to our respective military DM response mechanisms so as to make them more efficient.

PART – 4 : IMPORTANT LEARNING POINTS FOR ALL ARMED FORCES

16. The main points are as follows : --

(a) Our DM structures must be 'flat', not 'pyramidal'. They must be conceived as 'knowledge organizations' and not as 'fiefdoms'. Within these, we need to create 'Lessons Learnt / Not-Learnt Cells' at State as well as Central Govt levels. Bigger organizations involved in DM, such as the Armed Forces, must also set up their own cells. These will be repositories of DM knowledge and experiences gained over the years, easily accessible by all. The aim here will be to formally build on lessons from previous DM experiences and to use this knowledge to create new approaches as also to improve existing plans.

(b) We need to identify and formalize measures to shape the environment (akin to what is known in military parlance as 'shaping the battle-field') in the pre-incident stage of disasters so as to make our response pro-active, better anticipated and prevention oriented, rather than reactive.

(c) We need to specify whether or not the aspect of 'law enforcement' in included in the list of duties assigned to military forces in a DM situation.

(d) We need to specify the communication equipments to be used by all agencies in DM tasks so as to ensure inter-operability, seamlessness in data and voice exchange and better coordination.

(e) Who will be the one single person overall in charge to whom all agencies, including Armed Forces, will report in a DM operation ? We need to specify this. Perhaps the State Governor may be most apt to fulfill this role.

(f) There is a need to clarify and list out the military's roles in DM situations under three distinct heads : Primary, Secondary and Specialist.

(g) For international DM missions, there is a singular lack of clarity in our mechanism on some of the important issues like staging support, status of forces agreements, over-flight and landing clearances, simplified entry for relief personnel, etc. These need to be clearly spelt out. Moreover, there is a need for a multi-national approach for joint planning between the SAARC & ASEAN Groups and for creation of a multi-national force in the Asia-Pacific Region, one of the most disaster prone regions of the world.

(h) Legal provisions and safeguards need to be built-in to our DM response in a formally codified manner and not left open to varying interpretations.

(j) Equipping our military units with state-of- the-art DM gadgets, technologies and equipment is an essential requirement.

(k) Creating / reorganizing / trnasforming military units as ‘professionally specialized (as opposed to ‘generalized’) DM units is an essential requirement.

(l) Identification and protection of eminent persons who form an important component of the national / regional knowledge resource base, needs to be included as a specific task for our govt DM agencies. This is applicable to the Military too.

(m) DM exercises need to be incorporated in to armed forces training.

(n) When armed forces units are called to assist the civil administration in DM, there is a need to specify the tasks assigned to them in a formal, written order. These tasks must take in to account the capabilities and core-competencies of the military. The military units must therefore confine themselves to execution of the assigned tasks only.

(o) The armed forces must be provided the wherewithal for DM duties by the local / state govt. This includes technical support and preferential use of all available govt as well as non-govt services.

(p) The entire mechanism, method and modality of participating in international DM efforts needs to be put in place. This includes a carefully composed and optimally equipped “Quick Response DM Force”, possessing all the required infrastructure, ready to be deployed anywhere on the globe within 2 to 5 days ; the Advance Party getting airborne within 24 – 48 hours of the green signal. This force must be self-contained for at least 3 weeks, like the Japanese GDRF and the UNDAC Teams.

(q) Inter-govt protocols, agreements and procedures facilitating speedy deployment of multi-national disaster response forces, without any encumbrances, need to be worked out. We need to link our embassies worldwide in the DM apparatus to bring in much needed synergy between foreign policy and international disaster relief. It is vitally important to incorporate our embassies / high commissions in to this strategic DM mechanism since, in all probability, it will be the Ambassador / High Commissioner who will ultimately be vested with the overall authority to execute the international relief effort.

(r) Inter-ministry coordination between various govt ministries and departments needs a re-look. Within this, the charter of the Ministry of Defence needs to be clearly spelt out. A ‘mother document for international DM’ needs to be prepared that governs the actions of all concerned and demarcates responsibilities of each ministry / govt department. A very high degree of coordination is called for to ensure that, globally, the DM response is faster, better and more efficient than that of most individual countries.

(s) Setting up a Global Disaster Information Exchange will forge greater trans-national synergy and improve international disaster response as well as coordination.

Conclusion

17. One aspect that comes out quite clearly from my presentation is the richness of knowledge, expertise and experience in the field of disaster management available across the world as well as with the United Nations. To derive maximum benefit from this knowledge, we need to delve deep in to this global repository of wisdom and probe for solutions, answers and clarifications. We need to cull out the strengths of other systems so that we too can build on them to strengthen our own disaster response mechanisms, be they military or civil. Finally, we need to build bridges of friendship with other militaries, promote mutual interactions and frequent exchanges. Doing so will contribute significantly in enhancing our individual capabilities to combat disasters. I hope I have been able to draw out some vital and insightful lessons for our policy makers to incorporate in to their future plans, policies, structures and procedures so as to substantially enhance our collective effectiveness in Disaster Management.

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DISASTER INC.
WHY CORPORATIONS SUFFER IN CRISES

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Abstract
To paraphrase an old expression, „*The best laid plans often go astray*‟. This is true for organizations with no developed business continuity and/or disaster recovery program. It can also be true for organizations with well established programs. The culture of the corporation will dictate how effective a program will be developed and what the plans will contain and it will also provide an insight as to why a corporation will suffer without or with a program in place. Why?

It‟s because the driving force of a continuity or disaster program isn‟t just the documented plans but the philosophical and cultural workings of those within the organization. The suffering of a corporations starts well before a disaster or crisis strikes; it starts in the boardrooms, meeting rooms and training rooms of the corporation. A disaster will only accentuate and punctuate the troubles that lie beneath the surface, ensuring the corporation will suffer when a disaster strikes. That culture, aligned with a continuity or disaster program that fails to meet the needs of the organization, ensures that even with the best intentions a corporation can still suffer as a result.
This paper/presentation will identify some of the internal workings and corporate mindsets that will lead to the corporation‟s inability to respond effectively to a disaster or crisis even with contingency plans in place.

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Introduction
To paraphrase an old expression, „*The best laid plans often go astray*‟. This is true for organizations with no developed Business Continuity Management (BCM) and/or Disaster Recovery (DR) program but it‟s also be true of organizations with well-established programs. The culture of the corporation will dictate how effective a program will be and what the plans will contain. The level of maturity and the content of the program will also provide an insight as to why a corporation might suffer when a crisis or disaster strikes, even though there is a BCM/DR program in place. If no program exists, it‟s almost a given that the corporation is going to suffer during a disaster. How? Why?

It is because the driving force of a continuity or disaster program isn‟t just the documented plans but the philosophical and cultural workings of those within the organization and those who build the plans on the cultural foundations and guidance. The suffering of a corporation starts well before a disaster or crisis strikes; it starts in the boardrooms, meeting rooms and training rooms of the corporation. A disaster will only accentuate and punctuate the troubles that lie beneath the surface, ensuring that the corporation will suffer when a disaster strikes. Glossy binders full of wordy pages and colourful charts only go so far; the substance must be there.

This culture, aligned with a continuity or disaster program that fails to meet the needs of the entire organization, ensures that even with the best intentions of corporation to respond to a disaster, it will suffer as a result. This paper will identify the kinds of corporate mindsets and the internal workings that will lead to the corporation‟s inability to respond effectively to a disaster or crisis even with contingency plans in place.

Project, Program and Portfolio Management

A disaster can happen at any time and planning and preparing for an eventuality must be continuous. It may be a lot of work at the outset to develop plans but with on-going maintenance, it can ensure the corporation is always prepared. The exception is that many corporations don‟t see Emergency Response Management (ERM), Business Continuity Management (BCM) or Technology Recovery Planning (TRP) as a program but rather as separate projects.

A project, as defined by the Project Management Institute (PMI), has a specific start and end date and delivers a unique product or service. A program however, contains many like-minded projects that are specific to a larger goal – or deliverable. These programs such as all that is combined to construct a Technology Recovery/Disaster Plan, Emergency Response Program together can be consolidated to create an overall portfolio, which would make up the “Disaster Portfolio” or part of the “Risk Management” portfolio. The Risk portfolios can contain programs such as Emergency Response, Business Continuity and Technology Programs and in turn, these programs contain such projects as a Business Impact Analysis (BIA), Fire Wardens and Contingency Strategy developments – and maintenance.

At the outset of the ERM/DR/BCM project, there are many individuals involved with the aim of establishing the required program components noted above. When the project is completed, the misconception is the corporation is ready for a disaster and to some extent it is. The plans – or components – have been developed so no further work is required. The issue comes when the project is over. What is often forgotten and will add suffering to the company when a crisis strikes, is that there is no on-going maintenance or review of these plans.

Over the years, people will change roles and move on to other corporations. Job descriptions, will be refined and redefined over and over again through organizational change and other initiatives - even by other projects. New policies, processes and procedures will be introduced or even discontinued. The plans that were developed earlier will all need to reflect these changes as they happen or at least on an annual basis, so that the plans continually reflect the organization as it is, not as it once was.

This will cause suffering for the organization. All the plans it has in place are just project deliverables, not actual living documents that reflect the corporation as it exists. The project to develop the plans is long dead and gone but the organization they are to represent is still a living entity, growing and prospering – and changing. If the plans and processes put in place don‟t reflect these continuous organizational changes then they won‟t be of any benefit for those who need them when a disaster strikes. Program Management and maintenance of the plans must continue even when special projects within the program – developing department contingency plans for example – are long completed. It is like building a facility; laying the foundation might be the easy part, the maintenance of the entire facility if what will keep it a workable place of operation.

IT Owns and Knows It All

One of the biggest problems with programs related to Disaster Planning (DR), Crisis Management and even Emergency Response, is that many believe Technology (IT) own all the aspects under the false impression that everything falls under the term disaster planning. Since the term refers to disasters, and many think of technology recovery first, that all other aspects related to disasters must then fall within the IT realm. Technology is but only one component of a BCM program.

A disaster, at least one that seriously affects a facility, will surely include implementing evacuation procedures but because it is equated with a disaster, IT is expected – or thought to – own the processes associated with it. In many organizations, evacuations and Emergency Response procedures fall under Health & Safety Committees, Facilities Management or even Human Resource groups - rarely IT.

Imagine the confusion that abounds when IT doesn‟t – or can‟t – take leadership in evacuation procedures. They must follow the same processes as the rest of the organization. There may be IT representation with Fire Wardens but that doesn‟t mean that IT owns this process (evacuation procedures). Technology looks after its name sake – technology.

One of the other misunderstandings is that if IT owns all of the disaster or business continuity program, then it automatically understands what the business units require when disaster strikes; meaning it knows what needs to be recovered when, how and in what order. In some mature programs this may be true but that only comes with long investigative discussions and planning sessions. More often than not, this isn‟t the case. A corporation will get into trouble when it believes that the systems will come up in the right order and that everything will be available for business units and their clients when they expect.

Business Units and Senior Management need to decide what the priority is for each system, process and service; IT will ensure the right restoration and recovery strategies are in place to meet the need. IT doesn‟t decide the priority order for restoration and recovery for business processes, it matches the IT restoration and recovery to the business need. The decision of what order of criticality comes from the corporations leadership and through discussions with the business units.

If this isn‟t clearly addressed and dealt with, the restoration and recovery of technology systems may occur and become available for users and clients but it won‟t come up in the order expected to support the core services required. This will cause more issues and concerns for an organization because even though it is recovering services, they won‟t be recovered or available in the order expected. Not being able to service clients and customers when expected, is going to cause serious issues and problems for an organization when trying to respond to a major disaster or business interruption.

Fear

No one likes to discuss disasters, crises, emergencies, catastrophe‟s or the potential of casualties when a disaster strikes, at least not those sitting in an executive boardroom. It‟s not surprising that sometimes executives don‟t want to talk about BCM and approach a subject that can (and sometimes does) assume people have died in an organization as a result of a disaster. It‟s tough enough to deal with these kinds of things in peoples personal every-day lives, let alone having to go to the office and discuss it and build plans for it. In a way, it‟s a morbid subject. That fear of death or discussing the potential of disaster is apparent when many executives side-step the issue or continually try to distance themselves from responsibility or take responsibility for their roles during a disaster; as part of the disaster team. Executives are responsible to ensure the safety and livelihoods of their employees, as well as the financial stability of the organization itself, when a disaster strikes. Holding discussions about disasters ultimately isn‟t an option for executives.

Fear, from all levels of the organization can cause the wrong decisions to be made and can cause paralysis in getting the appropriate disaster response processes activated. This delay will show to the public that the corporation doesn‟t know what it‟s doing – or has no idea *what* to do – and thus, is going to have a second disaster on its hand by way of a public relations nightmare. Fear – of doing nothing or the wrong thing - can cause the corporation to suffer during a crisis. It must proactively address the questions posed by what a disaster could do to the organization.

No Ownership for BCM / ERM / DR

When a crisis or disaster has the potential to occur, many people wonder who‟s in control and who should be the leader of the program so that the right processes and procedures will be initiated to stave off any detrimental impacts. The problem is, either everyone steps up and says they are in control or no one steps up. What causes problems for corporations is that there is no clear champion or leaders who owns the end-to-end Emergency Response, Business Continuity or Disaster Recovery program.

When there is no clear owner, a clear champion and supporter, it translates down to the management and employee levels where they do not need to take the programs seriously. With such groups as Human Resources and Finance, there are clear owners responsible to make sure the activities within these areas are addressed and executed as required. With ERM/BCM/DR, if there is no clear champion in management, employees won‟t focus on the activities required to help build the program; their focus will slip to more pressing concerns and won‟t become a top priority. These programs must be part of the organizational mind-set; a part of the overall strategy. After all, if something does occur by way of a disaster, the entire organization‟s future is dependent upon having the right program in place; having the approved and supplied resources, both physical and financial.

For many, if it isn‟t mandated or have it as part of their operational plan, why would they direct resources and attention towards BCM/DR/ERM? The adage "what‟s in it for me?" comes to mind in some cases. If there‟s no foreseeable or understood value that BCM offers, then what incentive is there for people to pay attention.

No ownership means no real proper program. It has no real champion. Emergency Response isn‟t an IT issue. IT, or Technology Recovery, isn‟t a Business issue. Business issues aren‟t Emergency Response issues. They can all inter-twine but they are distinct issues and areas of concern that need to be addressed. And so it goes around in a loop, so it finds no home and thus no real champion for it all. When it does, different groups don‟t like being told by others what they need to do. For example, during the H1N1 Pandemic Planning initiatives, it was lead for the most part, by many Human Resource departments. They were telling IT teams what they should have for Technology Recovery. In most cases, thanks to the Technology Recovery Plan already in place, it was repetitive work; work that had already been done. A pandemic could potentially be another trigger to activate a Technology Recovery Plan – depending on the situation.

If a role doesn‟t make it onto someone‟s operational plan, then they aren‟t going to focus on it. ERM/BCM/DR needs to be on an executive‟s performance review before it will make a key focus onto others. If it doesn‟t hurt someone‟s bonus financially, then it won‟t get attention. Ironically, when a disaster occurs the corporation will be hit financially and the media and public will be wanting to know what the corporation is going to do about it but nothing is in place.

Training

Training is different from awareness. Awareness is having a basic knowledge of an item but training is actually developing and obtaining the skills to perform a task. Many corporations confuse the two and group them together to mean the same thing.

No one knows what to do or how to do things - Sometimes the planner / developer knows but others haven‟t been brought into the equation - The one who needs to activate or implement the plan doesn‟t know when or how or what needs doing - It‟s been talked about but not validated by testing, which is a form of training.

For example, the coordination of activities with Public Authorities. Often, there is no person to speak with them on behalf of the organization. If there is, it ends up being someone who doesn‟t fully understand the facility; the sprinklers, the full facility layout, the control panels, the HVAC systems etc. Communication with 1st responders would be more effective if that person in the role knew the systems for which 1st responders needed information.

Are there individuals that can speak to CPR or 1st Aid instances, where company Health & Safety representatives may perform these roles? What information is required for the 1st responders under these circumstances or is it left to the responders to figure it out for themselves?

The public and most definitely the media will believe that the CEO or President will know all the answers but it is impossible to know everything. Others must have these roles assigned to them and they must understand – and practice – these roles so that the CEO can at least be able to speak to any issues.

Is the CEO most knowledgeable person in the corporation? As knowledgeable as they may be, they won‟t know every aspect of the corporation and they won‟t know everything about assisting those in need; 1st aid, CPR etc. However, they can step in as being the person in control and help coordinate activities and make critical decisions.

A final example is training pertaining to fire wardens, or those who help evacuation a facility. Over time, these individuals change as well and there may not be enough people associated with the roles anymore. Not only that, but often people that volunteer for these roles get a red hat and a clipboard (or some other identifier) but don‟t get the chance to validate their roles; they don‟t get training or receive the opportunity to practice what is required.

When a crisis or disaster occurs, you have people assigned to do specific roles but they don‟t know how to perform them. If they have the opportunity to learn and make their role stronger, they make them their own and they take ownership. Not practicing and learning the role is a problem waiting to happen.

Communications

Communication is a fundamental aspect that identifies good corporations from bad ones especially during crises and disasters; how they communicate to employees, vendors and the surrounding community. When a disaster strikes – and inevitably, a disaster will strike – communication will be a cornerstone in ensuring the right message gets out to the right people and that they are understood.

Having the opportunity to pre-validate „disaster‟ communications will help aid a corporation through disastrous times. Communications are utilized in every aspect of restoration, recovery and response. Finding potential „gaps‟ or „errors‟ in assumptions and communication messages will help ensure additional issues aren‟t encountered above what the corporation is already trying to address. To help with this, a corporation should utilize the RACE communication methodology.

RACE is an acronym that stand for *R*esearch, *A*ction Plan, *C*ommunicate and *E*valuate.

For **R**esearch, a corporations must collect the facts – not conjecture or rumour – but the facts of the crisis or disaster. If the full facts aren`t know, then those involved wi the communication should be asking questions of all those involved and where necessary, probe for facts so that the conjecture, speculation and rumour can be separated from the truth of the matter; the facts.

An **A**ction Plan must then be developed that spells out the organizations priorities, timelines, their key messages and what actions are going to be taken. In many instances, the framework for this can be prepared as part of the `disaster` or `continuity` program, with details plugged in when its required during a disaster.

This action plan isn`t just used to communicate externally to clients, customers, suppliers the public and the media. It`s also used to help stimulate and manage communications amongst `disaster` or `crisis` teams, so that internal response activities are managed appropriately and effectively.

What will cause issues for corporations is if these messages aren`t communicated in a way that helps keep the communications flowing and match to what is actually occurring during the situation. This can be done pre-disaster by testing the messages. Like all BCM components, an organizations should develop some message templates and test them out during tests and exercises. The more refined and better prepared the messages are, the easier it is for an organization to provide timely and concise messages to employees, media and other external sources. Based on the results of some of the communication messages tested, stronger and more defined message templates can be developed.

Once Research and Action Plans are developed, the next is to actually **C**ommunicate the plans and communicate all the facts that make up the developed plans and strategies. This means, it`s time to implement the communication plan. This includes all the various components needed to effectively manage communications; external partners such as the media, the public, shareholders, suppliers and clients as well as the internal components such as employees, management and the disaster or crisis team members. This might also include such items as any internal phone lines – or employee information lines, and external facing web sites, which can be utilized to communicate instructions and status.

There are challenges with implementing the communications strategy though. From too many messages to mixed messages will send the corporation down a difficult path because the public, the media and employees won`t be able to follow what is actually occurring.

Providing too many messages can cause problems. Before the content of one message has been received and comprehended, there is already a second message being disseminated. This makes it hard for those receiving the message to keep up with the status, especially if one is missed because people are already acting on the first message.

Mixed messages will do the same thing. This occurs when a message is placed on a phone line stating that a specific action is required of employees or that family members should call an identified number but when a company executive or spokesperson is in front of the media, they are asking that employees and family call different numbers. It also occurs when the actions of the corporation aren‟t matching what is being stated. For example, it could be communicated that an Employee Assistance Program

(EAP) has been activated but the EAP provider states they haven‟t been contacted. Communications are key in a crisis or disaster, as they can mean the difference between life and death of individuals – especially if communications isn‟t dealt with correctly. It can cause more suffering.

Finally, there is the last component of the RACE methodology; **E**valuate. Not evaluating the communication strategy can mean big problems for corporations. Taking into account the first three components, continuous evaluation must be performed if communications are kept current, relevant and timely.

How can a corporation evaluate its communication strategy?

One of the key method is to document and log all communications, so that key messages are repeated but those communications that aren`t clear or understood can be refined and updated with new information so that they can be understood by the intended audience. What is working and being understood can be used again and again, while those strategies that aren`t working can be stopped and clarified where necessary. If the public or media perception is not in the corporations favour – and it won`t be, if communications aren`t in line with actions – then the evaluation stage will help identify areas that need addressing.

Bad communications can mean either a positive outcome or a negative outcome from any crisis or disaster, regardless of the other responses put in place or the plans developed to address situation; they mean nothing if communications aren`t effective. What works well can then be utilized again and incorporated into plans, as lessons learned.

An evaluation of the of messages can also be done when a company is mindful of another company that is experiencing a disaster. When a competing corporation has a

disaster, a corporation can watch and learn on what and how the affected company deals with the situation. A corporation can take the best components – those that are working for the corporations experiencing a disaster – and ensuring that these actions are input to their own plans. This helps strengthen their own plans. It helps reduce the amount of time it will take to develop the appropriate strategy because they will already have something on which to build.

Learning from others is a tool that can be utilized by any corporation and those that do will help strengthen their communication strategies – and continuity and disaster plans. A corporation won`t suffer as much as it could because it is actively allowing its program to mature and learn from the experiences of others, not just from its own.

Roles & Responsibility

For all areas of the corporation, people must understand their roles and responsibilities; if they didn‟t, the corporation would spend more time trying to fix issues that actually progressing and delivering products and services. This is also true during crises and disasters; people must understand their roles and the part(s) they play.

One of the ways in which problems and issues will be encountered revolves around the disaster teams themselves; how they are established. Team are created and people are assigned to them, which is a positive aspect, however, people get placed into roles they don‟t normally perform. Their job descriptions or areas of responsibility suddenly morph into something they aren‟t familiar with. If disaster teams are developed, the people in the roles should be those that are already performing the roles on a regular basis. There is no point in placing a Human Resources person into a communications role, when there is already a group who specialize in the role of communications during normal – non-disaster – time periods. To make these sudden changes makes no sense and will cause confusion for employees, the media and by the community impacted by the disaster.

For example, Fire Wardens and Emergency Responders receive training on specific tasks and activities to ensure the safety of individuals. They communicate amongst each other and with First Responders but often, managers will step in and try to take control but have no training or skills sets to operate in such areas. This will only compound issues and potentially place lives in danger.

There is also the assumption that people automatically know what their role(s) and responsibility is; not just during normal operations but during a disaster. Every individual has a role to play in a disaster but each has a different role to play. A CEO has a different role to play that someone who manages the mailroom or an individual that is part time and only enters the office twice a week. Each has specific parts to play, which are determined by what they do and what they are responsible for. Too often, it is assumed that people clearly know what is expected of them. Without proper training and awareness, employees and management can‟t be clear on their responsibilities during times of disaster. It must be communicated and clearly established, otherwise people may be performing activities that aren‟t required while key tasks are being ignored. No one should be able to feign ignorance or deny responsibility when the office around them is crumbling.

When it comes to roles and responsibilities, the BCM/ERM/DR professional sometimes neglects to approach the senior management or for political reasons, are kept from approaching the senior levels of the organization. These are the individuals that are responsible for the organization and yet aren‟t included – for whatever reason – into the planning or development of the BCM/ERM/DR program. Often, the roles are established *for* upper management and not *by* upper management. They aren‟t included in the process development. This isn‟t to say they are able to attend every single meeting – highly improbable – but they may be able to attend the odd session and provide guidance on their expectations and what they want from the program. Issues are encountered when a senior representative is confronted by the media – and by extension, the public – but they don‟t have an understanding of what the corporation is actually doing to address the situation at hand.

This author has met a "C" level representative that did not know what was in their organizations BCM/DR program, yet they knew they were responsible for the entire

organization. They simply assumed that something was there because they‟ve never been approached by anyone giving them direction or involving them. They simply went on the word of other management representatives. What was happening was that their role was defined by others – not by themselves. This has the makings of concern if a disaster strikes.

What might occur is the BCM or DR person becomes the one in control of the disaster – in some respects this may be true. However, they don‟t suddenly take on the role of CEO but they do help coordinate the response plans they‟ve developed and validated.

Roles and responsibilities must be clearly established if the coordination of response activities you are to be executed effectively. This includes those who speak with the first responders (i.e. fire personnel, police, EMS staff…) and those that will be coordinating internal restoration and recovery activities. Without clearly defined roles, there is the chance and organization will „wander in the dark‟ trying to re-establish itself, which will only lead to suffering – for suppliers, responders, clients, customers, communities and the corporation itself. .

Media & Media Portrayal

Whether a corporation likes to admit it or not, social media sites such as Facebook, YouTube and Twitter are a part of modern-day society; there is not getting around it. Many organizations can block these sites in the workplace so that employees can‟t access them and potentially send confidential information across the internet – or inadvertently open a „door‟ for a less-than-scrupulous person from accessing company files. However, corporations cannot stop employees from using these sites on their personal phones and other portable devices. What they can do is educate employees on how to use these wisely during a disaster.

During disasters, in fact immediately upon the inception of a disaster, social networking sites are being utilized by employees, management and communities wanting to know more about the situation. During the Virginia Tech shootings, a complete list of casualties was established in roughly a half hour; conventional methods would have extended that timeframe significantly.

When these sites are being accessed, employees need to understand what information shouldn‟t be shared with others – even if they are close friends receiving their messages. It is one thing to confirm with family and friends that you are safe and that there is a situation at the workplace but it is another to spread rumours or simple conjecture about the situation. These rumours will be sent around the internet and people may unnecessarily be alerting parents, friends, spouses, children and the media that there are casualties or other harm inducing scenarios when in fact, there are none. This can cause fear and panic amongst a community membership over things that are rumours and not based on fact.

Organizations must educate their staff on how to use social media sites for the benefit of the situation and ensure the right messages are sent out. Like the Virginia Tech experience, positive aspects can be achieved using the sites; it just takes some education on the part of the corporation.

Finger Pointing

Even when everyday people experience a situation, they tend to want to blame another for the reason why it occurred. It is always someone else`s fault and in today`s world, people don‟t like to take responsibility for the things that have gone wrong. Corporations can – and do – the same thing. BP oil at first blamed the Gulf of Mexico oil disaster on the company that owned the oil rig and the oil rig owners blamed BP for not following proper safety concerns. The finger of blame was pointing furiously at anyone other than themselves. When finger pointing occurs it caused friction between what once were long-time friends and partners. When corporations begin this, the media and public immediately believe there is something wrong and that something is being hidden by the corporation in crisis.

Many believe that if the finger is pointed in another direction, the public and media – and anyone else paying attention – will follow the direction in which it is pointed. However, that isn`t the case. Focus tends to increase on the corporation, as it did with BP oil. This didn‟t occur with Maple Leaf Foods in Canada, where 21 people died of tainted meat products. The company took responsibility for the disaster and took some solid action plans to deal with it. It did not lay blame on anyone. In fact, others that came into the fray – the Government of Canada – were criticized for not having good enough inspection procedures, something Maple Leaf Foods never discussed or introduced to the media‟s attention. The media when they found out didn‟t go after the company, it criticized the government. Admitting responsibility and not using the finger of blame helped keep a positive view by the public and media. In fact, they were credited with performing well and not once did Maple Leaf Foods ever take away the responsibility of their actions and didn‟t contest any court cases filed by victim‟s families.

The first thing to worry about is people – not technology. If technology is first then there will be issues because it will be shown that people are not the main concern for the organization. This doesn‟t mean that technology activities aren‟t occurring, it means the public perception and focus must be shown to be about people. If people aren‟t shown to be a major concern – the organizations primary focus – then the perception is that the organization might be trying to hide something. This causes people to go digging for information, even when information is wrong; it will cause problems for the corporation simply because they *appear* to be focusing in the wrong direction even when they might be focusing correctly.

Conclusion

A disaster doesn`t necessarily mean that a corporation must suffer in crises. A corporation can prepare for disasters but if it doesn`t prepare appropriately, what may seem small and insignificant can suddenly become large and impacting.

Corporations don`t just suffer from the disaster itself; in many instances it is already suffering because it doesn`t have the right processes and procedures or mind-set in place to address and prepare for disasters. It`s the ignorance of the awareness to prepare for a disaster that will cause corporations to deal with disasters. The suffering begins before any fire alarm or emergency situation begins. It starts from within the corporation and how it deals and thinks about disasters. It`s why corporations will suffer in crises.

A corporation can suffer in a crises before a crisis even occurs. If it doesn`t take the threat of a disaster seriously with the proper focus, ownership and responsibilities. When a disaster does occur it will suffer through the lack of planning, commitment to service, communications, lack of ownership, roles and responsibilities and discover that the finger of blame will become the main focus of the disaster – at least in the media and public eye. This is something that will instil and entirely new level of suffering.

Author Biography

Alex Fullick has been helping major Canadian organizations initiate and manage customized Business Continuity Management (BCM) programs for over 15 years. He is the Founder and Managing Director of **S***tone***R***oad*, a consultancy and training firm specializing in BCM. Alex is routinely asked to speak at global BCM conferences such as the "BCM Symposium 2009" London, UK and "Continuity Insights Conference" Phoenix, AZ.

Alex is the author of two books; *"Heads in the Sand; What Stops Corporations from Seeing Business Continuity as a Social Responsibility" and "Made Again – Volume 1; Practical Advice for Business Continuity Programs."* Both books are helpful manuals with tips and advice for hesitant companies who want to develop a BCM programs but don‟t know where to start, or have difficulty understanding why their program isn"t as effective as it could be. Alex has his Member level certification with the Business Continuity Institute; earned his Certified Business Continuity Professional status with the Disaster Recovery Institute, and holds a Certified Business Resiliency Auditor designation.

Alex resides in Guelph, Ontario and is currently hard at work on his next book and Volume 2 of the *Made Again* series. He can be reached at alex@stone-road.com .

URBAN STRATEGIES FOR RISK REDUCTION IN CENTRAL PROTECTED AREA – STUDY CASE BUCHARESTTITLE

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Keywords

Bucharest, urban planning, habitual patrimony, zoning, protected area

Abstract

Within the research conducted by The University of Architecture and Urbanism Ion Mincu – Bucharest a case study of protected central area for about 10,000 sqm of the city was created in order to identify strategies for urban planning and architecture to reduce the hazard risk that the Romanian capital is exposed to.

Regarding the protection of architectural, urban, historic and natural environment values as a whole, a maximum level of protection was recommended.

Study components:

1) Connection between the subject theory and history of architecture and urbanism and the management of risk reduction, by implementing the concept of secure habitual patrimony.

2) Investigation of the risk exposal of the architecture objects, of proximities, of the urban sector, of locality and territory (hazard mapping, exposed elements, vulnerability, and risk).

3) Zoning of the locality territory on criteria for protection to disaster, in securities areas, sizing of area according to the risk class and especially to the possible number of affected people, capable of being evacuated towards a given point, named security node, energetically independent and utilitarian, where the emergency habitation, medical and social assistance, alternate communications system is ensured; this contributes to a decrease of the intervention costs.

4) Building-up of a poly-nuclear system of space security centers, able to relocate the affected population after disasters' occurrence, named support system of emergency habitat.

5) Identification of post-disaster reconstruction opportunities generated by the system of the emergency habitat, having as support the specific components of patrimony habitat – Bucharest case study.

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The case study has shown that such operation is possible but requires political will, financial and legislative support, having a huge impact on the population likely to be affected.

Introduction

Bucharest, the capital of Romania, is mainly exposed to the hazard coming from the Vrancea earthquakes, given the soil conditions of a city located on the valley of two rivers generates local site effects. The presence of the rivers used to be in history the source of flood hazard as well. From the climate conditions in which the city is placed, other hazards could occur, such a precipitations, heavy snowfall etc. In history less earthquake resistant housing was done as this used to be fire prone, and fires destroyed the city more frequent than earthquakes. There are few houses kept in Bucharest older than the Great Fire in 1847. Today fire affects historic buildings, such as were in the recent past the Assan Mill and the City Hall in Banu Manta, as well as new buildings such as the tower near Armeneasca Church. Also not to be neglected are man-made hazards including pollution (also visual pollution), but also extended aggression of the landscape, through wild building and demolition of historic buildings in the recent years due to speculation of the highly priced inner city parcels. Thus high rise buildings are more affected by earthquakes, as their vibration period is in resonance with the soil movement from Vrancea earthquakes, and low rise buildings may be more prone to aggressions such as demolition.

The major study area was located adjacent to the major axis E-W of Bucharest , in proximity of the City Hall (Fig. 1), and area which is also adjacent to the Dambovita river which crosses the town, and which was affected by demolition in the Ceausescu Aera and building of the boulevard Unirii, which cuts the urban tissue. Following the demolition there are empty spaces in the otherwise dense central urban tissue. A number of attempts have been made to revitalize the zone, including the Bucharest 2000 competition.

Thesis

1. Research questions

- In this study the question of pre-planning of emergency architecture in a dense central zone including historic monuments was approached
- The studied zone was traumatised by earlier interventions during the dictatorship of Ceausescu and is therefore inhomogenous

2. Research objectives

How risk can be diminished through architecture and mainly urbanism strategies in this area for: buildings, building proximities, urban sector, locality, region-territory.

Risk management was seen by the fundamental principle of durable development (Fig. 2).

Sources of information

- Statistical information for number, type of hazards, exposed elements and risk
- Scientific documentation from books, scientific review of sources
- Analytical files from cadastral map for exposed elements information (structure type, population, height, function, property type)
- Direct observation on the field: photography, description (analytic files, questionnaire as in Fig. 3)
- Archives investigation (history of building, vicinity, urban area, locality, territory) – old maps, photos and literary description
- Direct evaluation of vulnerability of building exposed elements through expertise

- Indirect evaluation of vulnerability of exposed elements (building, urban area, population, economical, heritage values) through analytical research questionnaire (Fig. 3)

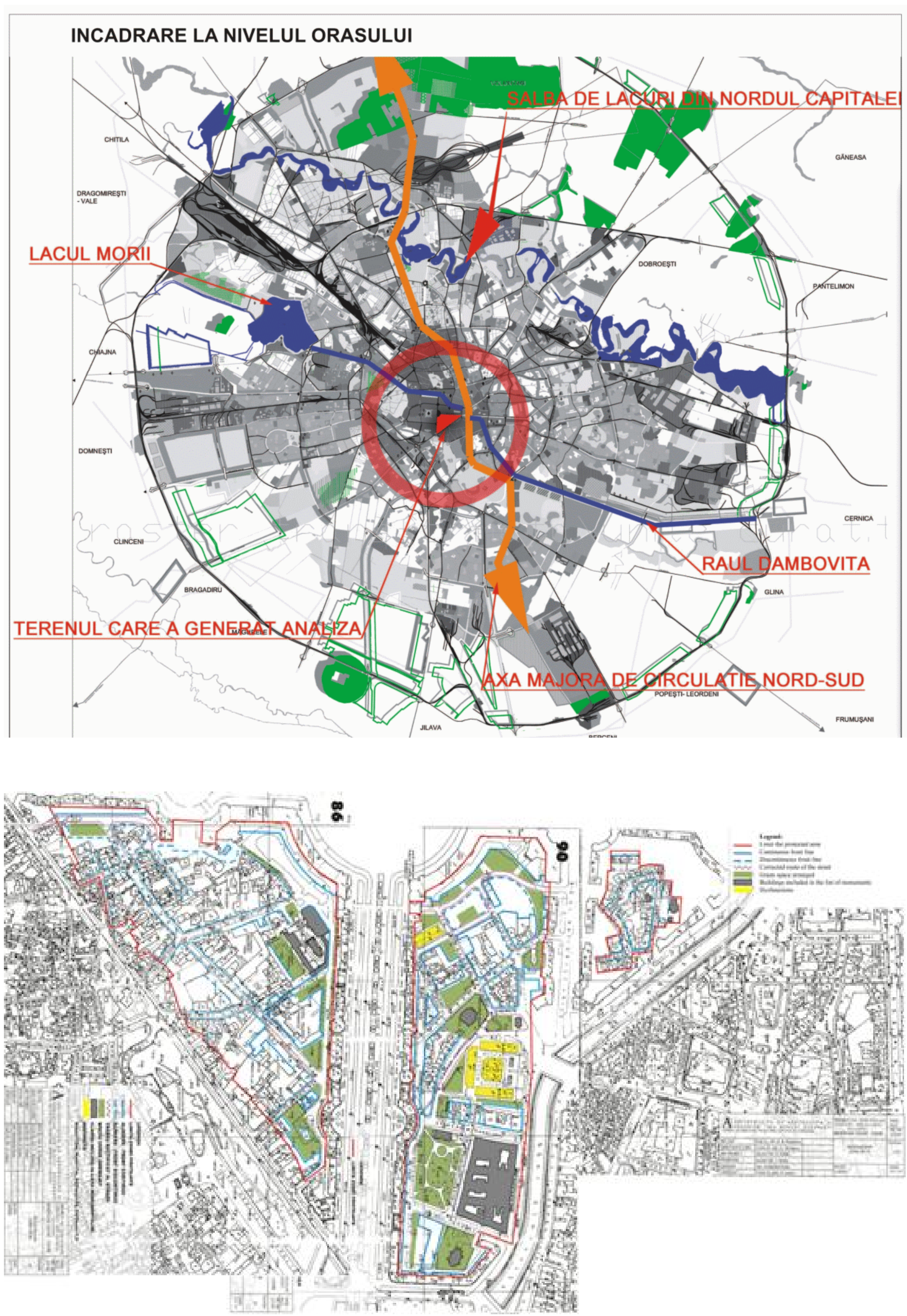


Figure 1: location of the study area in central Bucharest

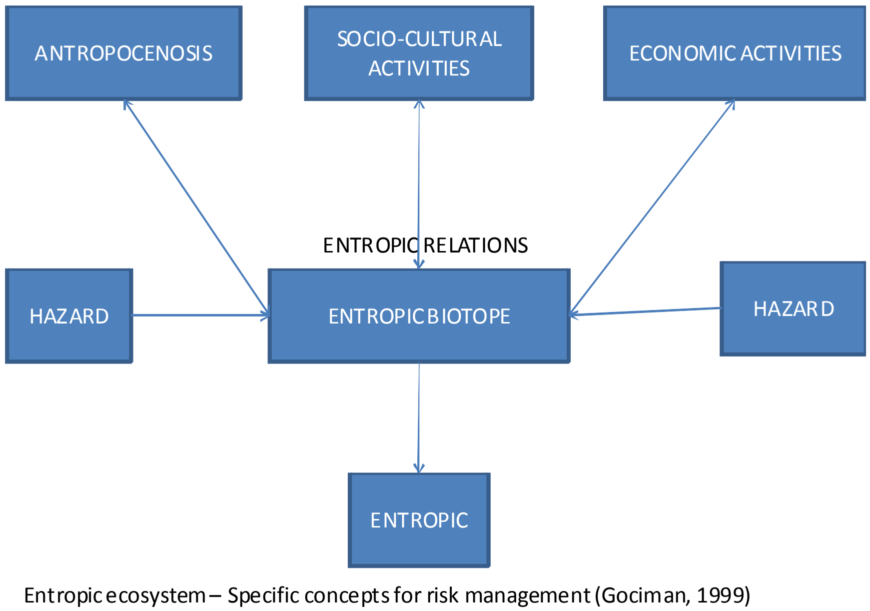
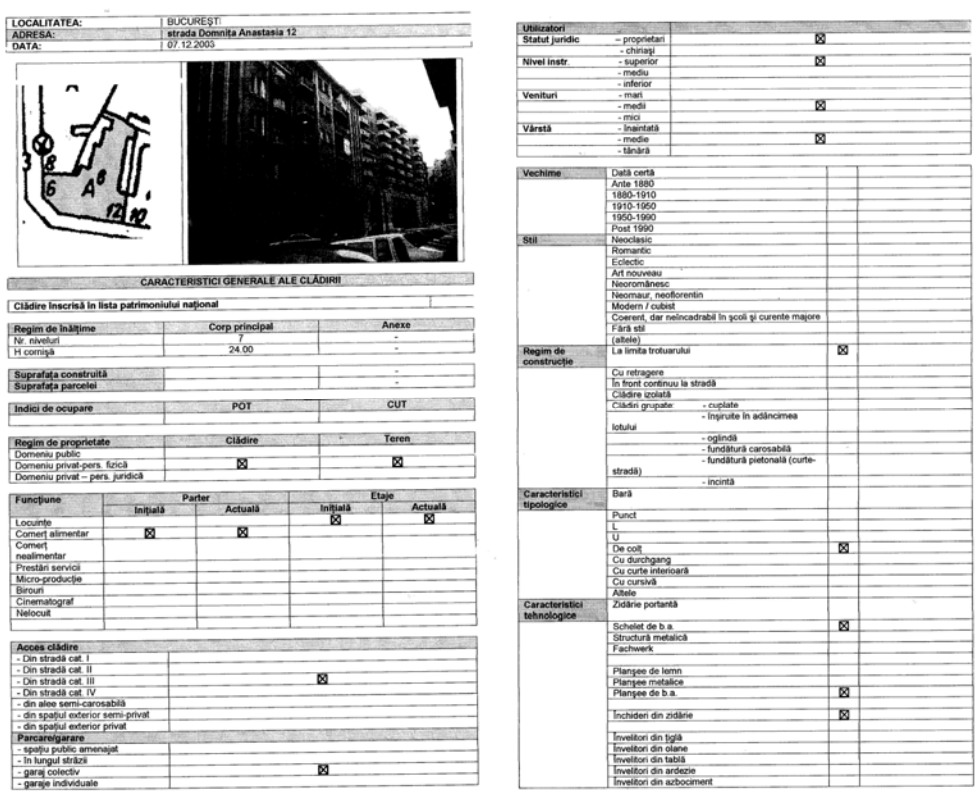


Fig. 2: Entropic ecosystem – Specific concepts for risk management



LOCALITATEA:	BUCUREŞTI
ADRESA:	strada Domnita Anastasia 12
DATA:	07.12.2003

CARACTERISTICI GENERALE ALE CLĂDIRII

Clădire înscrisă în lista patrimoniului național

Regim de înălțime	Corp principal	Anexe
Nr. niveluri	7	-
H cornişă	24.00	-

Suprafața construită		-
Suprafața parcelei		-

Indici de ocupare	POT	CUT

Regim de proprietate	Clădire	Teren
Domeniu public		
Domeniu privat-pers. fizică	☒	☒
Domeniu privat – pers. juridică		

Funcțiune	Parter		Etaje	
	Inițială	Actuală	Inițială	Actuală
Locuințe			☒	☒
Comerț alimentar	☒	☒		
Comerț nealimentar				
Prestări servicii				
Micro-producție				
Birouri				
Cinematograf				
Nelocuit				

Acces clădire	
- Din stradă cat. I	
- Din stradă cat. II	
- Din stradă cat. III	☒
- Din stradă cat. IV	
- din alee semi-carosabilă	
- din spațiul exterior semi-privat	
- din spațiul exterior privat	
Parcare/garare	
- spațiu public amenajat	
- în lungul străzii	
- garaj colectiv	☒
- garaje individuale	

Utilizatori		
Statut juridic	– proprietari	☒
	- chiriaşi	
Nivel instr.	- superior	☒
	- mediu	
	- inferior	
Venituri	- mari	
	- medii	☒
	- mici	
Vârstă	- înaintată	
	- medie	☒
	- tânără	

Vechime	Dată certă		
	Ante 1880		
	1880-1910		
	1910-1950		
	1950-1990		
	Post 1990		
Stil	Neoclasic		
	Romantic		
	Eclectic		
	Art nouveau		
	Neoromânesc		
	Neomaur, neoflorentin		
	Modern / cubist		
	Coerent, dar neîncadrabil în şcoli şi curente majore		
	Fără stil		
	(altele)		
Regim de construcție	La limita trotuarului	☒	
	Cu retragere		
	În front continuu la stradă		
	Clădire izolată		
	Clădiri grupate: - cuplate		
	- înşiruite în adâncimea lotului		
	- oglindă		
	- fundătură carosabilă		
	- fundătură pietonală (curte-stradă)		
	- incintă		
Caracteristici tipologice	Bară		
	Punct		
	L		
	U		
	De colț	☒	
	Cu durchgang		
	Cu curte interioară		
	Cu cursivă		
	Altele		
Caracteristici tehnologice	Zidărie portantă		
	Schelet de b.a.	☒	
	Structură metalică		
	Fachwerk		
	Planşee de lemn		
	Planşee metalice		
	Planşee de b.a.	☒	
	Închideri din zidărie	☒	
	Învelitori din țiglă		
	Învelitori din olane		
	Învelitori din tablă		
	Învelitori din ardezie		
	Învelitori din azbociment		

Fig. 3. Extract from the questionnaire used to gather data in the field survey

Findings

First drawn pieces were visualising the results of the analysis according to separate criteria, such as building height, structure, state, population which inhabits the buildings, which of the buildings are monuments. Some of the groups included information on the difference in building occupation to different times of day/night.

The following mapping has been performed:

- Local hazard mapping (natural hazard: geological, hidrological, meteorological or man-made hazard
- Exposed elements mapping to a specific hazard (buildings, urban system, public space, heritage value, institutional value, environmental value, occupational structure An example of such a mapping done by a work group (see acknowledgements) is shown in Fig. 4. The information mapped was obtained as described in the previous section. The specific hazard considered is earthquake.
- Vulnerability mapping of exposed elements to one specific local hazard. An example of such a mapping done by a work group (see acknowledgements) is shown in Fig. 5. The specific hazard considered is again earthquake, but also secondary events, such as, for example, fire and epidemics from earthquake. The vulnerability of buildings and population is considered, mapping differently the degree of use during the day and the night. Also measures which reduce vulnerability, such as presence of firefighting are considered. A vulnerability score is given.
- Global risk mapping to superpose local hazards (ex. fire, flood, earthquake).

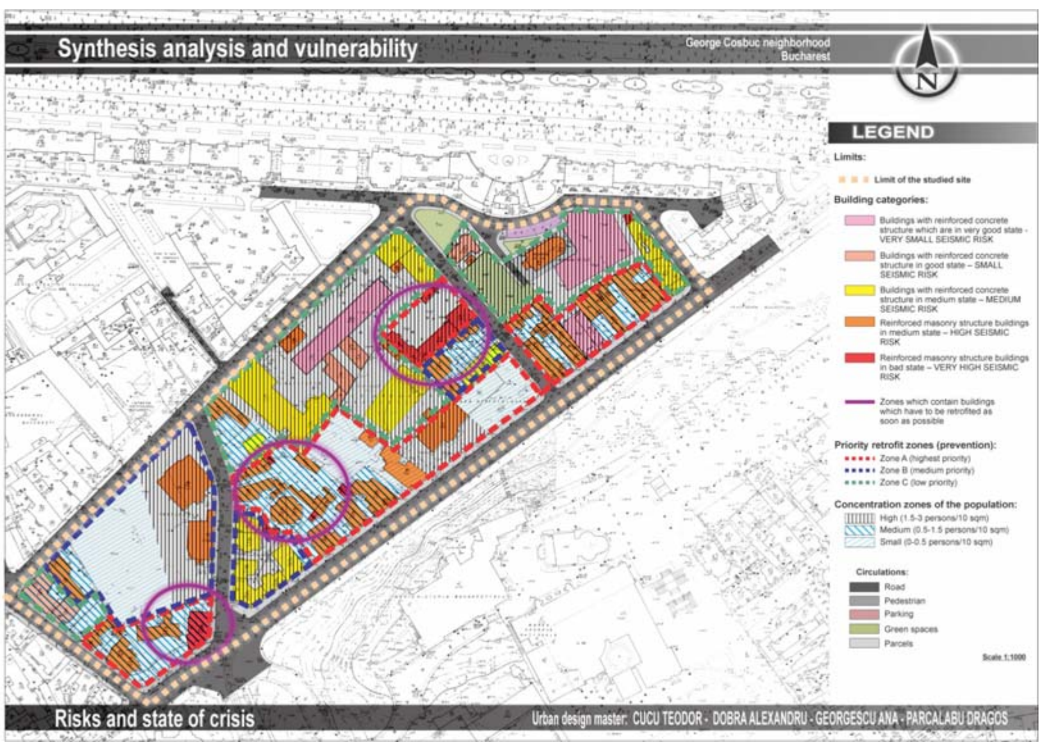


Fig. 4. Exposed elements mapping to different hazards

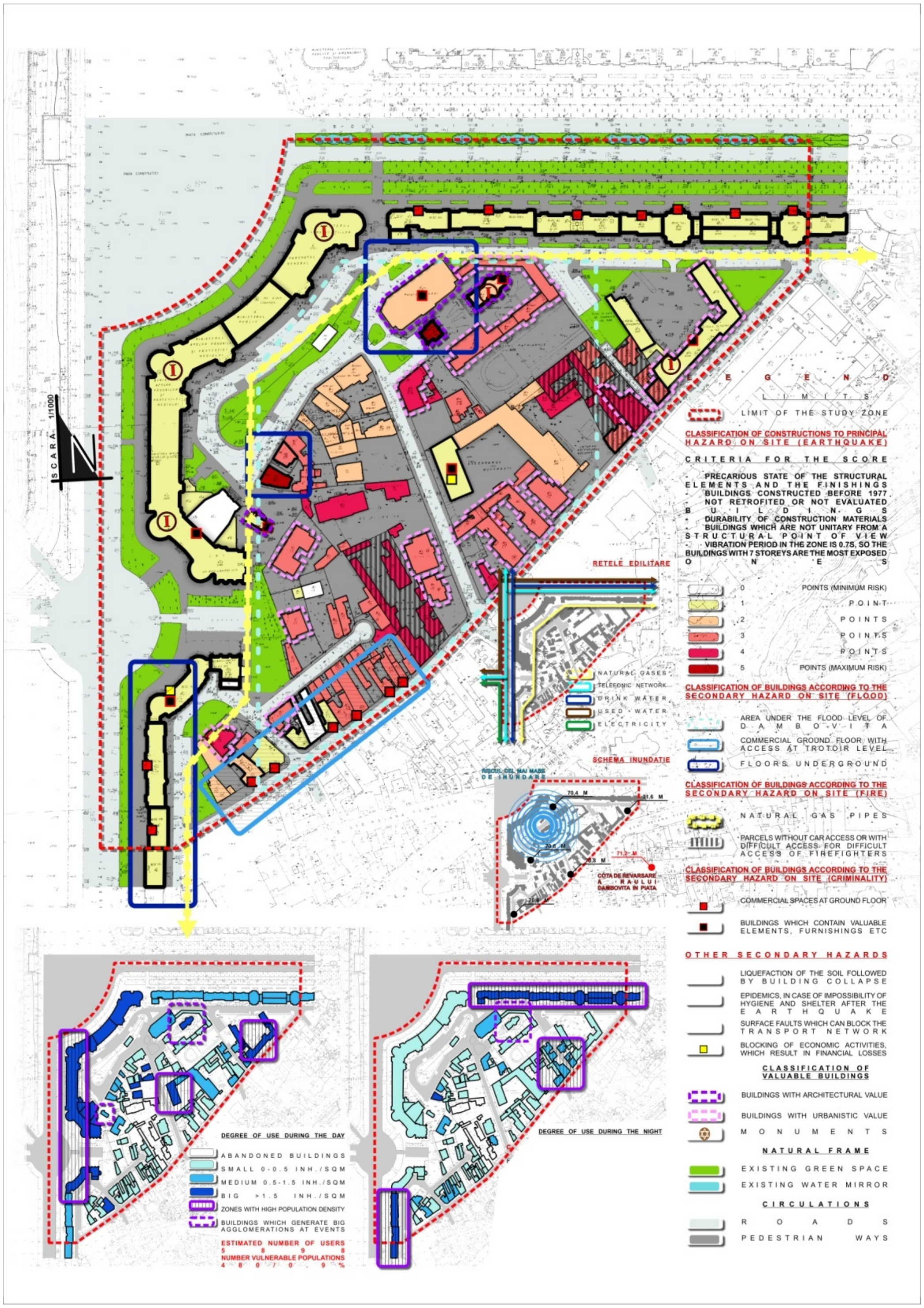


Fig. 5. Exposed elements mapping to different hazards and vulnerability mapping

In defining the mapped elements the following definitions were used:

Exposed elements or risk elements represent the material or spiritual values that can be negatively affected, directly or indirectly by a major event

The vulnerability of exposed elements is defined as the possibility of such elements to be negatively affected (damages, losses) by such an event

Discussion

A theoretical approach was done in Gociman (1999) to define the steps in the disaster cycle: their timing and the phases in which these take place (Fig. 6). Following this theoretical approach a strategy for the study area has been proposed (Fig. 7). The strategy follows principles of strategical planning, and according to project management methodology objectives are identified. For each objective there are several projects to reach the goals, for which costs have been estimated. The actors, seen as project initiators or investors are listed, and the project management tools facilitated a timing of the phases in years.

Another theoretical approach followed in Gociman (1999) is the one concerning security zoning. While there are known types of zoning, such as microseismic zoning in seismology, and functional zoning in urban planning, security zoning proposes as shown in Fig. 8 to react with means of architecture and urbanism to risk. Thus in planning greens spaces or other empty spaces such as parking areas have to be foreseen to assure the minimal distance of access without being covered by rubble in case of building collapse. In case that the disaster strikes security centres have to be identified to evacuate population: first in buildings such as schools then in green spaces to provide emergency housing. An example of such a planning is shown in Fig. 9. Groups which had to deal with other subzones of the study area proposed security centres even in a church, following the Transylvanian tradition of fortified churches. Such analyses for subzones have to be connected, as in other more central dense areas, which were not affected by the demolitions in the Ceausescu Aera, there might be lack of such spaces and the emergency housing zones have to be coupled to neighbouring areas. The security centres are priority areas in the pre-disaster phase to be retrofited so they can accomplish their function. An organisation plan must be done for each of them so they can be easily converted from the current function to this in case when a disaster strikes.

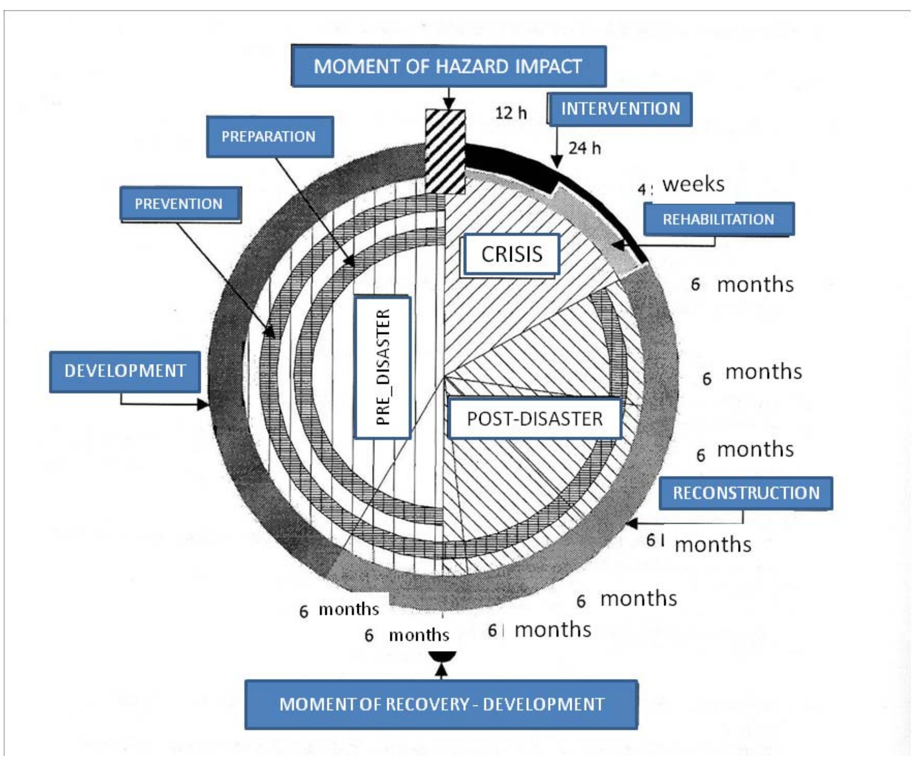


Fig. 6. Steps in the disaster cycle

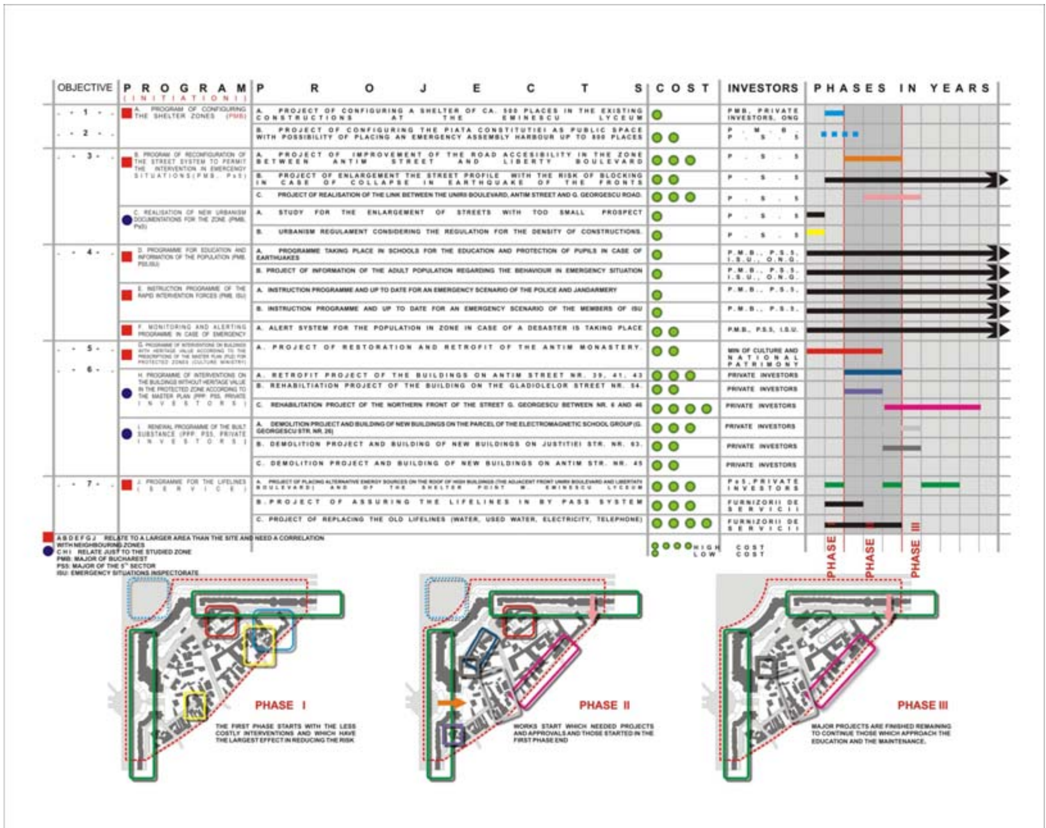


Fig. 7. Strategy

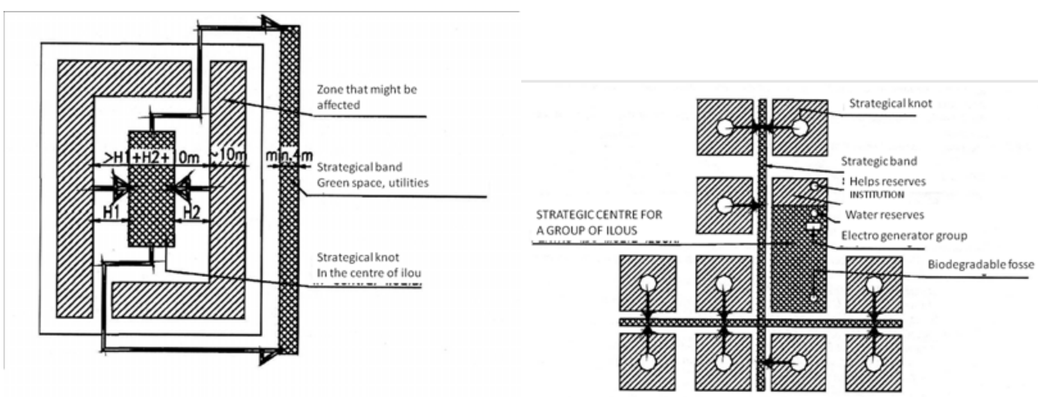


Fig. 8. Security zoning

The history of architecture study of different housing typologies which occur in the study area served to identify the environment the residents identify with. In case of rebuilding after disaster the same typology has to be followed, in order to minimize the disruption which occurs with relocating them. The typologies identified are called habitual patrimony. The same is valid in case of relocating the people for performing retrofit works during hazard mitigation measures. This local diagnosis instituted in the context of relating to patrimonial and institutional values different strategies of intervention in the area; Consolidation, restructuring or demolition of buildings. The result was the building-up of a poly-nuclear system of space security centers, able to relocate the affected population after disasters occurrence, named support system of emergency habitat and the identification of a post-disaster reconstruction opportunities generated by the system of the emergency habitat, having as support, the specific components of patrimony habitat.

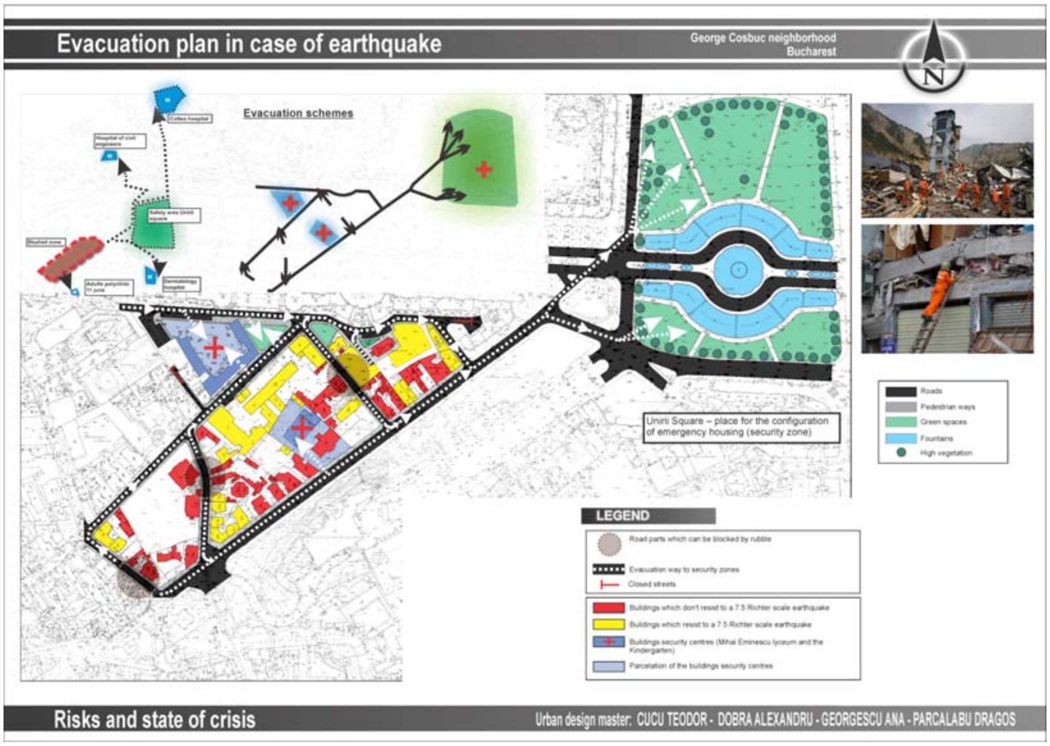


Fig. 9. Evacuation plan

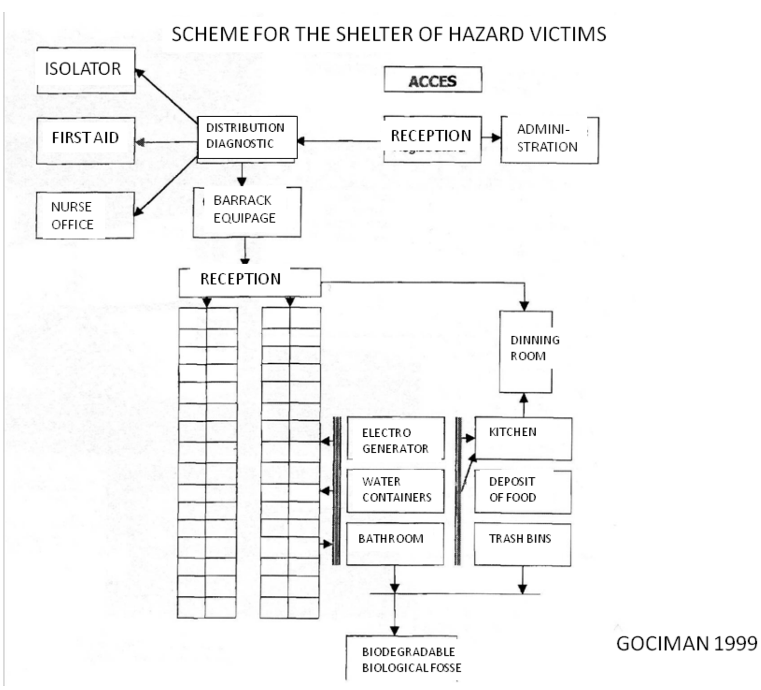


Fig. 10. Scheme of emergency housing

Fig. 10 provides a theoretical example (Gociman, 1999) of the functions an emergency housing area has to provide. Some working groups detailed the emergency housing approach organizing the camp this way, and even proposed emergency housing in containers, as well as the way the containers have to follow to reach the site in case of intervention.

Key lessons learned

- The traditional urban planning approach does not include this type of documentation, and this shall be changed
- Security centres shall be planned
- The population shall be educated at urban level on how to react to disasters
- In the investigated area there are zones capable to accomodate the security centre and the emergency housing area

References

Gociman (1999)

Acknowledgements

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