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11th Annual International Conference Proceedings, 2004

Facing New Challenges

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WELCOME FROM THE TIEMS VICE PRESIDENT and HOST OF 2004 CONFERENCE

The expansion of The International Emergency Management Society into the Southern Hemisphere marks the evolution of a truly global organisation. The recent workshop in Seoul, Korea and subsequent high interest from Chinese delegates has heralded this expansion.

It is an honour and a privilege to be involved in the inaugural conference in Australia to be held in the Shire of Yarra Ranges, Melbourne. This event has received much support at many levels including Emergency Management Australia (EMA - the Federal agency responsible for emergency management) and the Office of the Emergency Services Commissioner in Victoria.

The 2004 conference features many prominent Australian and international practitioners and academics from diverse backgrounds. As another first this conference will be digitally videotaped for the benefit of TIEMS members unable to attend and will contribute to establishing a library for posterity. This combined with the five star venue of the Sebel Lodge Yarra Valley setting a new standard in the professionalism of the annual conference. The concurrent establishment of an Australian TIEMS Chapter also provides a further platform for the TIEMS network

The setting of the Yarra Ranges is arguable one of the most scenic places to visit in Victoria. I would like to take the opportunity to especially thank the Shire of Yarra Ranges CEO, Rob Hauser, who has provided an enthusiastic organising committee lead by Director of Physical Services, John Ross, and comprising Councillor Robyn Hale, Conal Creedon, James Martin, Jacqui Reiter, Tina Bishop, Joan White, Mark McGuire, Roxanne Jenkins, Sandra Staggard. A special thanks to James Martin, Fiona Symon and Courtney Colour Graphics for their professional work in producing the brochures and other publications relating to the conference. The technical support of the Shire's IT Team lead by Craig Whalley and the field support provided by the Shire's Emergency Planning and Safety Unit, Glenn Hunt, Don Collard, Kevin Johnson and Daniel Johnson are also fundamental to the success of this event.

I take this opportunity to thank Alan Jones, John Stoop and Ross Newkirk for their effort in collating, reviewing, and editing the papers, Ulrich Raape for his fantastic work on the website and of course the President, Harald Drager, whose vision to globalise TIEMS is now a strong reality.

It would be remiss of me not to thank our sponsors, Det Norske Veritas, EMA, the OESC, Courtney Colour Graphics and QANTAS for their support. For those attending the conference I bid you safe travel and for those TIEMS members unable to be here, don't despair, you will have the opportunity at least to view the proceedings in video and written formats in due course.

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FORWARD FROM THE TIEMS PRESIDENT

As President of TIEMS, it has been a pleasure to deal with all that have contributed in making TIEMS 2004 a success. We have accepted abstracts for 66 papers and two workshops from authors representing 20 countries for presentation at the conference in the Shire of Yarra Ranges in Australia. Those papers included in the conference proceedings were selected to make contributions of quality to emergency management. The number of participants is expected to be close to 300 or more illustrating the good international foundation of TIEMS, and that the program is of interest far beyond the authors themselves.

Borders do not limit catastrophes for instance the Chernobyl catastrophe was an accident that had enormous consequences in neighbouring countries. When natural hazards like earthquakes happen (eg., the city of Bam in Iran) the stricken country will most often need international help to deal with the tragedy. The threat from international terrorism calls for global cooperation to understand the root of terrorism and fight the threat. The financial scandals of large international enterprises show the need for global emergency management for securing business continuity. The threatened spread of new diseases, calls for open and trustful global communication and immediate actions when new cases are detected. These examples show the need to address emergency management in a global perspective and in a non-political atmosphere. This is The International Emergency Management Society (TIEMS) mission.

The participants and sponsors of this conference are all engaged in important and far-reaching subjects of emergency management. The group feels that open international gatherings like the TIEMS conferences give an excellent opportunity for exchange of ideas and discussions on ways and means to make our environment safer. This also leads to increased international cooperation in this highly non-border problem area.

The published papers of these proceedings give a broad international view of emergency management and through them TIEMS hopes to stimulate a continuous and ongoing international / global debate on emergency management.

TIEMS is a non-profit society with limited financial resources. TIEMS 2004 in Shire of Yarra Ranges would not have been possible in the form it is presented without the financial support and help of TIEMS 2004 participants and sponsors. TIEMS is thankful to all of you.

Special thanks go to Norm Free, John Stoop, Ross Newkirk and Alan Jones all of whom have worked closely on the proceedings and conference arrangements. Special thanks also goes to Ulrich Raape, who has been responsible for the TIEMS WEB-site, and announcing the event. The proceedings will also be published on TIEMS WEB-site, www.tiems.org

Finally we offer special thanks to the Council of Shire of Yarra Ranges, who have supported the conference and formed a local organising committee, preparing all practicle details of the conference. Organising of the conference has been hectic at times, but seeing the fruitful result of the work, is very satisfying.

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CHANGING PERSPECTIVES

A FOREWARD BY THE CONFERENCE PROGRAM CHAIRMAN

This year the 11th Annual Conference of TIEMS in Australia, Melbourne confirms a change in perspectives that have emerged in previous conferences. Contributions from all across the world indicate a shift in focus in various aspects of emergency management. This shift in perspective is taking place from a disaster preparedness emphasis to a prevention and risk management perspective.

A need for a reactive approach and disaster preparedness is still necessary and inevitably will remain so due to the instantaneous nature of catastrophic events. Earthquakes have destroyed the city of Bam in Iran with a tremendous death toll and have taken many lives in Marokko. Such major events put high demands on large scale preparedness. Modern information and communication technology devices may support a timely reconnaissance on the extent of the damage in order to allocate adequate resources but cannot prevent natural disasters.

In the case of major hazards characterized by a more gradual progress or evolving broad spatial extent, (such as in the case of a gas release or spreading of a disease), a timely oversight of such critical situations is required in order to take precautionary measures to prevent escalation of disaster consequences. Risk communication, disease control and contamination control are required to support adequate emergency preparedness.

In order to be prepared for major emergencies, organizational learning from previous events and training of emergency staff is becoming more and more important. Cooperation between professionals is not only a matter of best practice experience, but should be planned while integrated tools for a high quality performance are being developed. This should be done at least one step before the vulnerability and crisis resistance of critical infrastructures are discussed. This is particularly true when designing modern high-tech environments such as airports, railway stations, power supply plants and other objects which are vulnerable to terrorist attacks. This conference's discussion shifts the focus more toward prevention and eventually pro-action in the design of complex and critical infrastructure, objects and projects.

Finally, investigating major events in order to learn from deficiencies in the system has gained importance. Independent assessment of incident/accident handling and management is important in order to provide the public confidence in the professionals who design, construct and manage the world they live in.

Throughout the program conference in keynotes addresses and through the individual contributions of participants, these themes are presented and new issues at stake in emergency management are explored. We do not need to have a disaster to recognize the potential of major hazards. Recent examples in designing new railway infrastructure in middle Europe demonstrate that we should recognize during design stage factors such as: climatic change in the Alps regions, establishing Trans European Networks in seismic activity areas, multiplying passenger and hazardous materials traffic volumes and urban development that coincide in a relatively small region. Designs should call for a risk prevention strategy in the early phases of the design process by establishing methods for safety impact assessment on an integral systems level. This could be a theme for a subsequent TIEMS conference.

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Chairman, TIEMS International Program Committee

EDITOR'S INTRODUCTION TO THE 11TH ANNUAL INTERNATIONAL EMERGENCY MANAGEMENT CONFERENCE (2004)

The papers in this conference explore several important elements involving ***Facing New Challenges in International Emergency Management*** – the overall conference theme. This peer reviewed collection of conference papers clearly demonstrates that TIEMS conferences are not focused on simply providing an opportunity to tell heroic tales of emergency practice and response, rather they provide a forum for critical analysis and sober second thought as well as reporting on "test bed" new technical and policy approaches critical to emergency management and mitigation against emergencies. The editor has organized the papers into eight topic areas that speak to key areas of emergency management. In most of these topic areas, the reader will find papers written by a cross section of TIEMS contributors: practitioner, academic researcher, industry, government, or policy contributor. This provides the reader with a useful balance of views. In each topic area, one will find new approaches to long standing problems, the identification of new or emerging challenges facing emergency management, and novel approaches (particularly in applying information technology) to mitigating emergencies. An important general tone underpinning most of the topics is the desire to strengthen mitigation against a wide variety of emergencies. In one sense this shows that this professional organization is dedicated to eliminating itself! If mitigation of emergencies was really achieved there would be no need for future conferences on emergency management. Sadly, the profession is far from such an achievement. Perhaps the papers in the topic areas discussed below will contribute to helping move the profession forward toward this goal.

It is not the intention of the editor to single out individual papers for special consideration or to give special emphasis to particular topic areas. Readers naturally will be attracted to the topic areas closest to their personal or professional interests; but, the editor encourages them to read further in related topic areas as there one will find cross stimulating ideas. It is natural, given the nature of TIEMS that the papers in the *Emergency Management, Response & Training* topic are most numerous. The reader will find these papers involve many applications from around the world and a full development of concepts ranging from organizational learning through system evaluation, information technology architectures, to business continuity and industrial accidents. The *Disaster Management & Recovery* topic explores technology that enables disaster management, explores using community risk analysis to develop a disaster management plan, considers recovery issues in developing countries, and identifies an emerging concern about addressing flash flood disasters. In the topic area *Community Vulnerability and Safety* papers explore among other ideas the concepts of community understood vulnerability, risk perception and communication, issues of counter terrorism, knowledge transfer and the value of educating children regarding emergencies to develop resilient communities. *Risk Identification and Management* remains an area of challenge to society, governments and to the emergency planning profession. In this topic area are interesting discussions of developing country level risk management programs, the challenges of risk identification and management in industry, the application of information technology to help control communicable disease and a report showing that even after experience with a

SARS outbreak agencies still have difficulties in addressing directly risk identification and management.

Safety is a central focus of several topic areas. *Transportation Accidents and Safety* is an area of increasing interest to the emergency management profession – particularly due to a continuing pattern of major transportation emergencies around the world. The importance of independent accident investigation and evaluation is discussed in this topic area. The reader is encouraged to explore further ideas and achievements in the topic areas *Infrastructure Safety and Security, Hazards of Contaminant Transport, and Earthquake Response.*

A conference obtains much of its value through its papers and the discussions and debates around the paper presentations. In many cases the "icing on the cake" in conference value comes from the special conference workshop presentations, and keynote presentations. Many of these are not available in written format. We are pleased to provide in the non peer reviewed section of these conference proceedings entitled *Conference Presentations* many of these special presentations.

This is a conference for emergency management but it is really a conference for the people of the world. There would not be a TIEMS if it were not for the existence of a group of professionals dedicated to making people safe. We hope that these papers and the discussions they stimulate lead to improving the safety and security of people around the world.

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Proceedings Editor.

List of Sections in the Conference Proceedings

The International Emergency Management Society
11th Annual Conference Proceedings, May 18-21, 2004
Melbourne, Victoria, Australia

Academic and Professional Practice

Peer reviewed articles

COMMUNITY VULNERABILITY AND SAFETY

ASSESSMENT OF THE CAPABILITY OF LOCAL GOVERNMENT FOR THE VISUALISATION OF COMMUNITY VULNERABILITY

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Keywords: Local Government, Community, Vulnerability

Abstract
Information available to officers of Local Government and regional authorities on community risk associated with hazards such as landslide at a particular location is typically limited to an assessment of the risk of the hazard eventuating. However, community vulnerability to these hazards is related to many aspects of a specific location. Factors include the proximity to the source of the hazard, proximity to the propagation path of the hazard, demographics (population density, age, income, ethnicity, education etc), value of land and improvements, and post-incident availability of essential services and support (a destroyed bridge may isolate an otherwise unaffected community from essential services) and continuity of utilities such as gas, electricity water etc. Information on these further variables is often available to Council, but not in an integrated form immediately useful for community education and hazard mitigation. The Thredbo Landslide (New South Wales, 1997. 18 people dead) has prompted many responsible authorities in Australia to commission geotechnical landslide risk assessments, typically resulting in classification maps (eg. high, medium & low risk). While these classifications provide a useful planning tool, they do not necessarily represent the true community risk. For example, a high value, high density residential development located on stable ground (low risk) downhill from a high-risk area may represent a far greater overall community risk. This project develops a framework to validate geotechnical risk assessments using Geographic Information System (GIS) and visualisation technology to integrate existing landslide probability assessments with social, infrastructure and economic measures to provide a visualisation of community vulnerability to landslide. The resultant information tool will then be evaluated for practicality and usefulness in community education, mitigation of landslip and other hazards.

Introduction
Landslides in Australia are attributable for at least 83 deaths and property damage involving over 200 buildings in the order of $30 million (AUS) present day dollars since 1842. Major incidents to receive international media and community attention occurred at a ski resort in 1997 at Thredbo, New South Wales, involving the displacement of 2,000 cubic metres of liquefied soil resulting in 18 deaths and a cliff collapse in 1996 at Gracetown, Western Australia, resulting in nine deaths. (Emergency Management Australia Reducing the Community Impact of Landslides 2001**)**

The Shire of Yarra Ranges is a municipality located on the eastern metropolitan fringe of the Capital City of Melbourne in Victoria, Australia. With an area of almost 2,500 square kilometres

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the Shire is the largest of any metropolitan or fringe Council in the State. The Shire has a population currently estimated to be 141,170 people.

In terms of population it is the seventh largest municipality in the metropolitan area and the eighth largest in the State of Victoria in terms of population.

The Shire has an extensive history of landslides. The types of landslides that occur in the Shire include falling boulders, debris flows, slow long-term earth movements, small landslides up to the size of a residential block and large landslides involving entire hillsides. Some landslides move relatively frequently whereas others have not moved for hundreds, perhaps thousands of years. Landslides can be caused by both natural and artificial causes. Heavy rainfall has triggered many landslides in the Shire, such as those that occurred in 1863, 1891, 1928,1934, 1958, 1992, 1994 and 1996. Many landslides often occur then re-occur in the same location, therefore sites where landslides have previously occurred have a higher risk of future landslide.

The largest recorded landslip occurred at Montrose (at the base of the Dandenong Ranges) in July, 1891, and involved the displacement of approximately 30,000 cubic metres of earth and rock causing damage over 1.4 kilometres and was estimated to have travelled at a speed up to 40 kilometres an hour. Two horses were killed, a house destroyed and a lady was trapped but quickly pulled from the debris with minor injuries. In 1992 a significant shift at an active landslip in Blackwood Avenue, Warburton, resulted in permanent closure of the road, evacuation of a number of houses and ultimately the demolition of some houses in that area. (Coffey Partners International Pty Ltd Emergency Response Procedures for Landslides within the Shire of Yarra Ranges M2964/2-AG dated 19 June 2000)

It has been estimated that as a direct result of heavy rainfall in August, 1996, four significant landslips resulted in disaster funding claims to the order of $500,000. In 1998/99 the Shire obtained the services of engineers to conduct a geotechnical survey of the municipality with a view to devising an Erosion Management Overlay for inclusion into the new Planning Scheme and the Shire's Geographic Information System.

The following table describes the risk categories and criteria designated under the Erosion Management Overlay:

Ex	Exempt	Flat land, unlikely to be any instability, no impacts
L	Low	Landslip unlikely even though the land is gently sloping
MO	Medium Risk	Construction requires compliance with guidelines
M1	Medium Risk	Construction requires compliance with guidelines
M2	Medium Risk	Slopes>20% require a mandatory planning permit and site specific geo-technical assessment
H	High Risk	At risk of landslip without any development. A planning permit can only be issued where a geo-technical investigation shows risk is acceptable. There may be circumstances where a planning permit cannot be issued.

There are approximately 55,000 rateable properties within the Shire of Yarra Ranges.
The survey identified 434 properties in the High Risk category and 5,556 properties in the M2 Medium Risk category. This translates to approximately 11% of total properties.

Given the large percentage of properties affected within the municipality, considerable resources were directed at ensuring extensive community consultation was undertaken. Other than an initial influx of general inquiries from property owners requesting access to static mapping information in their particular areas, there has been little response to the information program. Council Officers are now questioning whether there might be a general lack of appreciation of community vulnerability arising from the use of static risk maps.

The information on community risk associated with hazards such as landslide and fire at a particular location, which is available to officers of Local Government and regional authorities, is typically limited to an assessment of the risk of the hazard eventuating. However, community vulnerability to these hazards is a function of many aspects of the location. These include proximity to the source of the hazard, proximity to the propagation path of the hazard, demographics, engineering and other lifelines and the environment.

From an emergency planning perspective the information gained by this survey for the Erosion Management Overlay was limited in that it focussed on the risk of landslip for a given geographic location but it did not provide information indicating the direction of a landslip or debris flow. Emergency planning for landslip would be greatly enhanced if the current information could be modelled to provide an insight as to the impact of an event. Such a tool would be useful in determining the vulnerability of the community by identifying the number of properties affected, the disruption caused by loss of infrastructure such as roads, gas, water, sewerage, electricity, etc. It would also assist in the identification of risk to specific buildings deemed through the nature of their occupancy to be more vulnerable, for example kindergartens, schools, aged person accommodation, hospitals etc.

The Shire's Geographic Information System (GIS) currently captures information relating to rateable properties, topography, satellite imagery and various planning overlays however current resources were insufficient to undertake this project. The Shire also lacked specialist geotechnical knowledge regarding landslip.

In acknowledging the need for expertise and in keeping with its collaborative approach to emergency management, the Shire commenced dialogue with the Royal Melbourne Institute of Technology (RMIT) and the Australian Geological Survey Organisation (AGSO). A joint application was then made to the federal government body, Emergency Management Australia (EMA), to assist in joint funding to assess of the capability of local government for the visualisation of community vulnerability.

The project has been managed by a panel consisting of the research supervisor, Mr Norm Free, Executive Officer Emergency and Safety Planning, Shire of Yarra Ranges, and Matt Hayne, Geoscience Australia. A researcher, David Fraser, a Senior Lecturer, has been appointed and is directly supervised by Dr Ron Grenfell of the Department of Geospatial Science, RMIT University. The researcher has consulted with members of the panel on a formal and informal basis and other members of their organisations on an as-needs basis.

Role of Local Government in Emergency Management

Local government has a moral and legal responsibility of duty of care to its citizens. Legislative controls are put in place to ensure that local government meets its obligations in this area. In Victoria, Australia, the Emergency Management Act 1986 requires that each municipal council forms a Municipal Emergency Management Planning Committee (MEMPC) for the purpose of formulating, monitoring and reviewing a Municipal Emergency Management Plan (MEMP) in relation to the prevention of, response to and recovery from emergencies within the municipality.

The Shire of Yarra Ranges Community Risk Based Emergency Management Plan has been modelled against the Australian and New Zealand Standards for Risk Management AS/NZS 4360:1999 and the Victoria State Emergency Service Community Emergency Risk Management Model (Risk Management and Municipal Emergency Management Planning 1998 p.vi), creating a transparent process and auditable trail in recording the identification, analysis, evaluation and treatment and decision making. This process relies on community consultation and the Shire has made the completed plan will be available to the community. With the integration of 'risk management' into Municipal Emergency Management Plans, (MEMP) the Shire of Yarra Ranges fulfils the recently revised funding requirement under the Commonwealth/State Natural Disaster Relief Arrangements.

Under the Australian and New Zealand Standards for Risk Management AS/NZS 4360:1999, risks are analysed through qualitative measures of likelihood and consequence and then prioritised according to a risk analysis matrix. In many cases it is possible to reduce the likelihood or impact of a risk by adopting various strategies ranging from physical engineering mitigation works to community awareness campaigns. The aim of any mitigation strategy is ultimately to reduce or eliminate the likelihood of an event occurring. If it is not possible to eliminate the possibility of an event occurring then efforts need to be directed at reducing the impact of an event. This structured and rigorous risk management process rated landslip as a high priority.

Topography and history of landslip in the Shire of Yarra Ranges

The Shire of Yarra Ranges can be divided into three zones, the undulating country to the west with suburban development, the forested hills to the east and the valley of the Yarra River, which runs east to west and is surrounded by farmlands. There are four major water reserves in the mountainous areas which supply drinking water for the Shire and metropolitan Melbourne: the Silvan Reservoir in the Dandenong Ranges, Maroondah Reservoir above Healesville, the smaller O'Shannassy Reservoir north-east of Warburton and the Upper Yarra Reservoir further east again. The majority of the suburban areas are found in the western part of the Shire around Mooroolbark, Montrose and Lilydale. The Dandenong Ranges are moderately populated, especially, the Belgrave-Upwey area. Even though much of these hills are heavily wooded approximately one third of the Dandenong Ranges is given over to forest parks, the remainder being zoned for residential or agricultural purposes. Forested mountainous areas also stretch from the surrounds of Healesville in the north-central part of the Shire across almost the entire eastern section. This forms part of the Great Dividing Range. The highest point is Snowy Hill at 1380m above sea level and is located at the northern most point of the Shire. The other major geographical feature of the Shire is the Yarra River, which flows along the eastern part of the Shire and runs through the Melbourne CBD into Port Phillip Bay.

There are 1116 kilometres of sealed roads and 838 kilometres of unsealed roads crossing the Shire. Approximately 60 road bridges providing major links to townships throughout the Shire. Many of the bridges carry essential services such as water and communication cables. Electricity is supplied to all residences with natural gas covering the majority of residences. Council has recognised that the physical diversity of the Shire, in particular the mountainous terrain and large floodplains, also creates challenges in developing and maintaining the infrastructure and in servicing the residents to the desired levels.

Origin of the Project and the Partnership Approach

The value of networking amongst emergency management and associated professionals cannot be underestimated. The annual conferences of the International Emergency Management Society (TIEMS) are based on the strengths and advantages of providing an opportunity for professionals to gather and debate theories and provide insights as to practical application of emergency management.

The concept for this project was born from informal networking of professionals following the Australian Disaster Information Network (AusDIN) workshop conducted at the Australian Emergency Management Institute at Mt. Macedon Victoria, in 2000. The Institute is the education and training centre managed by Emergency Management Australia a Commonwealth (National) body established in 1974 as the Natural Disasters Organisation (NDO) to absorb the functions of the existing Directorate of Civil Defence, coordinate Commonwealth physical assistance to States and Territories in the event of disaster, and assist them to improve disaster management capabilities. Since then the organisation has provided assistance in numerous major counter-disaster operations such as the Cyclone Tracy (which decimated the Northern Territory Capital City of Darwin) in December 1974, the 1983 "Ash Wednesday" Bushfires in Victoria and South Australia, 1986, Cyclone Winifred in Northern Queensland, the 1990 "Great Floods" in central NSW and southern Queensland, the 1993 north-eastern Victorian floods and the 1994 NSW bushfires. In 1993 NDO changed its name to Emergency Management Australia (EMA) and currently performs emergency management functions in relation to natural, human-caused and technological hazards. (Emergency Management Australia website www.ema.gov.au)

Geoscience Australia was first established in 1946 as the Bureau of Mineral Resources, Geology and Geophysics (BMR) with its main aim to perform the systematic geological and geophysical mapping of Australia. It then shifted focus in 1978 to develop a geological understanding of the Australian continent and its offshore areas and subsequently moved towards strategic research. During the 1980s BMR gained expertise in remote sensing and groundwater investigations and commenced nuclear monitoring and geohazard assessment, by building on its activities in earthquake monitoring.

BMR became the Australian Geological Survey Organisation (Geoscience Australia) in 1992 and provided much of the geoscience information that underpinned exploration and development work for petroleum and minerals in Australia. A review carried out in Geoscience Australia's infancy concluded that geoscience was relevant to society by providing information essential for economic prosperity and for the proper use of resources to protect the local and global economy. The change of name to AGSO – Geoscience Australia in August 2001, and to Geoscience Australia in November 2001, is recognition that the agency's work is vital in a wide range of contexts. (Geoscience Australia website www.agso.gov.au)

RMIT is a university with a global focus in Melbourne, Victoria, with three main campuses and offers many qualifications in collaboration with more than 190 partner institutions around the world including a student exchange program with the University of Waterloo. It is a member of the Australian Technology Network (ATN), a coalition of five leading Australian universities across the country and part of the Global University Alliance (GUA), a partnership of ten international universities, dedicated to providing students across the globe with accessible education using the latest interactive web and data-based technologies.

The RMIT University Geospatial Science Initiative (RMIT GSI) - an initiative of RMIT University's Department of Land Information - aims to create business and strategic partnerships, ensure the commercial application of the university's best R&D in the geospatial sciences , and

grow the geospatial science industry in Victoria and nationally. RMIT University's Department of Land Information is recognised nationally for supporting leading edge R&D in specialist areas including technology convergence, remote sensing and geographic information systems, information modelling, satellite positioning, measurement and mapping sciences , multimedia, visualisation, the World Wide Web applications and sustainable development. (RMIT University website www.rmit.vic.gov.au)

Project Aim

The primary aim of this project is to assess the capability of local government to produce an effective visualisation of community vulnerability from currently available data, modelling techniques and technology, suitable for community education and hazard mitigation. The project will develop a methodology for integrating currently available data, models and techniques for this purpose and will then assess the effectiveness and limitations of the resultant visualisation. Geographic Information System (GIS) and visualisation technology will be utilised to integrate existing landslide probability assessments with social, infrastructure and economic measures to provide a visualisation of community vulnerability to landslide. The resultant information tool will then be evaluated for practicality and usefulness in community education and hazard mitigation.

Project Objectives

The project's objectives are deliver the following:

- A methodology for Local Government to integrate currently available data, models and techniques for community vulnerability visualisation
- An assessment of the adequacy of currently available data, models and techniques for visualisation of community vulnerability, together with an assessment of the likely improvements from wider knowledge and information sharing
- Identification of hazards originating from land owned by other agencies, eg Department of Natural Resources and Environment, other municipalities, that impact on vulnerable elements of the Shire of Yarra Ranges thus requiring a collaborative approach to mitigation
- Increased awareness of community vulnerability to landslide by the Yarra Ranges community
- Incorporation of the information into all facets of emergency Management within the Shire of Yarra Ranges including planning, preparation, response and recovery
- A case study in the Shire of Yarra Ranges as an example of the degree to which an authority with significant need for such an information product is able to do so with generally available resources and organisational arrangements. The case study will be packaged in a form suitable for dissemination through the World Wide Web.

Project Methodology

Review literature on community vulnerability landslide modelling, and visualisation. Considerable research has been conducted utilising resources of the University, EMA (which is reputed as having the most extensive emergency management library in the Southern Hemisphere) and Geoscience Australia.

Review suitability and availability of existing data, models and technology identified as relevant following the literature review. The Shire currently possess a mature Geographic Information System (GIS) to support Council's mapping and information needs. An initial review

of the data suggests that there is a clear deficiency in information relating to the specific location of utility infrastructure relating to electrical and gas utilities. The AGSO Cities Project which assesses the effects on urban communities of a range of natural hazards incorporates examples of some of the models currently being reviewed.

Consult with Council and AGSO officers to develop a model of community vulnerability to landslide. The model will be a function of proximity to the source of the hazard, proximity to the propagation path of the hazard, demographics (population density, age, income, ethnicity, education etc), value of land and improvements, post-incident availability of essential services and support, and other variables identified in previous steps. Two levels of vulnerability were established. Primarily the community, infrastructure and environment directly in the path or immediately adjacent to the debris flow and secondly to those elements not directly impacted upon but vulnerable as a result of the damage and disruption caused by the landslide which would include people isolated by the damage to roads or from the loss of engineering and other lifelines.

Knowledge of the level of vulnerability to an event becomes a crucial element in reducing its impact. If one considers vulnerability as the relationship between susceptibility and resilience then by reducing susceptibility (such as ensuring physical distance of community to a risk) and increasing resilience (by educating a community on the existence of a risk and how to respond appropriately) one can effectively decrease the level of vulnerability to which that community is exposed.

Select an appropriate case study site with guidance from Yarra Ranges Shire Officers.

The choice of the case study site was based on needs of both the Shire Officers and the researcher and included the need to select a relatively small geographical area with preferably a well known active landslide that had been studied by a geotechnical engineer to provide expert advice as to the anticipated debris flow in the event of a catastrophic failure. The project model could then be tested to ascertain whether it provided information consistent with that predicted by the geotechnical engineer. Other factors were also considered relating to the location and proximity of a variety of vulnerable elements to the site.

In October 1992 an active landslip in Blackwood Avenue, Warburton (located in the eastern region of the Shire), moved significantly resulting in the evacuation of houses in the immediate area and the permanent closing of the road. Historical information indicates that this landslip has been in existence for, perhaps, thousands of years and was almost certainly well established prior to European settlement in the Warburton area. The earliest recorded movement of the landslip occurred in the early 1950's. The landslip has moved every decade since then and is expected to continue moving. It is believed that total movements in the order of 20 to 30 metres have occurred since the landslip formed (based on the present slope profile and the assumed pre-landslip profile).

The Blackwood Avenue landslip lies on the north bank of the Yarra River at Warburton. The toe of the landslip is at the edge of the river. Cumulative movements up to about 1.5 metres have been measured on the Blackwood Avenue landslip in the last seven years. Concern has been expressed that this landslip may fail catastrophically, blocking the river, and this could lead to flooding of the Warburton area. The landslip covers approximately 6 hectares. It is irregular in shape and has a maximum length of about 320 metres and a maximum width of about 230 metres. Currently there are no occupied buildings on the landslip. Four houses were on the site until the early 1990's. They have since been demolished or permanently vacated. Four houses lie in close proximity to the edges of the landslip.

No evidence has been found to suggest the landslip may have blocked the Yarra River in the geological past, let alone in more recent times. The available evidence indicates the landslip is "slowly shuffling" along, most likely in response to heavy rainfall and that substantial movements

causing the river to totally block are unlikely to occur. Irrespective, given the narrowness of the river and the uncertainties regarding the behaviour of any landslip and the events that could take place in a major storm/flood event, the consequences of the landslip blocking the river need to be considered.

In the opinion of the geotechnical engineers engaged to assess the landslip, in the very unlikely event of a total blockage of the river, the resulting landslip dam is likely to be made up of loose debris, which would erode quickly, particularly if over topped by the river. If the unexpected happens and the dam is not rapidly eroded, flooding will occur. This will, in turn, primarily effect infrastructure, such as the bridge spanning the Yarra River (shown above), which carries the main Highway through the township. This will result in the isolation of services such as the hospital and the volunteer fire brigade and loss of engineering and other support lifelines. (Coffey Partners International Pty Ltd Emergency Response Procedures for Landslides within the Shire of Yarra Ranges M2964/2-AG dated 19 June 2000)

Obtain and integrate relevant models and data in a GIS environment, developing general integration methodology. A number of relevant models are still being explored including those incorporated by AGSO in its Cities Project which assesses the effects on urban communities of a range of natural hazards.

Four broad data sets are currently being collated and/or considered for inclusion in this project . Each set has been categorised into a general and more specific groupings.

SET 1 - Hazard identification: Awareness Level 1 – general includes land cover, streams, flood plain, slope gradient. Level 2 – specific includes geology, mantel of soil and rock fragments, bare soil, erosion gullies, forest cover and groundwater regime.

SET 2 - Areas prone to instability in the Shire: Awareness Level 1 – general includes broad geographic areas such as the rolling slopes of Mooroolbark, Silvan, Wandin Yallock, Forest Hill and Wandin East; Kalorama and the western and north-western slopes of Mt. Dandenong. Level 2 – specific includes land fill, soil creep, batter slopes, seepage.
SET 3 - Critical facilities analysis Level 1 – general includes **e**xisting development, key economic centres. Level 2 – specific includes hospitals, emergency services, retirement villages, government offices. Level 3 – detailed includes roads, gas lines, electricity lines, water mains, telecommunications, public transport. This data set will also be considered to include an inventory incorporating details such as facility name, type, street address, town, owner, contact name and title, contact telephone number and emergency service district.

SET 4 - Environmental analysis Level 1 – general including **e**nvironmentally sensitive locations, areas subject to primary environmental impact, areas subject to secondary environmental impact. Level 2 – specific includes structural vulnerability, operational vulnerability, societal vulnerability. Level 3 – detailed includes critical facilities hazard risk areas, natural hazards risk areas, population (*housing*) density, location of hazardous or toxic sites, cleared sites, natural drainage interference, assembly areas for population.

Create alternative visualisations of community vulnerability

To date the following visualisations have been created:

- Warburton satellite image
- Blackwood Avenue landslide
- Topographic map of the Blackwood Avenue Case study Area
- The Yarra River and Bridge at the Blackwood Avenue study site
- Digital Elevation Model of Blackwood Avenue Environment
- Site of the Blackwood Avenue landslide

- Possible flooding extent after the landslide shown with public buildings (buffered)
- Buildings on low lying land
- Steep slopes in relation to buildings
- Steep Slopes on terrain model
- Steep slopes in relation to road locations

Evaluate information products through focus groups consisting of community members and council officers.

Stakeholders, including the community, other land owners and other stakeholders, who have been identified as vulnerable to the impact of a landslide in the selected site such as a local school and an aged care facility, are currently being canvassed as to their needs with a view to conducting a public meeting. This forum will provide and opportunity to demonstrate the various visualisation models and obtain feedback as to the relevance and effectiveness of the visualisations. The forum will also provide an opportunity to gauge support for community involvement in a system to monitor the landslip.

Evaluation of the project

The project will be evaluated in achieving its objectives and its effectiveness by:

- surveying the community and stakeholders regarding the visualisation in meeting their needs.
- survey of Shire of Yarra Ranges Officers from the Emergency and Safety Planning, Planning, Building Surveyor and GIS areas as to the suitability of the model to meet individual needs.
- survey of other municipalities regarding the model.
- survey of RMIT and AGSO stakeholders.
- Overall assessment for broader application by Emergency Management Australia.

Conclusion

Although this project is still in progress a number of significant factors are worthy of note:

- The opportunities derived from informal networking at emergency management forums to initiate collaborative inter-agency projects
- The appreciation for community involvement in emergency management projects
- The acknowledgment of State and Federal Agencies of the need for tools to assist emergency management practitioners and the community in reducing vulnerability
- An acknowledgment of the advantages to be gained through the application of computer technology to aid emergency practitioners
- The opportunity for effective practical advances in emergency management through the collaborative efforts of practitioners and academics.

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Norm Free is a Senior Executive Officer appointed to manage the Shire of Yarra Ranges' Emergency and Safety Planning Unit and has represented local government on emergency management at State National and International Forums. He previously served for over twenty years as an officer with the Victoria Police Force and was awarded the Australian National Medal and Victoria Police Service Medal & 1st Clasp He has completed a Graduate Certificate in Disaster Management Swinburne University and was elected as a Director on The International Emergency Management Society in 2001.

TOWARDS RESILIENT COMMUNITIES IN DEVELOPING COUNTRIES THROUGH EDUCATION OF CHILDREN FOR DISASTER PREPAREDNESS

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Keywords: Knowledge transfer, Public awareness programmes, Earthquakes, Educational campaigns.

Abstract
In developing countries, educating all levels of the society in disaster threats is not always possible due to the lack of experts and educational materials. Therefore, one of the best ways of publicising awareness programmes can be the integration of these initiatives into children's activities. Since over half of the population in many developing countries is under 18 years old, it is possible to convey vital information to most of the population via the knowledge, skills and enthusiastic motivation of children. They are able to disseminate messages throughout their societies, starting with their parents. Fortunately, the level of acceptance in parents from their educated children is generally high in developing countries. The aim of this paper is to firstly look at awareness raising as a core to all disaster mitigation programmes. The paper then focuses on earthquake education through children. The study will also illustrate this process through a selection of examples of educational campaigns in different developing countries resulting in successful public awareness raising. These programmes strengthen resilience in a community by enabling them to withstand shocks, cope with emergencies when they occur and bounce back from disaster impact.

Introduction
Past experiences have proved that lack of preparedness can result in many problems at the time of disasters and afterwards. With the rapid urbanization, the developing countries are witnessing an observable change in their socio-economic structure which continues for years and even decades. Education can be regarded as one of the best media for making a community prepared for disasters. Unfortunately, in most developing countries educating all levels of the society for disaster preparedness is not always easy due to the lack of expertise and materials. Therefore, one of the

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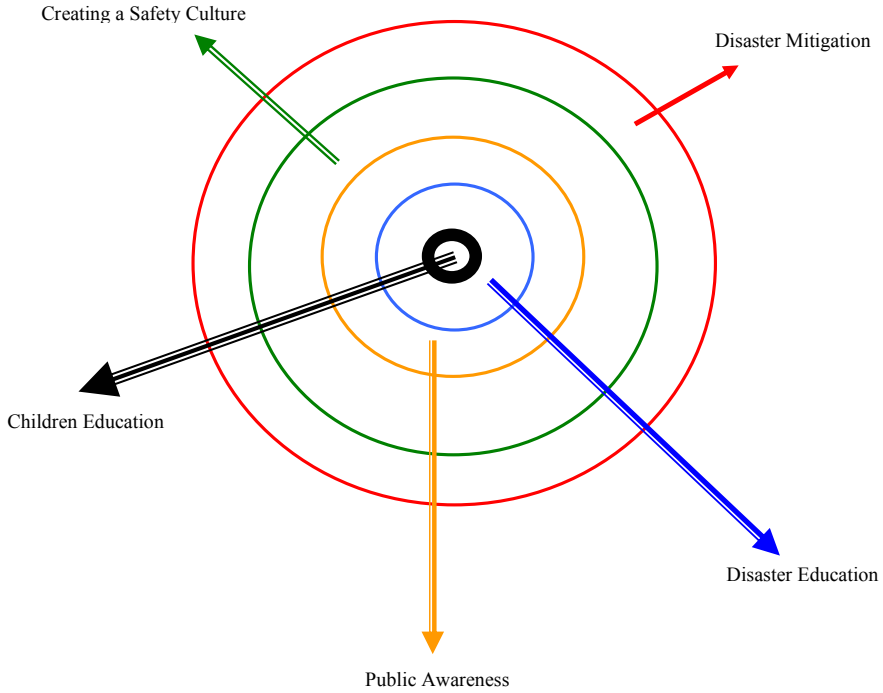
best ways of publicising awareness programmes would be the integration of the awareness initiatives into children's programmes. However, based on the fact that over half of the populations of most developing countries are under 18 years old, it is possible to disseminate vital information regarding disasters and preparedness to most levels of the society through children as they are good messengers in transferring this knowledge to their families. As was mentioned, the level of acceptance in parents from their educated children is generally high in developing countries, and this encourages the decision-makers to invest more and more on education of young generations.

One of the main goals of the International Strategy for Disaster Reduction (ISDR) is to 'reduce risks and make all communities resilient to the effects of natural, technological and environmental hazards'. It also aims to proceed from protection measures to the management of risk through the integration of preventive actions into sustainable development. The aim of enabling all communities to become resilient to the effects of different hazards has been announced in the Inter-Agency Task for Disaster Reduction in April 2000 in Geneva. There is a need for shifting the approach from disaster recovery to disaster reduction and 'focus on human security, people education and training' with the aim to improve community disaster preparedness. This need is receiving increasing attention at present.

Disaster Mitigation

Disaster mitigation is one of the central tenets of any comprehensive disaster management programme. It is evident that the overall goal of disaster reduction and mitigation aims at creating a safety culture. In the meantime and as a key element in mitigation policies within disaster-prone countries, public awareness and education play important roles (Davis, et al 2003). Regarding this, a model in the form of a circle is presented in Figure 1. The model of the disaster mitigation circle narrows down to public awareness and finally to education as a core element for raising the awareness of the public. It becomes even narrower and focuses mainly on educating children with the aim of transferring the knowledge from them to their families. It also highlights the interrelationships of all the rings of this circle and the way disaster mitigation is linked to public awareness.

Figure 1: The overall disaster mitigation circle and interrelationships of the rings



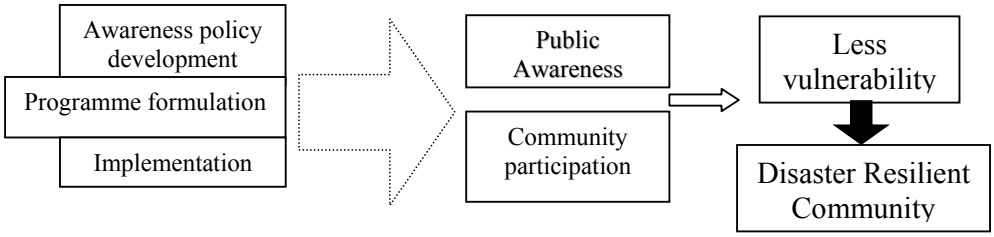
Public Awareness Programmes

The importance of developing effective and sustainable public awareness programmes became evident during the International Decade for Natural Disaster Reduction (IDNDR). These initiatives included the practical ways for individuals and communities to protect themselves from disaster risks. Public awareness is a broad process embracing public education, simulated drills as well as life-saving plans. The objectives of a public awareness programme are achieved by the exchange of specific information through various media concerning ways to ensure personal and community safety to all who are 'at risk' (Davis, 2000). The word 'exchange' denotes that the information needs to be conveyed up the system, from the public to policy-makers as well as down from the disaster community to the public.

Evidence from numerous disasters indicates that where societies had been prepared and educated for damaging events, significant reductions have followed in reduced casualties and physical losses. For example, the dissemination of information on the warning of heavy rains through radio-stations in Mali in 1998 resulted in an effective displacement of over 300 persons in the flooded area. Also, a national programme in Cuba raised the people's awareness of hurricane threats and as a result at the onset of hurricane season in 1998, during Hurricane George, around 700,000 people, together with their cattle were evacuated (Davis et al, 2003).

Disaster preparedness and hazard reduction initiatives can be introduced to people to minimise longer term social and economic disruptions resulting from hazard impacts. The general awareness policy development and its relation to disaster mitigation is shown in Figure 2 (Davis et al, 2003).

Figure 2: Relationship between public awareness policy and disaster reduction



In addition, what should also be considered is about what information is specifically needed by different range of people who are at risk. For example, a seven year old child may encounter the hazard threat the same as his grandfather, but each one requires a very different message to suit different perceptions and everyday circumstances. Also differences in social groups require different information channels or materials.

Disaster Education

Disaster education has been effective from many years ago. It has been proved in many countries that education is one of the best media for making a community prepared for disasters. In other words, one of the best ways of publicising awareness programmes can be the integration of these initiatives into children's programmes in both preschool and school levels. There are various issues on health, safety and hazards that have been incorporated to a greater or lesser extent into the formal curriculum in schools. The aim is to increase the knowledge and understanding of children about risk and teaching them the preparedness issues and also how to react in the time of a disaster (Twigg, 2003).

Why Children?

These days, schools and particularly children present a very crucial role in the development of a culture of prevention. Young people especially the existing generation learn easily and they can act as good channels for transferring the ideas to their families.

They should be encouraged and motivated even from the teachers for a direct and active participation in order to make them involved in making the world move toward a safer living place. The theme of the United Nations 2000 World Disaster Reduction Campaign was "Disaster Reduction, Education and Youth" which aimed to continue and develop a culture of prevention through education channels so that young people can take a pro-active role in understanding risks and reducing the impact of disasters. The campaign notifies that

> *'A culture of prevention is something that forms over time. What is needed is a change of attitude, based on the conviction that we do not need to be fatalistic about disaster risks and a willingness to act upon that conviction. The mind-set is best developed at any early age'.*

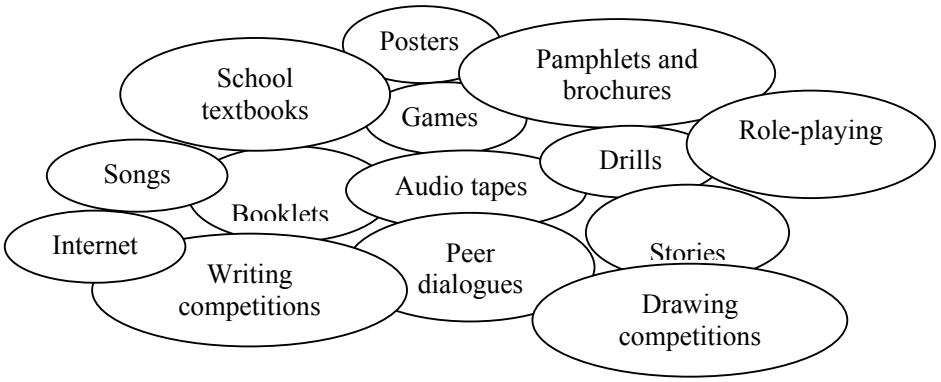
Therefore, children are believed to be more receptive to new ideas than adults and they can also influence their peers and parents. These days many disaster mitigation and preparedness programmes have tried to introduce disaster issues into schools.

Why Preschool and School Levels?

Nursery schools can be an ideal place for children to learn about disasters. They can then pass on to schools with basic background knowledge about disasters and its consequences. In the next level, schools can play a major role in the development of good citizens (Lidstone, 1999). Schools particularly children can contribute in developing a culture of prevention and safety. They play a vital role in the community and are considered as a very important institution in forming the culture of a society. During IDNDR, the strategy of supporting school disaster education was developed. The aim was to instruct the students with the preparedness guidelines in disaster mitigation. The strategy also aimed to raise the public awareness and education toward disasters and risk reduction. The challenge was to shift to the culture of prevention through the school system. In accordance, many countries, such as Iran, Nepal, Vietnam, etc developed strategies for supporting disaster education in schools. The purpose was to include the information that may be used for students as the next generation in order to make them the leaders for raising the awareness of their communities in the future.

It is believed that schools can be used for disseminating knowledge as well as acting as an interface between those who are willing to reduce the impacts of hazards. Therefore, having a plan for disaster education to be inserted in the textbooks of the elementary, secondary and high school students in many parts of the world, developed as well as developing countries such as Iran has been proposed and already implemented. Also various programmes and activities have been designed and used in different parts of the world for teaching children on disasters as shown in Figure 3.

Figure 3: Various media used for teaching about disasters to children



Children Awareness Initiatives

There are various initiatives for raising child awareness regarding disasters, and there are many different media as well as a range of educational materials for schools. Providing a data bank of all the existing materials is difficult, if not impossible, however that is beyond the scope of this paper.

Iran as a developing country has been selected as the case study in this paper. Also few other initiatives from developed as well as developing countries are mentioned. The International Institute of Earthquake Engineering and Seismology (IIEES) in Iran has started the public awareness and preparedness on both the earthquake phenomenon itself and its consequences, plus dissemination of safety culture and policies on how to take essential safety measures for different levels of preschool and school children levels. With the cooperation of Ministry of Education, a pictorial brochure titled *"Earthquake Hazards Reduction at Educational Institutions*" has been produced and widely distributed among Iranian school children. Moreover, education-aid materials such as painting books, comic strips, story books, and crossword puzzles are being developed for even a wider spectrum of the Iranian children and youngsters. A bilingual pictorial booklet entitled "*Earthquake Preparedness*" is conducted with the proper procedures and steps that one should take at home or at work before, during and after an earthquake. Another booklet conducted with the cooperation of UNDP titled *"E for Earthquake"* written in both English and Persian will help children to learn the individual precautions to protect themselves at the time of earthquakes. The scientific concepts of the earthquake and safety measures for reducing its damages have been presented in this workbook in the form of puzzles, illustration sand easy-to-read explanations for the children of seven to eleven years of age.

The IIEES safety drill programme has been officially integrated into the curriculum of school children by the Iranian Ministry of Education. The First National drill was held successfully on Nov. 29, 1999 in 15499 high schools in Iran. The Second National drill with the subject of "*Earthquake and Safety*" was held on November 28, 2000 in all Iran's secondary and high schools. The aim of this drill was to prepare students for the appropriate and quick responses in the time of an earthquake. The educational guidelines were sent to all high schools before the drill by IIEES and were broadcast two weeks before the drill through almost all of the radio channels. On that day, the "*Safety Bell"* was heard between 8:30 to 10:30 a.m. for about 30 seconds from the National radio concurrently in all secondary and high schools in Iran. Hearing the bell, the students were to get to correct sheltering according to the guidelines given by IIEES. Radio programmers broadcast educational guidelines to the public. All radio channels broadcast the programmes related to the drill concurrently. This drill covered about eleven million students at a time in 48 thousand secondary and high schools. IIEES with the cooperation of Ministry of Education, the Red Crescent Society of the Islamic Republic of Iran and Iranian National IDNDR Committee were the organisers of this drill. The last drill in November 2003 covered all levels of school children all

around the country. The earthquake drills have also been organised for preschoolers since 2000 and are underway almost once every year.

Disaster lessons are integrated within different curricula such as science, geography, preparedness book, literature, and practice book for different levels of students in Iran. Since 1991 a six-page chapter, explaining the seismic hazards and safety measures, titled "*Safety Against Earthquakes*" has been inserted in the geography textbook for students of 8th and 12th grades. Also IIEES has authored and designed a special textbook titled "*Earthquake Preparedness*" which is added to the 8th, 9th and 10th grades curricula. A lesson entitled "*Mysteries of Earth*" has been included in the literature textbook of the 8th grade. A similar plan has been implemented for the elementary school textbooks. A chapter has been inserted in the science textbook of 4th grade and a chapter called *"Calmless Earth"* has been included in the 5th grade science book. This nationwide programme is being completed with the cooperation of the Ministry of Education and many related organizations.

Also in other countries such as, Costa Rica, the book entitled *"Como Enfrentar Un Terremoto"* is produced about the geography of earthquakes with guidelines for children and adults. The Fiji Red Cross has produced a kit with lessons and issues for teachers on earthquakes, tsunamis, fire, floods and cyclones (Lidstone, 1999). As examples of school curriculum materials on disasters, in many different developed countries such as Australia and New Zealand, the hazard subject is taught in the geography lesson. In the United States, both hazards and environmental studies are part of the science lesson. Also in UK, teaching about disasters is inserted in geography and science curriculum (Brownlie, 1999).

There are also various websites regarding information on disasters for children. IIEES Public Education Department has provided a website for children, (http://www.iiees.ac.ir/edu.kids). The most widely recognised website is FEMA website, (http://www.fema.gov/kids), in the United States with tips for children on how to get prepared for disasters. There are also various resources for teachers and parents on the website and the safety rules for disasters. It also contains a 'connection line for kids to kids' that children can give their ideas about disasters and also to submit any drawings for other children to view online. Also USGS has a site for kids, including information on earthquakes, science of earthquakes and earthquake facts. The Australian IDNDR Committee has funded the development of a CD-ROM multimedia programme entitled *"Hazards Happen"* for schools (Lidstone, 1999). In Queensland, Australia, a CD-ROM game has been designed to instruct children for appropriate preparatory behaviours for cyclones called *"Storm watchers"*. In this educational package, children are offered a choice of five scenarios in preparation for a cyclone. Children in these scenarios are faced with a range of interesting experiences and social situations (Berry and King, 1998).

It is worth mentioning once again that in designing disaster awareness programmes, many factors need to be considered such as age and sex of the children, however, the overall emphasis of most of these initiatives is still on the safety procedures as what to do before, during or after a natural hazard.

Problems to Overcome

As mentioned before, there have been several disaster education programmes in developed as well as developing countries for children, and most of them are being improved more and more. However, there are some problems which are particularly related to developing countries. One is the great difference between the level of education in the capital and other cities, especially small towns. This is while, in most cases, the victims of disasters in these countries are the people living in small towns and villages. Because of the local cultural problems and religious beliefs of the people living in those areas there is some kind of inherent resistance to every change of manner or

diversion from the traditional live styles. This decreases the level of acceptance of newly-taught materials in general, and even nullifies them in some cases. To overcome this problem it is suggested to choose some selected groups of people from each area for a pre-education process before disseminating the materials to the community, including children. The authors believe that the school teachers are the best candidates for these selected groups of people in those areas.

Another problem is the availability of internet and other information dissemination tools in developing countries which is much less than developed ones. In a recent paper of the authors, the use of internet communication in increasing earthquake disaster awareness and preparedness has been discussed (Izadkhah and Hosseini, 2004). The necessity of contribution devoted by developed countries to developing ones for increasing the mentioned availability is emphasised. This can be, at the same time, much more effective than the aids given to these countries after a disaster such as a devastating earthquake.

Conclusions

It is assumed that educating the general public through children in the early levels of their education is another non-structural mitigative approach which has been increasingly used in disaster mitigation strategies with positive results. Children as the leaders of tomorrow and future can protect themselves and their environment in the long-term through a global culture of prevention. This will help them to guarantee their own, their family and their community safety as they grow up. They are considered as 'powerful forces' in behavioural change for the next generation.

It has been well proved that an effective public awareness programme can create an 'informed and self-reliant' community able to take protective measures. A programme of public education should become a continuous process which can devise long-term low profile campaigns through general education, or as an integral part of the school curriculum. It is hoped that the continuous implementation of children initiatives in different developing countries result in successful public awareness raising and therefore grow the seeds of less vulnerable and more resilient communities in the future.

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A SOCIO-TECHNOLOGICAL APPROACH TO DETERMINING APPROPRIATE LEVELS OF PROTECTION FOR PUBLIC SPACES

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Keywords: Physical security; counter-terrorism; social judgment theory; risk management

Abstract
Since September 11, 2001, the vulnerabilities to terrorism of our urban areas, and how best to address them, have been subject to considerable discussion, debate, and reflexive defensive measures. However, despite the continued threat of terrorist vehicle-bomb attacks worldwide, a coherent strategy for protecting public spaces while maintaining access to them has yet to emerge. Protecting people, building and other public spaces from bombing attacks essentially has been framed as a binary decision problem with "security" and "openness" constituting mutually exclusive poles. This has limited discussion of critical issues such as what the public views as appropriate levels of protection, what constitutes a prudent government response, and the sustainability of long-term public expenditures. Although the imposition of direct physical barriers as a response to such frightening events is certainly understandable, it is not based on a true assessment of risk, nor does it necessarily represent an effective, let alone cost effective, approach to addressing the threat of urban terrorism. This paper will discuss how methods from the social and policy sciences can be used to develop balanced approaches to physical security and help to establish realistic priorities for implementing them. It will seek to demonstrate that a holistic strategy that integrates social values with technical and fiscal objectives is achievable and will achieve far greater long-term security than reliance on physical measures alone.

Introduction
Since September 11, 2001, the vulnerabilities to terrorism of our urban areas, and how best to address them, have been subject to considerable discussion, debate, and reflexive defensive measures. Physical access control measures have ranged from "temporary" concrete barriers, to planters and street furniture, to permanent bollards. These are usually supplemented by armed guards aided by closed circuit TV cameras and other surveillance measures. Buildings have received retrofit window treatments and structural enhancement of columns and slabs to mitigate blast effects, and some buildings are being considered for systems of sensors and filters to guard against chemical and biological agents. Although these direct physical responses to the frightening events of September 11th are certainly understandable, they are driven more by the desire to protect people and assets from what could happen rather than what is likely to happen. In other words, these measures address the *vulnerability* of people, buildings, and other public spaces to certain

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types of attack and not a true assessment of the *risk* of that attack. This approach essentially removes the public from the decision process and eliminates from consideration any willingness on the part of the public to accept some portion of that risk. It is not surprising then, that the debate over appropriate security for public places has often degenerated to a simple binary set—secure but unaesthetic on one side and attractive but vulnerable on the other.

Providing Physical Protection

Until modern explosives and aerial bombardment rendered them moot, most physical protection strategies for cities and towns were aimed at keeping an attacker at bay by means of moats, walls, and other physical obstacles. Even today, *standoff* (the distance between a bomb and its intended target) is still considered the most effective defense against a terrorist vehicle bomb because blast energy falls off with the cube of the distance and dissipates very quickly. It is for this reason that the initial reaction of those faced with "doing something" to enhance security is often to move in the concrete barriers and checkpoints in the hope of maintaining an adequate standoff distance. However, when effective standoff distance is not available or cannot be enforced by these measures, other steps can be taken to protect targeted buildings from bomb damage.

The numerous terrorist bombing attacks experienced in the past twenty-five years have generated considerable research into the effects of bomb blasts on buildings and people (NRC, 2000). As a result, the vulnerabilities of buildings to deliberately placed bombs are reasonably well understood, as are the relative effectiveness of various countermeasures (Little, 2002). Blast-resistance in buildings is generally provided by passive features such as additional reinforcement and connections in the structural frame for increased ductility, composite fiber wraps to prevent shattering of columns and slabs, and high-performance glazing materials that resist blast pressures (AMPTIAC, 2003). When such structurally-enhanced buildings have been attacked, these measures have been shown to be effective in reducing damage and casualties (Mlakar, et al, 2003).

Security and Risk

Although governments and other stewards of the public welfare have a clear responsibility to provide for the safety of those entrusted to their care, , the government must also consider the cost of providing that level of safety to buildings and infrastructure. Ultimately, a choice must be made whether an investment to reduce risk to those directly affected is of greater benefit to society than expending the funds for some other purpose (NRC, 1985). Given the high cost of providing security to all public buildings and spaces, this is a question that reasonably should be considered by the public at-large. In any event, as has already been determined in the provision of seismic resistance, questions of this type are not for engineers to answer alone (NIST, 1994).
Risk assessment has classically been defined by three questions (Kaplin and Garrick, 1981):

- *What can go wrong?*
- *What is the likelihood that it would go wrong?*
- *What are the consequences of failure?*

Although these questions are relatively straightforward, in practice they often prove difficult to define precisely. Therefore, risk management seeks answers to a second set of questions (Haimes, 2002):

- *What can be done and what options are available*? (What is the mix of site selection and configuration, building features, and management practices that will provide the desired level of protection?)
- *What are the associated trade-offs in terms of all costs, benefits, and risks*? (For example, reduced risk and improved confidence in security normally would be traded off with increased cost.)

- *What are the impacts of current management decisions on future options*? (Policy options that seem cost-effective at present must be evaluated under plausible future changing conditions. For example, providing certain physical protective features may preclude building modifications to increase functionality in the future.).

These questions are particularly relevant to the current discussion because experience has shown that all too often "temporary" security measures become *de facto* permanent solutions (NRC, 2003). In effect, these measures represent a precautionary approach to the possibility of future attacks without further discussion or assessment of risk, costs, or benefits. Such physical protective features typically target generic vulnerabilities and are not generally selected based on a quantified (even if somewhat subjective) risk calculation.

Given the high cost of implementing an effective physical security strategy for public buildings and spaces, the participation and knowledge of all affected parties, including citizens, policy-makers, law-enforcement officials, building owners and occupants, planners, architects, engineers, and security specialists should be elicited. Much of the current debate on security in an open society is unproductive because it fails to recognize the distinct difference between the technical elements in the risk calculation (e.g., terrorist threat levels, tactics, bomb sizes and delivery methods, building construction, etc.) on the one hand, and community value judgments (i.e., architectural aesthetics, freedom of movement, etc.) that must be incorporated on the other. The social and policy sciences provide some interesting and useful tools to frame this complex and often emotionally charged discussion and three of these tools will be discussed.

Three Useful Tools for Goal Setting and Decision-Making

Three useful tools for goal setting and decision-making within the context of protecting public spaces are judgment analysis, the Taylor Russell diagram, and the system dynamics model. Each of these tools was developed for a different purpose and adapted for policy formulation over time. The first, judgment analysis, can be used to design a safety indicator for a given public space that is based on a consensus judgment of a group of technical experts. The method of judgment analysis and the theory surrounding it, Social Judgment Theory (SJT), is about 50 years old (Cooksey, 1996; Stewart, 1988; Hammond, 1955; Brunswik, 1955). SJT was recently reviewed by Meacham (in press) as a potentially useful approach to fire risk problems. The second, the Taylor-Russell diagram, can be used to engage public values in a decision about the appropriate threshold for that safety indicator, that is, how much safety is "enough." This tool dates back to signal detection theory (Swets et al., 1991; Green and Swets, 1966) and has been effectively applied to a variety of policy formulation questions (Swets, 1992; Hammond, 1996). The final tool, the system dynamics model, can be used to investigate a management or regulatory structure to allow for changes to the indicator threshold over time and across contexts. The system dynamics model is a computer simulation tool developed by an electrical engineer who addressed business strategy problems (Forrester, 1961). Like the Taylor-Russell diagram, this tool has been applied outside its original domain to great effect; these applications have been reviewed in depth by Sterman (2000). Each tool is presented in turn, together with the scenario for its application, the method, and the outcome or deliverable that would result.

Judgment Analysis

In the development of a physical protection strategy for public spaces and buildings, it is important to have an index or indicator of safety. One way to construct such a safety indicator would be to gather historical data about how spaces with particular attributes performed in the past under a range of actual bombing attacks. Next, a regression analysis of building performance could be conducted with respect to the various features of the buildings and attacks (e.g., bomb size, standoff distance, building type). Once the regression parameters were established, other buildings could be scored on how secure they would be against a given type of attack. This approach requires

abundant and accurate data that is often difficult or impossible to obtain. But even without such data, it is still possible to develop an indicator by analyzing the judgment of experts.

The development of an indicator using judgment analysis involves the following steps (Cooksey, 1996). First, experts could be interviewed about the attributes of the problem that constitute the cues to the judgment of safety, including active security measures, standoff, and building features. While experts might differ on the importance of each of these to overall safety, they may be able to agree on a list.

Second, real buildings could be sampled to assemble a representative set of cases with attributes that occur together in plausible ways. (For more on representative design, consult Hammond & Stewart, 2001; Cooksey, 1996; Stewart, 1988; Brunswik, 1955). Third, once a set of representative cases has been gathered, each expert could rate each case for safety. Finally, regression analysis could be used to model each expert's "policy" for making judgments of safety. The judgment policy would represent a weighted combination of important safety factors, with the importance weights determined from expert judgment as influenced by past experience, research results, and so on.

Note that the reason for using regression analysis is that people (including experts) are not always accurate about the judgment policies they hold or that they assume others hold. The use of statistics greatly increases the likelihood that the exercise will produce actual expert judgments rather than the experts' guesses about how they make judgments. The policy of a given expert could then be applied to any building to determine a safety score.

If all the experts' judgment policies matched, the result would be a consensus safety indicator. However, consider a scenario in which there was no clear expert consensus. Perhaps one expert thinks that active physical security is the most important factor in safety and another thinks that passive features such as standoff and physical hardening are paramount. Where experts show differing judgment policies, one could cluster expert approaches. In this case, indices might be developed to represent the different clusters.

A judgment analysis could provide insight into how diverse experts rate buildings on safety, as well as models of the judgment policies of clusters of experts. With time, one could conduct research to assess the relative effectiveness of the differing judgment policies. Meanwhile a policy maker, or advisory group charged with developing policy recommendations, could craft a compromise among the judgment policies to create an acceptable indicator of safety. The result would be an experience-based safety index for security features.

The Taylor-Russell Diagram

If it is assumed that there is an indicator with a known success rate at predicting building safety, whether developed by analyzing past data or by analyzing expert judgment, the next step is to select a safety threshold or cut-off point, such that buildings above the threshold would be considered "safe," and those below it would be considered "unsafe." Unless the indicator is perfect, any threshold for a safe/not-safe decision will result in some buildings rated as safe when they are not (false positives) or some buildings being rated as unsafe when they are safe (false negatives). A Taylor-Russell diagram can be used to clarify the components of this situation (Hammond, 1996; Green & Swets, 1966).

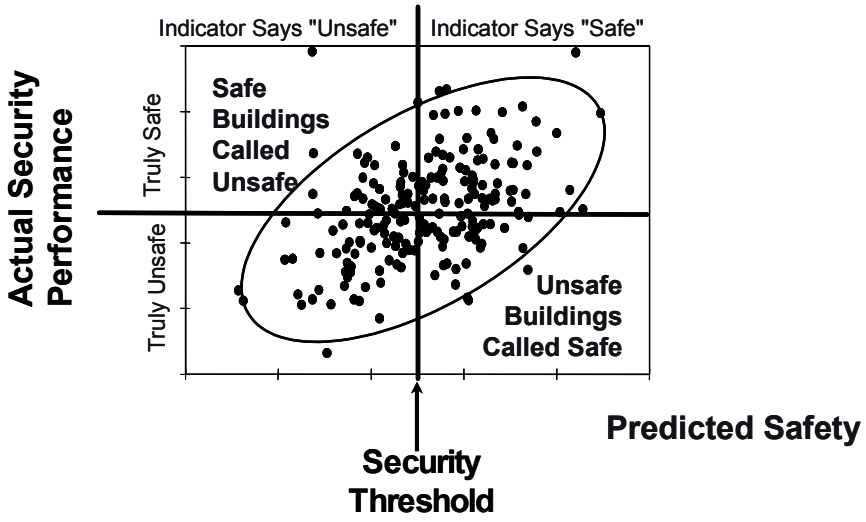
A Taylor-Russell diagram is presented in Figure 1. Along the horizontal axis are building safety indicator scores. Along the vertical axis are building security performance scores. Each point represents a particular building. The quality of the indicator is shown by the spread of the points around a line angled at 45 degrees.

A lower or "lenient" threshold for an acceptable level of building security may reduce costs, but there is a risk of constructing buildings that will turn out to be unsafe if attacked (false positives).

On the other hand, as the threshold for the acceptable level of security is raised or made more "strict", unnecessary costs on the builder may be imposed as unnecessary security measures are implemented (false negatives). Hammond (1996) describes this tradeoff between false positives and false negatives for any choice of threshold as the duality of error, which is made instantly visible in a Taylor-Russell diagram.

A Taylor- Russell diagram is constructed by plotting individual buildings as points, with their predictive indicator score along the horizontal axis and their actual performance score along the vertical axis. Next, a threshold for true safety is set.

Figure 1: The Taylor-Russell Diagram



Finally, a value-based threshold on the predictive indicator is set that results in consequences (false negatives and false positives) that are tolerable to all stakeholders in the process. By splitting the diagram into quadrants, one discovers the number of true positives (i.e. "safe" according to the indicator and safe in reality), true negatives (i.e. "unsafe" according to the indicator and unsafe in reality), false positives (i.e. positive according to the indicator for safety, but unsafe in reality), and false negatives (i.e. negative according to the indicator for safety, but quite safe in reality) that result from the threshold selection, given the uncertainty or quality of the indicator.

Note that the number of false positives and false negatives depends not only on the threshold chosen, but also on the degree of association between the indicator and the true safety rating. The correlation between these values represents the quality of the indicator. The indicator will show as much uncertainty as is currently present in the predictive science regarding security measures and actual safety.

Working with a Taylor-Russell diagram, individuals can discuss the numbers of false positives and/or false negatives they are willing to accept and, given the quality of the indicator, they can select an appropriate threshold. The Taylor Russell diagram provides a means of envisioning simultaneously the connection between 1) the choice of threshold; 2) the effectiveness of an indicator; and 3) the resulting consequences.

The System Dynamics Model

Imagine that an indicator has been chosen, data obtained on its performance, and a threshold selected. Ideally, the community at large would accept this as a stable threshold. Unfortunately, it cannot be guaranteed that the selected tradeoff of false positives and false negatives will be shared by others or that the particular threshold selected will always be appropriate. In fact, if a highly

salient event occurs for which there is a false positive, say, a building turns out unexpectedly to be unsafe (i.e., it performs less well than expected) those constituents concerned with safety will pressure policy makers to move the threshold higher. This debate is currently raging about the performance of the twin towers of the World Trade Center in New York with implication for both structural design and fire protection. As additional safety measures are implemented for buildings that were already safe enough, there will be diminishing returns on investment. The community concerned with the cost of buildings might then pressure the policy makers to lower the index. Swets (1992) has described the potential for a threshold to oscillate in light of recent salient events. Hammond (1996) suggested that the oscillation would occur as stakeholders respond to recent events and pressure policy makers to change the threshold. Weaver and Richardson (2002) designed a system dynamics simulation to analyze the systemic requirements for such an oscillation to occur.

As the selection of a threshold represents a value-based decision, it may become outmoded as societal values respond to recent events and as indicators improve. In order to have a responsive policy context that is protected from too rapid and vigorous an overreaction to recent events, it may be necessary to build in legal structures that manage or regulate the threshold in an appropriately responsive manner. These phenomena are particularly amenable to computer simulation that can model a much broader range of scenarios than would be found in practice.

A model that includes the legal and political regulatory structures that affect the policy threshold can be created that will permit the testing of different regulatory environments, including penalties for non-compliance, avenues for complaint, community values about outcomes, and the predictive quality of the safety indicator. The simulation might include stakeholder pressures to change the threshold, the quality of the index, the resulting false positives and false negatives and how the entire stakeholder community would react to an unacceptable number of either of these. It could include not only the information for which clear data are available, but also could embed the rich intuitions of experts, so that a broad range of possible scenarios could be tested. System dynamics has been used to simulate similar conditions in other contexts (Sterman, 2000).

The outcome of such a modeling effort would be a simulation that would allow policy makers to test the consequences of various threshold choices and a safety index that improves its predictive quality over time or with resource investment. In addition, it would allow them to set up and test a management and regulatory environment that would build in constraints against too sensitive a response to recent events, while guaranteeing the flexibility to update the model.

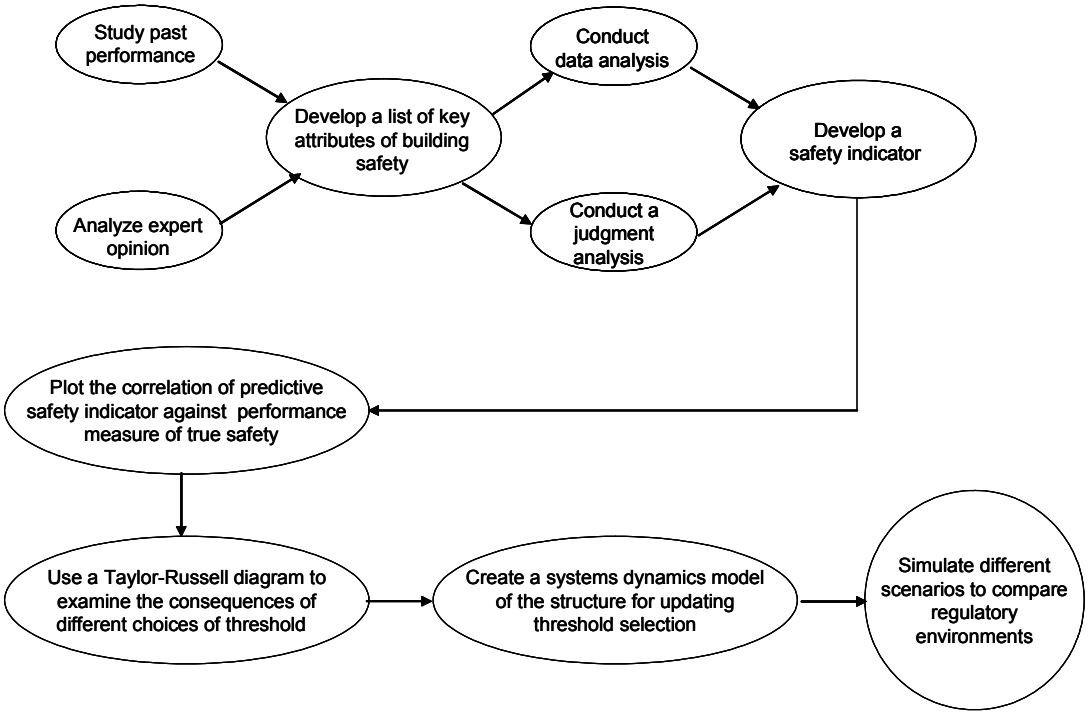
Summary and Conclusions

Unfortunately, we find ourselves in a time where former contexts of threat, vulnerability, and target have all changed and continue to do so. Threats are unpredictable and the full range of threats probably unknowable. We will never be able to anticipate all possible threats and even if we could, there is not enough money to deploy technologies to address them. Security in this situation needs to be flexible and agile and capable of addressing new threats as they emerge while still meeting the demands of the public for attractive architecture and free access to public spaces. This cannot be a one-time investment but rather an effort that will need to be revisited periodically as threats, resources, and community values continue to change.

Three tools from the social and policy sciences have been introduced for use at different stages of the process of developing a rational and holistic approach to security. Judgment analysis could be used to develop an index of safety; the Taylor-Russell diagram to select an appropriate policy threshold for that index; and the system dynamics model to simulate a policy environment that would respond to unexpected events with appropriate adjustments. Figure 2 illustrates how these three tools could be used together to include all stakeholders, experts and lay persons alike, in the

development of consensus levels of security for public buildings and spaces that achieves aesthetics and openness with reasonable security and safety.

Figure 2: A model for applying three useful tools for goal setting and decision-making.



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WHY DON'T THEY LISTEN – DEVELOPING A RISH COMMUNICATION MODEL TO PROMOTE COMMUNITY SAFETY BEHAVIOUR

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Keywords: risk communication, community safety, risk perception, audience segmentation, natural disasters.

Abstract
This paper will outline issues relating to developing a risk communication model in the context of severe but infrequent disasters such as significant floods, bushfires or storms. It will investigate the concept of risk perception and the elements that contribute to an integrated community safety campaign. The paper will review traditional approaches to community education that have been used by emergency agencies. It will suggest a need for an integrated risk communication model that acknowledges community perceptions about the risks they face, and while encouraging self-reliance, also acknowledging the limitations of this approach. It will then present a coherent conceptual framework for communicating and involving the public, focusing on the pre-disaster phase.

It also explores the risk optimism bias that occurs when communicating with people about natural disasters. Integral to this approach is the belief that people do not categorise all risks as the same and will underestimate or overestimate the risk according to their perception or understanding of the impact on their lives. The principal factors that contribute to an effective community safety program are explored including the nature of the disaster and associated risk, the perception of the risk and peoples willingness to act, identifying the stages of risk communication, identifying audiences and associated messages and community resilience.

Introduction
The emergency management field is in the midst of historic changes. The focus of expectations has changed dramatically, from a pure emergency response to a proactive 'risk management' approach involving disaster mitigation, prevention, and risk communication (Keys 1999a, Buckle 1998). At the same time as expectations of emergency services are changing, so is too the nature of the public changing.

These expectations reinforce the need for innovation, rigorous planning and an evidence-based culture in the design of community safety programs. However, while there has been considerable education resources developed in Australia, there has been little research to substantiate a link to an appropriate risk communication model: one that explains the relationship between vulnerable communities and their willingness to become involved with community safety programs (Boura, 1998).

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Traditional approaches to community safety

Traditional education approaches, often called public awareness programs, are currently being questioned. Historically, when emergency services have undertaken community education, they have informed the community about hazards and their risks through distribution of prepared material emphasising actions residents can undertake to protect themselves and their property. The communication process was often one-off and one-way, and assumed that the audience was an indistinguishable group of individuals who had the same needs and values.

The number of resources distributed measured the effectiveness of this traditional approach and the extent to which individuals implemented safety messages. The messages contained details of specific information or action necessary to prepare for an emergency. The indicators used to determine a successful campaign were focussed on the ability of the individual to demonstrate an awareness of the safety messages presented.

This traditional model is one where the emergency professional is the 'active agent' and the community member is the passive recipient of appropriate messages (Macdonald, 1998). The deficits of this model are at last being recognised and research has questioned the effectiveness of these education strategies in changing people's behaviour.

Implicit in this approach was the assumption that there was a direct correlation between awareness raising and behavioural change. "It is frequently assumed that providing the public with information on hazards and their mitigation will encourage preparation. This assumption is unfounded." (Paton *et al.*, undated). This failing of the traditional Information-Action model is contained in the supposition that merely informing the individual or community about a hazard, will lead to awareness and awareness to actions, and then to sustained behavioural change. Boura (1998) identifies the weakness in the belief that there is a strong and direct causal link between receiving information and acting.

Finding Better Risk Communication Approaches for Community Safety

It is apparent that new approaches are required to create the desirable behavioural changes. The focus in the current methodology on individual behavioural change through conveying information needs to be broadened to include social or community factors. Fortunately, rather than re-inventing the wheel, we are able to learn and adapt approaches and models which have been proven in other jurisdictions -- notably health promotion, social marketing, community safety and adult education -- to present a community safety model that identifies and addresses the concerns of all affected groups.

The behavioural models that have influenced the development of community safety programs are summarised in Speaking of Health (Institute of Medicine 2002). The first of these health promotion models is the Health Belief Model. According to this model, two main factors contribute to a person's willingness to adopt appropriate health behaviours. The person must believe that there is a significant risk to them and the suggested benefits will compensate for the cost of undertaking the appropriate behaviours. The second is the Social Cognitive Theory, that emphasises the importance of individual self-efficacy, or self-confidence that they can exercise some degree over their behaviour and the outcomes they want to achieve. The Theory of Reasoned Action asserts that the extent of behaviour change can be viewed as a function of a person's attitude towards performing the action and a person's perception of what his/her peers' attitude is towards performing the task. The identification of community norms as an incentive or hindrance to change is an important factor, especially in low perceived/high actual risk environments, and highlights the need to work closely with community expectations.

Factors that Influence Community Safety

One of the most contentious issues in the emergency risk communication field is the identification of factors that contribute to a successful community safety program. Previous programs had centred on the Information/Action model; however, research carried out by Pfister (2001) after the recent Grafton floods, have demonstrated that hazard and risk information, when distributed in isolation from the social setting, will not have a significant impact on awareness or behavioural change.

The principal factors that contribute to an effective community safety program include:

a) The nature of the hazard and associated risk;
b) The perception of the risk and people's willingness to act;
c) Identifying the stages of risk communication;
d) Identifying audiences and associated messages; and
e) Community resilience.

The nature of the hazard and associated risk

Emergency managers frequently express frustration with the public when they demonstrate a lack of concern at what experts know to be an extreme risk that threatens a community. This is particularly so when managers need to communicate the risk resulting from an infrequent but severe hazard.

As risk managers, one of the greatest dilemmas in flood and storm communication is how can the public be alerted to the risk of low-probability, high-consequence disasters such as severe floods? The conventional wisdom is that people need to be convinced of the risks. It is our role as risk managers, to give them sufficient details of the hazard, so that they will be prepared to protect themselves from the consequences.

However, conventional wisdom runs into a wall of public indifference -- an indifference with its own logic. "Why should I concern myself with risks that -- while they may be severe -- are rare and usually low-intensity, and which the government and emergency agencies are practiced at managing?" The fact is, we may be asking the public to act on someone else's problem – in this case, the risk manager's problem. The issue then becomes one of not only identifying the actual risk from a severe hazard, but also understanding how people will perceive the risk and be willing to adopt protective behaviours.

Risk Perception

Integral to the community safety approach is the belief that people do not categorise all risks as the same. In other words, they will underestimate or overestimate the risk according to their perception or understanding of the impact of the risk on their own lives. In situations such as an infrequent but severe hazard, the decision-making process is made harder by the complex variables that influence an individual's perception of the risk.

Sandman (1994) found that people were often hostile to the idea that they are at risk. People judged themselves less at risk than the 'average' person to a variety of natural and technological hazards. This view dominates most responses to risk, and people support it by devising a rationale for the conviction that the hazard will pass them by, or that it will only inflict minor damage to their property.

According to the Optimism Bias model, people usually underestimate risks because they would rather believe they are safe, free to live their lives without the responsibility of feeling vulnerable and obliged to make difficult or unpopular decisions that would affect their lifestyle.

Stages of Risk Communication

Risk communication may be defined as an interactive process of exchanging information and opinions between stakeholders regarding the nature and associated risks of a hazard on the individual or community and the appropriate responses to minimise the risks. The key to behavioural change lies in risk communication designed to change people's perception of the risk and to increase their willingness to manage the risk.

Several models of self-protective behaviour postulate that different messages are important at different stages of the process. Information about risk magnitude may be most important in making people aware of risks they have never heard of, while information about personal susceptibility may matter more in the transition from awareness to the decision to act. (Sandman, 1994)

Thus, specific risk communication activities can be viewed in discrete environments, with each environment and the audience determining the purposes, approaches and safety messages.

Identifying audiences and associated messages

A perennial challenge in risk communication is how to target the right safety message to the right audience. There is a related question of cost effectiveness - there is no point in spending time and effort if the audience is unlikely to respond to the specific message. If every community safety project focuses on different audiences, with different methods and messages used to achieve their aims, a system needs to be developed to logically categorise the different types of communication and public involvement approaches. Arnstein (1969), whose system is in widespread use today, has addressed this issue, by identifying successively stronger degrees of public empowerment and transparency in the communication process. Audience segmentation is therefore an important issue in program design.

Audience segmentation

This paper has focused on three main segmentation criteria that have been identified by researchers: demographic factors, psychological traits and degree of personal experience of the hazard.

Though often discussed, demographic variables do not appear to be frequently used as primary criteria for segmenting audiences in risk communication marketing campaigns. This may be because it has proved difficult to isolate the demographic variables that determine a person's willingness to act on safety messages. While intuitively it may make sense to link specific variables such as income and education standards to the willingness to accept and act on safety messages, little hard evidence has so far been identified to support these ascertains.

The area of psychological however, has proved more valuable in identifying attitudes towards risk. Psychologists have tried to explain predispositions to act based on psychological traits such as perceived self-efficacy, anxiety, and independence. In other words, people who are confident and want to be independent are more likely to be risk averse.

A recent AC Neislen social research project explored disaster preparedness in Brisbane, Cairns and Charleville (AC Neilsen 2003). In analysing the results of six focus groups, the researchers proposed two underlying psychological traits: level of anxiety and level of personal independence. The results may be viewed a matrix that aimed to predict both likely responses in a disaster and audiences' differing communication needs.

Table 1: An audience segmentation matrix. (Developed by O'Neill and Robinson 2003)

Self-efficacy:	**Independent** (make own decisions: self-empowering, confident)	**Affiliative** (socially connected - await decisions by authorities)
Low anxiety	**"Warriors"** **Risk seekers** - Feel disasters are a rare occurrence - Believe they can handle any situation - Don't believe preparation will make a difference - Will want to act independently from safety advice	**"Minimisers"** **Risk deniers** - Feel disasters are low probability - Believe a disaster won't be that bad - Don't believe it will interfere with their lives - Will expect help from emergency workers
Higher anxiety	**"Controllers"** **Risk averse** - Feel disasters are powerful - believe their own actions can make a difference - Believe that preparation can prevent further damage, save cost and time - Want to take care of the risk to their family (risk managers)	**"Watchers"** **Risk tolerant** - Feel disasters are dangerous and scary - Focus on ensuring family and community safety - Believe being prepared will mean less chance of damage or injury - Will need assistance to manage the risk

The need to identify risk-averse audiences has long been a goal of emergency agencies, as they are the most productive group to work with. Pfister (2001) surveyed Grafton residents after the 2001 floods and concluded that about one-third of respondents were 'risk averse'. However, a well-designed communication program may develop messages and tools for all four audiences. Table 2 demonstrates the way different messages can be developed for specific audiences.

Table 2. Developing Messages for different target audiences

Risk averse	Concerned with same hazard as the agency	Target this group with hazard-specific information and messages and focus on how they can manage their response to the risk (i.e. what to do in a *flood*).
	Concerned about different hazards to the agency	Target this group with non-hazard specific safety initiatives (i.e. what to do in *an emergency*). (Potential for joint agency partnerships)
Risk tolerant	Ambivalent about the hazard or the effect on them.	Target this group with general information about the hazard. Highlight the risk from the hazard and how it will affect their family.
Risk deniers	Denies that the hazard will occur or that it will affect them.	Target this group with messages that build the credibility and authority of the agency.
Risk seekers	Sees a disaster as an opportunity to become involved in rescue efforts or to pursue their interests.	During the event, warn of the dangers and the penalties for interfering with the work of the emergency agencies. After the event, target with specific messages relating to safety for individuals and families.

The third factor is the personal experience of the residents. Several studies have highlighted the role of personal experience of disasters as a driver of heightened risk perception (for instance Berry and King 1998, Goulter and Myska 1987). However just experiencing a hazard does not mean that a person will be willing to adopt safe behaviour. This was demonstrated in the 2001 Grafton floods, where the flood waters were within centimetres of overtopping the town levee and people still did not evacuate (Pfister 2001).

Although personal experience is likely to be the best teacher, people may also have surrogate exposures of hazards through vicarious experiences such as commemorations of disasters. As these experiences can't duplicate the personal and emotional turmoil, as well as the physical destruction produced by a significant disaster, they work best in raising general awareness of the hazard and the associated risks.

Resilience

Vulnerability and resilience have emerged as critical concepts in risk management, with research being carried out to isolate the variables that make one community more vulnerable then another during times of disaster. Vulnerability is a measure of the potential for events to damage the resources of a community. The issue of vulnerability involves subjective risk perception that needs to be included in the communication campaign. It is this combination of actual and perceived risk plus the perceived benefits and costs of behavioural change that determines the vulnerability of a community and the willingness of community members to accept safety messages. While technical groups may recognise a high actual risk, if the community regard it as a low risk, detailed or involved risk communication may be counter-productive.

Resilience is a measure of the capacity to recover. These reflect "a situation…whether the people affected can prevent and resist the damage and whether, if the damage does occur, they can recover

successfully" (Buckle 1995 p11). Concerning community safety programs, vulnerability and resilience may be regarded as two sides of the same coin (Buckle 1995). From a risk communication perspective, this means that both individual and community concerns need to be included in a community safety program.

The term 'community resilience' recognises that communities operate as networks and groups, rather than as discrete individuals. This is especially so in times of disaster, as the evidence also suggests that people do not react in isolation, but will help their families, friends and wider community (Buckle, *et al.*, 2003). For hazards that are ill defined or perceived as low risk, it may be more productive to first build up the sense of community resilience, rather than place an undue emphasis on individual responsibility.

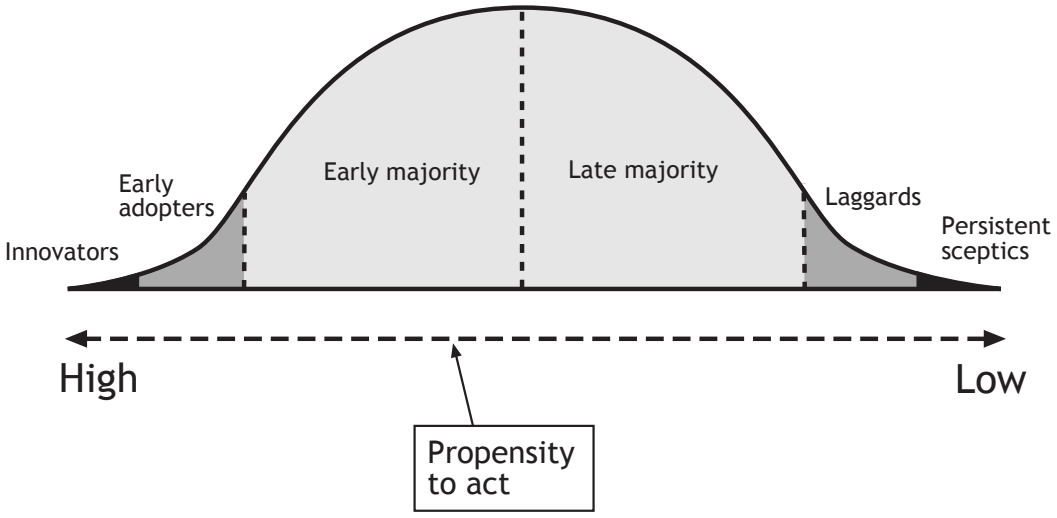
An Integrated Communication Framework

Thus the challenge for risk educators is to devise programs which both alter perceptions of risk and foster protective behaviours in target audiences, while acknowledging that not everyone will go on to adopt appropriate safety behaviour.

The approach discussed will have a significant impact on people who are concerned about the effects of the hazard and are able or prepared to manage their own risk. However, an effective risk communication model should acknowledge the differing perceptions that will guide individuals towards their understanding of their own flood hazard, their vulnerability to the flood risk and their willingness to develop their own risk-management plans.

This approach will also have implications for the development and delivery of warning messages during significant response operations. What is required is a holistic risk communication framework that builds on established insights into the processes of personal and social change. As a starting point, it is proposed to adapt a framework based upon Everett Rogers' *The Diffusion of Innovations* (1962-1995). This theory is widely used to explain the adoption of technological innovations, especially in the rural sector and in commercial product marketing.

Figure 1: The stages of change from the Diffusion of Innovations theory. The vortex shape has no mathematical basis. Its purpose is to illustrate the point.



The Diffusion of Innovations offers two advantages over social cognitive models derived from the health sector. First, it predicts the behaviour of large populations, whereas the social cognitive

models focus on the behaviours of individuals, usually in a clinical setting. Secondly, it offers guidance on the design of the actions which people are supposed to adopt, rather than focusing solely on the psychology of persuasion and decision-making.

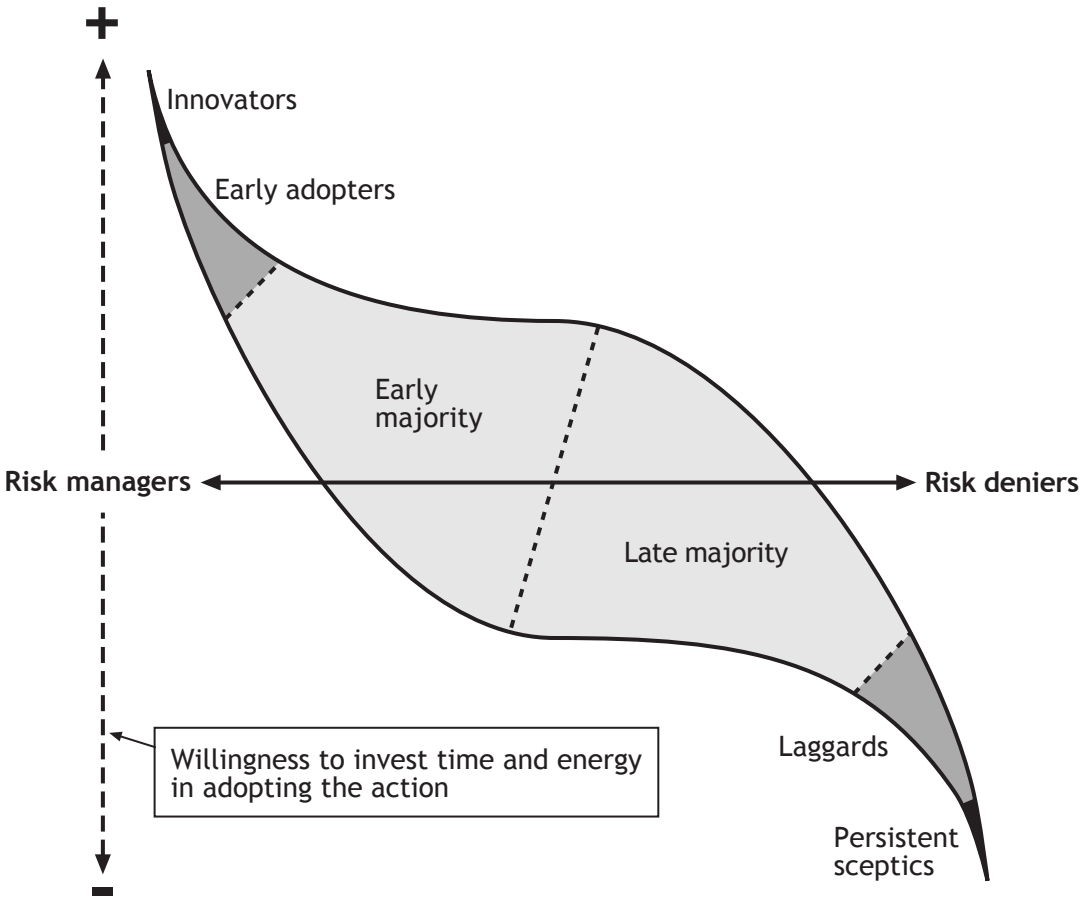
Rogers' theory assumes that consecutive groups adopt a successful innovation or strategy across a population, dependent on their openness to new ideas and willingness to experiment - beginning with innovators, then early adopters, early majority, late majority, and finally laggards.

The propensity to adopt a particular behaviour across a population at a given time, as well as the temporal process of adoption, is illustrated by the standard distribution curve, or 'bell-curve', where the shaded areas approximate proportions of a population in the different adoption classes (Rogers 1995).

Developing the model

Kent *et al.* 2000 developed the Diffusion model further by assuming a different *motivation level* for each of Rogers' adoption stages. These motivation levels notionally represent the different amounts of time and energy that members of the public are likely to invest in adopting a particular innovation. To illustrate, an additional axis is added to the diagram, producing a vortex shape.

Figure 2: The Diffusion vortex, after Kent *et al.* 2002. The vortex shape has no mathematical basis. Its purpose is to illustrate the point. Adopted by O'Neill and Robinson.



The advantage of focusing on desired levels of involvement is that is it possible to match Rogers' adoption stages with Arnstein's typology of participation methods, which also imply a scale of audience commitment.

Implications for Program Design

Many authorities speak of the need for multi-faceted communication programs. This model suggests that an integrated communication program is one that responds to the spectrum of motivational levels in the community. Quite different communication strategies and tools are required to target quite different levels of interest amongst the public. It is also acknowledged that for many people, the only time when safety messages will 'sink in' is during the warning period. Hence, there is not one catch-all educational methodology.

Instead, a holistic community safety program will involve a number of quite different sub-programs under one brand or banner. They would require quite different approaches, skill sets, outcomes, and investment considerations (for example, number of people reached per dollar). All however need to be integrated to ensure coherent 'behaviour change' and 'action' strategies are implemented to encompass the needs of all audiences.

Summary: the Proposed Model

The approach used in designing the proposed risk communication model includes the following principles:

- Programs support the development of self-reliant communities able to manage their own flood and storm safety.
- Programs convey safety information during operations to the public and the media in a timely, accurate and relevant manner.
- Programs contribute to an integrated public communication approach.
- People are empowered with the knowledge, skills and resources needed to work together as households or communities to ensure they have safer communities.
- Residents recognise the identifiers and roles of the emergency services.
- Emergency workers and community members are an integral part of the program.

The model consists of:

1) A strong process orientation, with emphasis on community participation, especially in the formative stages, social research, critical evaluation and adaptive management. Models such as action learning are valuable here.

2) Audience-focused content. The program begins with an understanding of audience needs and perceptions, not simply so these can be manipulated, but so that the program can be adapted to the audience's reality. Participative methods, focus groups, interviews, and quantitative research are used.

3) A sequential process of deepening public engagement. An integrated sequence of approaches is used; each approach caters for different segments of the population, with different goals and using different methods.

Conclusion

Emergency services across Australia are expanding their roles and taking a strategic view of their responsibilities. There is now a greater emphasis on mitigation, including community safety, rather than agencies being seen and acting purely as emergency responders. The greatest potential to minimise harm from large disasters is for emergency agencies to encourage community self-reliance, through long term community safety programs that are driven by affected residents. This in turn will reduce the immediate cost of a severe hazard in terms of life and property, and also the cost of social dislocation and psychological distress that occurs when vulnerable communities are exposed to a disaster.

The risk communication model presented in this paper also recognises that people will have different perceptions towards a hazard and associated risks and any community safety program needs to acknowledge this, by including strategies that take into account the needs of different audiences.

Programs that recognise this and take an integrated communication approach that emphasis meaningful partnerships with the community will be more successful and directly reduce the risk to vulnerable communities from severe hazards.

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Author Biography

Peter O'Neill has served as the Marketing and Communication Manager with the NSW State Emergency Service since 1999. A former school principal, he also has a Grad Cert in HR, a Grad Dip in Educ Admin, and a Masters in Emergency Management. Currently he is responsible for managing the marketing, public relations, media and community safety functions at State Headquarters, and supporting SES volunteers in community safety programs. Before his appointment to the SES, he was employed as a Regional Manager with the Cancer Council. His first major operation with the SES was the 1999 Sydney hailstorm, which occurred just a few weeks after he started in the position and resulted in twenty two thousand jobs completed in four weeks. The national and international media coverage resulted in over three million dollars of equivalent advertising coverage for the SES.

His research interests include behavioural change theory for emergency communication and the community safety aspects of vulnerable communities. He recently won the state Australian EMA Safer Community Award for his work in community flood safety.

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DISASTER MANAGEMENT & RECOVERY

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GIS AS A DISASTER MANAGEMENT TOOL IN THE U.S. ARMY CORPS OF ENGINEERS

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Keywords: GIS disaster management, models, decision support, enabling technology

Abstract

Geographic Information Systems (GIS) provide powerful capabilities that can assist emergency managers in performing a wide range of disaster-related tasks. The U.S. Army Corps of Engineers (USACE) makes significant use of GIS as an enabling technology able to provide critical data, information, and decision support capabilities during all phases of a disaster: readiness, response, recovery, and mitigation. This paper examines: how GIS is being used by the Corps for emergency management; the mapping services and map products provided by ENGLink, an automated information system developed for emergency managers; and the organizational structure, a cadre of disaster-trained USACE GIS experts, used to create and deliver GIS services and products to the Corps, the Federal Emergency Management Agency (FEMA), and other federal, state, and local emergency responders.

The use of GIS and GIS-enabled models to develop scenarios for disaster response planning, readiness, rapid estimation of damage before remotely sensed imagery can be obtained or direct observation of the affected region is possible, and mitigation is examined. This is followed by a discussion of empirical models developed by the Corps to help determine debris volume and the demand for potable water and ice. Sample mapping products and the use of GIS as it relates to debris clearance issues are considered. Examples of the mapping capabilities within the USACE-developed command and control software used for emergency management are provided and the GIS Planning and Response Team (PRT), the organizational element that provides GIS support during disasters, is discussed. We conclude with a description of an Internet GIS capability for multinational disaster preparedness, response, and recovery being provided by the Partnership for Peace Information Management System and USACE that was developed by the Corps for the Civil Military Emergency Planning (CMEP) Program and concluding remarks.

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Introduction

Prior to the introduction of GIS into emergency management in the late 1980s and early 1990s, a wide range of manually produced and semi-automated maps and overlays, often on acetate, were used to answer questions commonly asked by emergency mangers, responders, and the affected and interested public. Today, the data and information storage, analytical, and mapping capabilities provided by Geographic Information Systems (GIS) are all used extensively by the U.S. Army Corps of Engineers (USACE) and many other agencies as part of the organizations' suite of tools that enable emergency managers to more effectively perform tasks necessary for the preparedness, response, recovery, and mitigation phases of disasters. This paper examines: GIS, GIS and GIS enabled models, and maps; the geospatial tools contained within ENGLink, the USACE emergency management command and control software; the GIS Planning and Response Team (PRT), USACE GIS experts organized to provide GIS assistance to the Corps and other federal, state, and local agencies; and international GIS capabilities for emergency management provided through the Partnership for Peace (PfP) Information System (PIMS).

The maps, models, and decision support tools used by the USACE for disaster management are examined. The types of models that are most commonly employed and how they are used during the various phases of a disaster are discussed and some of the types of maps developed are presented. The paper concludes with observations on the current status of GIS as a disaster management tool and suggested next steps.

GIS and Models for Emergency Management in the USACE

GIS and models that are either part of a GIS or are programmed separately but are linked to a GIS for graphical display, provide emergency managers tools that have seen increasing acceptance over the last 15 to 20 years. Prior to that time, these tools were unavailable or were either so simplistic or alternatively so data and computationally intensive that their use was limited in applicability, timeliness of results, or circumstances in which they could be used. With the radical increase in computational power, decrease in the costs of hardware, availability of user friendly software, and increase in the availability of low or no cost (to the end user) data, this has changed.

Today, GIS tools and models exist for floods, earthquakes, hurricanes, landslides, and other disasters.[3] As a result of the information that GIS-based and –enabled models provide, the models are used by the Corps and others to meet needs in the planning and readiness, response, and mitigation phases of disaster management. As a planning tool, these models permit the development of response plans and exercises by enabling analysis of the impact of a real or hypothesized disaster. Damage to modeled structural types from a hurricane or earthquake (Figure 1), or area inundated by a flood event are example products. When the elevation of the living floor in buildings is known, and when economic models are developed for damage as a function of flood elevation above that height, it is possible to calculate and display damages per unit area (Figure 2).

[3] The Consequence Assessment Tool Set (CATS) developed by the Defense Threat Reduction Agency and the Federal Emergency Management Agency (FEMA) (for additional information see http://www.dtra.mil/td/acecenter/td_cats_fact.html), Hazards United States – Multi Hazard (HAZUS-MH) risk assessment methodology (see http://www.fema.gov/hazus) and water control models from the USACE Hydrologic Engineering Center (see http://www.hec.usace.army.mil/software/software.html) are examples.

Figure 1. Earthquake damage to single family homes, Slovakia, Workshop Fatra 2001.

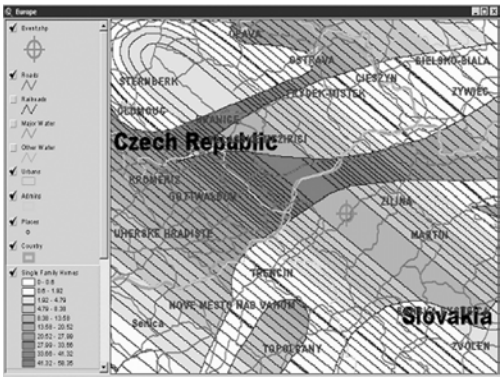
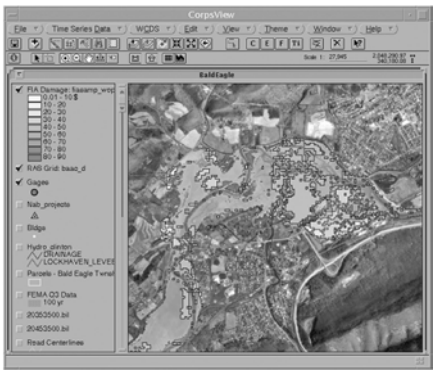


Figure 2. Flood damage inundation map with damages per pixel.



These same models can be used for readiness prior to predictable events such as hurricanes or large floods. In these cases, the models can be run based upon the expected maximum wind velocity or flood elevation. Further, when water control structures are present and release rates can be controlled resulting in more water either behind or below the structure (or both), the model and GIS can be used to view the area(s) that will be inundated for every analyzed option. When the economic models exist they can be used to compare the damages that will occur for each release rate option. Without the economic models, locational information about the population and critical facilities that will be affected by inundation can be used to assist decision makers in selecting the most preferred option. By using even more sophisticated models, it is possible to include real time meteorological data and snowmelt in the analysis.

During the response phase the models also can assist by providing an initial prediction of the disaster impact. Particularly for disasters that affect large areas, the chaotic nature of the situation immediately after the event may make it difficult to accurately identify the area(s) with significant damage, affects on the inhabitants, and the number of people, buildings, and infrastructure elements that have been damaged. Models can provide an initial estimate for each of these categories that will be refined later by remote sensing, manned overflight, windshield surveys, reports from affected citizens by cell phone, and ultimately from tabulated on-the-ground observations and reports.

Uses for mitigation range widely. Inundation models can be used in conjunction with proposed levee alignments and heights to determine both costs and benefits of project alternatives. Earthquake models can be used to calculate changes in expected damages as a result of changes in building codes and similar calculations can be made for wind damage. Cost-benefit analysis can be performed. The value of these results, however, depends upon the reliability of the models and the quality of the data that are used, as discussed below.

Empirical models

The USACE also has developed a set of empirical models to help with missions related to flooding and for disasters involving national multiagency response under the direction of FEMA. These models were developed to assist emergency managers in performing three missions often assigned to the Corps during disasters: debris clearance, provision of potable water, and provision of ice.

For the debris clearance mission, debris volume must be estimated. The model that is used is based upon rainfall, wind velocity, population (households), vegetation and development density. While

model results can be calculated for any areal unit, initial results are usually calculated for counties (Figure 3). The potable water and ice models use census data to determine initial population and the extent of loss of power. These numbers are modified by the time of day (working population commuting in or out of an area) and local information on the extent of evacuation.[4] These models originally were developed by emergency managers and converted to GIS models by the Corps' Louisville District. Performance of the hurricane model is being evaluated using data collected following Hurricane Isabel (September 2003).

Caveats Concerning the Use of Disaster-Related Models

It is important to note that limitations and cautions regarding the use of these models also exist. Caveats are related to the models themselves, the data used to populate them, and organizational issues surrounding model use. Initial model results from the Nisqually Earthquake, which had an epicenter between Olympia and Seattle, Washington, USA, in February 2001, indicated significantly more damage than actually occurred. Later model runs with more detailed geologic data and more accurate information on the location and depth of the epicenter[5] provided results that were much closer to the actual damage. Initial estimates for Hurricane Opal (September 1995, Florida, USA) similarly indicated that what was a category 5 hurricane just prior to landfall would cause tremendous damage. Collapse of the storm immediately before it reached the shore limited the significant wind and wave damage to a strip a few hundred meters wide along a relatively short section of the coast.

Other problems arise when different models for the same phenomena provide different predictions. Hurricane forecasting has demonstrated the value of having multiple models as no single model presently provides the most accurate prediction all of the time. Yet how do individuals, private companies or government agencies decide which prediction to use when preparing to respond? Validation of the best of the models presently available will help. Unfortunately, data from historical disasters (meteorological data including atmospheric soundings, wind fields with maximum wind velocities, capture of short-lived events such as tornados embedded within hurricanes, detailed soils and geologic information, and geographically referenced records of the extent and severity of actual damages) is often inadequate for validation purposes.[6] Further, our understanding of the complex phenomenology of natural disasters including earthquakes and hurricanes may preclude identification of a "best" model at the present time. The quandary that exists for emergency managers at present might best be served by better information about and understanding of the classes of uncertainty involved.

The GIS Planning and Response Team (PRT)

In the late 1990s a major change occurred in the way in which the Corps provided disaster-related services. The emergency management function at each district had been organized with complete or nearly complete capabilities to meet needs for all but the largest disasters. Recognizing both that such extensive capabilities were not needed at every district (hazards that the Corps responds to are not evenly distributed across the United States) and that the kinds of disaster-related expertise provided by the Corps was becoming increasingly specialized (flood fighting, debris clearance, temporary power, provision of potable water and of ice, temporary roofing and housing) the emergency management function was reorganized into PRTs. These teams consist of experts in a single area of emergency management who train and work together, with teams deploying as a unit to disaster locations. This new concept was called Readiness 2000 or R2K, and as part of this new organizational approach, three teams of GIS experts were selected and trained in July 2002. As

[4] Terry Siemsen. Louisville District, USACE, personal communication.
[5] Phillip Schneider, National Institute of Building Sciences, Washington, D.C., personal communication.
[6] Debra Meese, U.S. Army Corps of Engineers Cold Regions Research and Engineering Laboratory, personal communication.

with all Corps PRTs, the GIS PRT has a team leader and each team is lead by an Action Officer. These teams provide GIS mapping, data collection and analysis expertise to both the Corps and FEMA.

Since its inception, the GIS PRT has been activated four times, providing GIS support following Typhoon Chata'an (Guam, July 2002), Hurricane Lili (Louisiana, USA, September 2002), Super typhoon Pongson'a (Guam, December 2002), and Hurricane Isabel (Virginia, USA, September 2003). Data developed and maps created as part of the response to and recovery from Typhoon Chata'an demonstrated a key characteristic of digital geospatial data: value is not only in the maps themselves, but in the reuse of the data. Much of the potable water on Guam is pumped from deep wells. As part of providing temporary power, well locations and the size of the generators necessary to return the pumps to service were captured. These data developed for Chata'an were reused when Pongson'a again caused a loss of power (Figure 4). Other maps tracked the location of landfills (Figure 5). Post hoc analysis of these sites in conjunction with soils data indicated that some sites were on soils that were more permeable than is desirable.[7] Findings such as this are being used to change policy and involve the GIS PRT earlier rather than later in the response phase.

Figure 3. Debris volume calculations from USACE-developed empirical model.

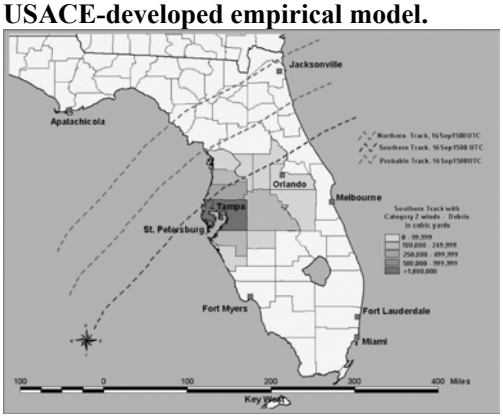
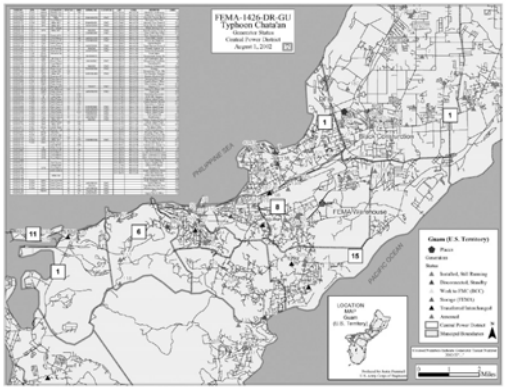


Figure 4. Typhoon Chata'an locations of generators providing power to deep wells.



ENGLink

The USACE has developed command and control software for all phases of emergency management. This "ENGLink" software is accessible by all Corps employees across the organizational Intranet. The initial implementation focused on regular reporting (situation reports) and reporting of extraordinary occurrences (spot reports) and linked access to financial, personnel, and mission-specific databases. The design concept also included access to maps (Figure 6) and an integrated GIS capability.

[7] Justin Pummell (GIS PRT member, Honolulu District), personal communication.

Figure 5. Super typhoon Pongson'a landfill locations.

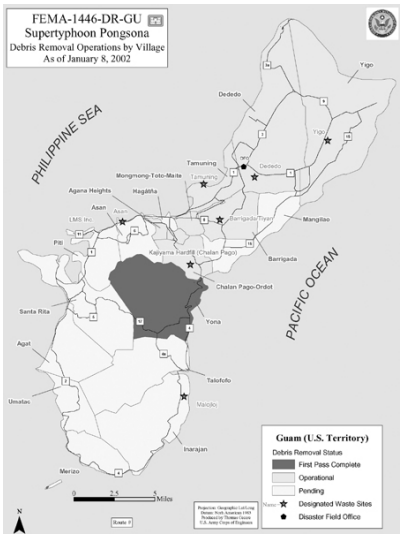


Figure 6. ENGLink-delivered map showing daily status of levees on the Mississippi River during spring flood.

All maps created by the GIS PRT are accessible through ENGLink. A subset of the functions provided by a complete GIS also is provided by the software. These have been developed using MapServer[8], an open source development environment for geospatial Internet applications (see http://mapserver.gis.umn.edu for additional information). GIS functions provided include delimiting a disaster area, on screen digitizing, labeling, pan and zoom, data query and reporting, limited map design, printing, and help (Figure 7).

Civil Military Emergency Preparedness (CMEP) Program

The CMEP is an international program that has the long term objectives of fostering cooperation between the civil and military disaster functions, moving civil disaster management out of ministries of defense and improved international cooperation and openness. Each nation's capacity to plan for and respond to all hazards will improve, particularly for those large or complex enough to require multinational response. The USACE provides technical management of the program and has developed an on-line mapping capability that includes access to open source data including high resolution data contributed by the participating nations. These capabilities can be accessed by those with PIMS accounts (see http://www.pims.org). Functions permit the creation of customized maps using data already in the system (Figure 8), and the downloading of data using an ftp function. This allows those with sufficient GIS experience to use data provided by the service in their own GIS applications.

The system has been used in CMEP workshops conducted in Hungary (2000), Slovakia (2001), Lithuania (2002), Poland (2002), and Azerbaijan (2003). Workshops are scheduled for Estonia, Armenia, and Georgia, in 2004.

[8] Mention of a product name does not constitute endorsement by the U. S. Army Corps of Engineers.

Figure 7. ENGLink tool to view ongoing disasters (Event Viewer).

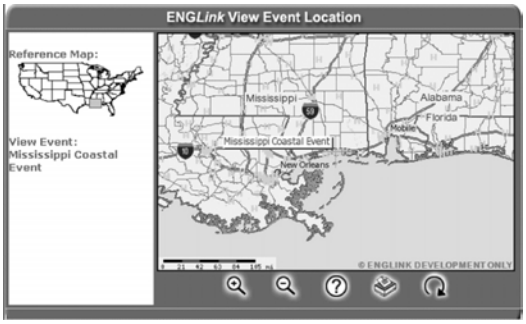
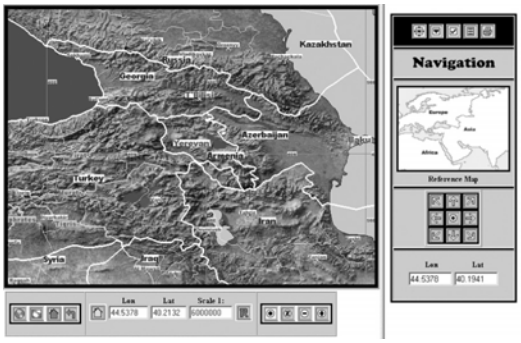


Figure 8. CMEP map viewing tool showing the Transcaucasus. Maps are served on the Internet.



Concluding Remarks

Emergency managers are using GIS and GIS-enabled models to a much greater extent than has been true in the past. The USACE GIS PRT is now routinely requested to support both the Corps and FEMA during large disasters. The Corps has identified a set of map products that meet needs common to the types of disasters to which the organization responds. These include models predicting the severity and extent of damage before and immediately after an event, maps showing the number of people in the affected areas, estimates of the quantity of assistance (daily potable water and ice requirements), magnitude of missions (debris removal, number and location of generators), and mission status (daily number of roofs installed, quantity of water and ice delivered by distribution site). It is anticipated that as acceptance of GIS and GIS-enabled models continues to evolve in the emergency management community, that this product set, along with a growing list of specialized maps, also will grow.

To best take advantage of the capabilities that GIS and disaster-related models provide the emergency management community, model validation and an understanding of the inherent uncertainties in model outputs are essential. Those running the models need to be aware of the sensitivity of the models to granularity of the data detail and the importance of data quality. Realizing that in the immediacy of a disaster, that caveats concerning uncertainty may not be heard or understood, it remains essential that as practicing professionals we not lose sight of them. Finally, when predictions are provided to the public, government agencies should seek to speak with a single voice.

Author Biography

Andrew J. Bruzewicz

Andrew J. Bruzewicz is director of the U.S. Army Corps of Engineers' Remote Sensing/GIS Center and Associate Technical Director for Geospatial Research and Development for the Corps' Cold Regions Research and Engineering Laboratory. He manages the Corps' civil works geospatial research and development program area (survey and mapping, remote sensing, and GIS), and is presently on special assignment to the Corps' Office of Homeland Security to provide liaison between the Corps' laboratories and the Homeland Security Office. His primary professional interests are the integration of remote sensing and GIS into the Corps' mission areas with particular emphasis on emergency management, data sharing within and between agencies, and remote

sensing and GIS education. For the last 12 years he has been actively involved in the application of remote sensing, GIS, and models to the full cycle of emergency management activities: planning and preparedness, response, recovery, and mitigation, and is leader of the Corps' GIS Planning and Response Team.

Edward J. Hecker

Mr. Edward J. Hecker, appointed to the position of Chief, Homeland Security Office, Directorate of Civil Works, Headquarters, U. S. Army Corps of Engineers, as of 23 February 2003.

Responsible for providing leadership in the coordination and facilitation of USACE. Homeland Security missions in support of the Department of Homeland Security (DHS), the Department of the Army (DA), and the Department of Defense (DOD). Program manager for all USACE efforts to assist Federal, state and local emergency management and emergency response organizations with mitigation, planning, training, and exercises necessary to build and sustain capabilities to provide protection from and respond to any emergency or disaster, including a terrorist incident involving weapons of mass destruction (WMD) as well as other natural or manmade hazards.

Mr. Hecker began his governmental career in the Corps Baltimore District office (Civil Project Management), and transferred to the Headquarters, U. S. Army Corps of Engineers in Washington, DC, before moving to San Francisco, California. In San Francisco he was the Chief, Emergency Management for the South Pacific Division, which encompassed California, Nevada, Arizona, Utah, and portions of Idaho, Colorado, and Wyoming. He was the program manager for the Corps response to the Loma Prieta earthquake in 1989.

In October 1991, Mr. Hecker returned to Washington, DC to assume the position of the Chief, Readiness Branch of the Operations, Construction and Readiness Division, having responsibility for overall management of the Corps disaster preparedness and response missions.

SHIRE OF YARRA RANGES: COMMUNITY RISK BASED EMERGENCY MANAGEMENT PLAN

Norm Free[1] & Steve Donner[2]
Shire of Yarra Ranges' Emergency and Safety Planning Unit

Keywords: Community Risk Emergency Management Plan

Abstract
In 1986 the State of Victoria, Australia, enacted legislation requiring each local government to form and administer a Municipal Emergency Management Planning Committee (comprising of stakeholders including emergency services and the community) chartered to devise a Municipal Emergency Management Plan. A need to undertake a comprehensive all hazards approach to emergency management was motivated by State and National Governments in the notification that disaster relief funding may be affected if the municipality had not adopted a risk management process. In keeping with the Shire of Yarra Range's philosophy of empowering its community with its role in emergency management and to meet State and National Government requirements, the Shire embarked upon a strategy titled the Community Risk Based Emergency Management Plan. The plan involved extensive community consultation including telesurveys, face to face interviews, the media and targeted community group participation to explore the community's perception of the risks that impacts upon it. The results were then analysed and prioritised according to the Australian/New Zealand Standards of Risk Management AS/NZS 4360:1999 involving identification of the risks and prioritisation according to likelihood and consequence factors. Treatment plans were then compiled for high and extreme risks followed by specific action plans assigning the responsible agencies involved and time frames. The Shire's plan has been targeted as a case study to educate other emergency management professionals on a national scale.

Introduction
In the State of Victoria, Australia, legislation in the form of the Emergency Management Act 1986 was enacted with the objective to "ensure that [prevention, response and recovery] are organised within a structure which facilitates planning, preparedness, operational co-ordination and community participation." (Section 4A) The Act sets out emergency management responsibilities at State, Regional and Municipal levels.

In accordance with Section 21 of that Act each municipal council is required to form a Municipal Emergency Management Planning Committee (MEMPC) for the purpose of formulating, monitoring and reviewing a Municipal Emergency Management Plan (MEMP) in relation to the prevention of, response to and recovery from emergencies within the municipality. The MEMP must contain provisions identifying resources & must specify how the resources are to be used in

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emergencies. The municipality accepts responsibilities for management of municipal resources and the co-ordination of community support to counter the effects of an emergency.

On the 14th of October, 1998 the then Minister for Police and Emergency Services, Hon. Bill McGrath MLA, wrote to all municipal mayors advising "of changes to the conditions for financial assistance provided to councils by the State under the Commonwealth/State Natural Disaster Relief Arrangements." The letter continued "In brief, financial assistance towards costs of a second and subsequent emergency would be conditional upon the council demonstrating that a structured risk management approach had been applied to the hazard/source of risk associated with the emergency."

In addition to response and recovery responsibilities the Victorian State Emergency Service (VicSES, a State agency) is vested with the task of providing advice and training to assist municipalities in developing their emergency management plan. VicSES are also charged with the responsibility to audit Municipal Emergency Management Plans.

Further guidelines for emergency management practitioners and other interested parties are provided in the Emergency Management Manual Victoria which is issued by the Co-ordinator in Chief of Emergency Management, the State Minister for Police and Emergency Services. The following agencies are involved in the Shire of Yarra Ranges Municipal Emergency Management Planning Committee:

Agencies/Organisations (Municipal Emergency Management Planning Committee)

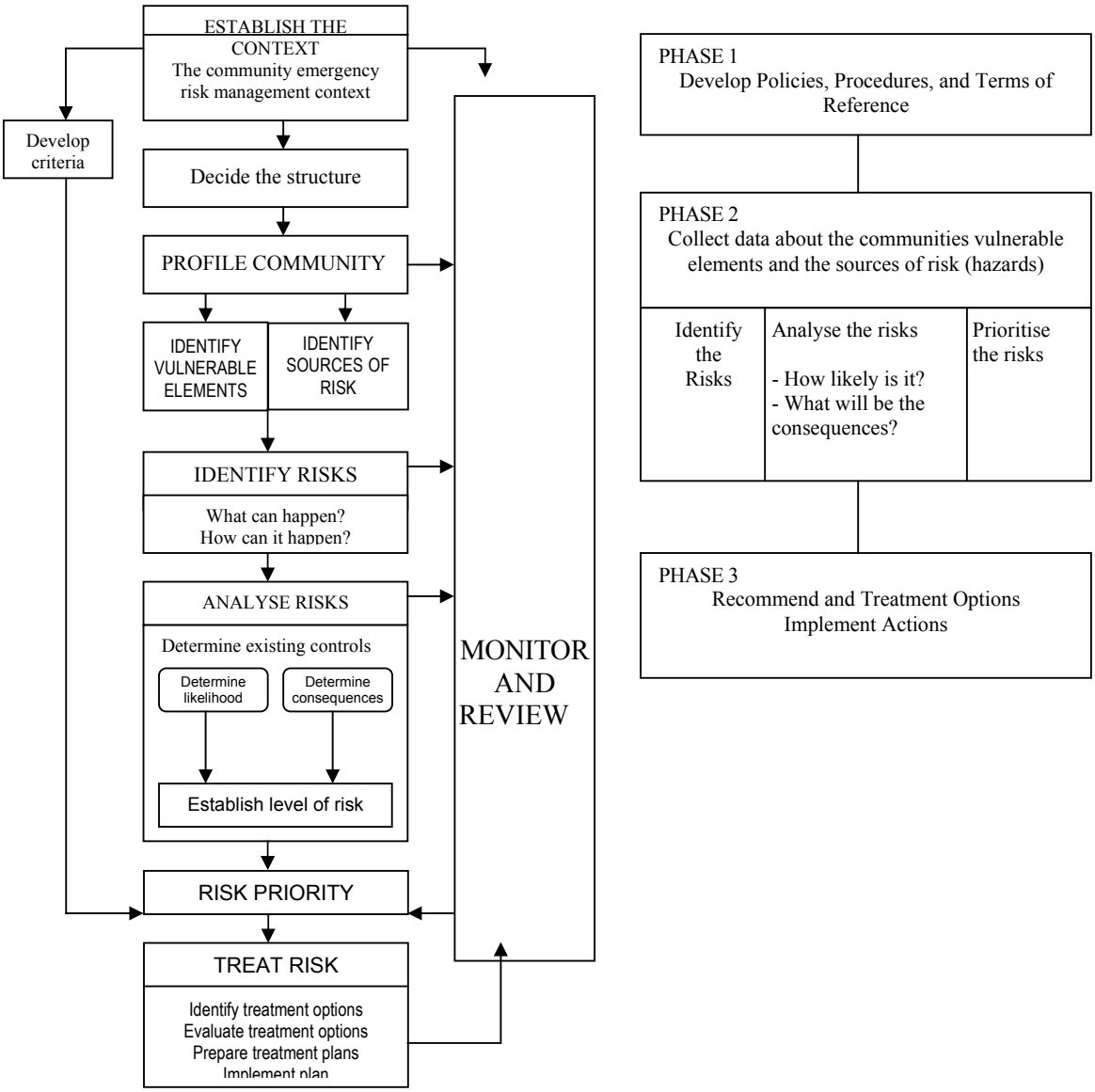
Shire of Yarra Ranges
Department of Natural Resources & Environment
(A State Authority responsible for managing Crown Land)
Country Fire Authority
(A State Authority predominantly volunteer based rural fire fighting service)
Department of Human Services
(A State Organisation dealing with the welfare of the community)
Australian Red Cross
Yarra Valley Broadcasters Inc
(A local Radio Station)
Mountain District Radio
(A Local Radio Station)
Victoria Police
(The State Police Agency)
TXU
(A regional Electricity Utility)
VicSES
(A State Agency for Emergency Planning Response and Recovery)
Metropolitan Ambulance
(A Metropolitan based service)
Telstra
(A State Agency for Telecommunications)
Centrelink
(A State Agency for welfare support)
Melbourne Water
(Responsible for water catchment and supply)
Others, as required

The Shire of Yarra Ranges Community Risk Based Emergency Management Plan has been modelled against the Australian and New Zealand Standards for Risk Management AS/NZS 4360:1999 and the Victoria State Emergency Service Community Emergency Risk Management Model (Risk Management and Municipal Emergency Management Planning 1998 p.vi)., creating a transparent process and auditable trail in recording the identification, analysis, evaluation and treatment and decision making. This process relies on community consultation and the Shire recognises that the completed plan will be available to the community. With the integration of 'risk management' into Municipal Emergency Management Plans, (MEMP) the Shire of Yarra Ranges fulfils the recently revised funding requirement under the Commonwealth/State Natural Disaster Relief Arrangements.

Community Emergency Risk Management Model

The Victoria State Emergency Service provided a model for the development of the Community Risk Based Emergency Management Plan as a three phase process (Figure 1).

Figure 1: Community Emergency Risk Management Model



APPLICATION OF THE COMMUNITY RISK MANAGEMENT MODEL BY THE SHIRE OF YARRA RANGES

PHASE 1

Development of Policies, Procedures and Terms of Reference.

The Shire of Yarra Range identified all key stakeholders and established reference group comprising all key stakeholders and developed key goals. This process was highlighted as a Key Result Area in the Shire Corporate Plan and resources were allocated to undertake the process. Policies and procedures are in accordance with the Emergency Management Act 1986, Emergency Management Manual Victoria and the Australian and New Zealand Standards on Risk Management AS/NZS 4360:1999.

Terms Of Reference

The Terms of Reference established by the working group for the project was to draft a holistic Emergency Management Plan for the Shire of Yarra Ranges that covers prevention, preparedness, response and recovery and is based on risk management principles, to consult with the community and other agencies in the preparation of the plan and to report to Council via the MEMPC.

Context Statement

The context statement has been recognised as a key component as it provides the structure and parameters to ensure a focussed reference for the process. After much deliberation the working party established the following context:

To create a safer community, the Shire of Yarra Ranges will work in partnership with the community, agencies and other stakeholders in order to create a holistic community risk based emergency management plan which will address risks that may affect the community, property and the environment.

The objective will be achieved by identifying analysing, evaluating risks and recommending treatment options based on Standard AS/NZ 4360:1999 and is underpinned by the Emergency Management Act 1986. The Shire of Yarra Ranges recognises that the risk based emergency management planning process may lead to suggested risk treatments that may effect or be an effect of social, political, economic and/or environmental aspects of the community and that risk treatment recommendations may be affected by the reality of political and financial constraints.

The Shire also recognises that risks which are assessed as extreme or high need to be reviewed to consider treatments which may reduce the risk to an acceptable level.

The community risk based emergency management planning process relies on community consultation and the Shire recognises that the completed plan will be available to the community.

PHASE 2

Investigation, Information Gathering and Analysis Phase

This phase includes profiling the community to identify vulnerable elements of the community and to identify sources of risk.

Demography

The Shire of Yarra Ranges is located on metropolitan Melbourne's eastern fringe. With an area of almost 2,500 square kilometres the Shire is the largest of any metropolitan or fringe Council in the State. The Shire has a population currently estimated to be 141,170 people. In terms of population it is the seventh largest municipality in the metropolitan area and the eighth largest in the State in terms of population. While considered as an "urban" council for funding purposes the Shire balances a mixture of both urban and rural communities. Approximately 80% of the Shire's population lives in the 10% of the Shire that is classed as urban, while the remaining population is unevenly dispersed throughout the remaining area. There are over 50 suburbs, townships, small communities and rural areas within the Shire. Population growth is expected to remain constant over the foreseeable future, with a projected growth rate of approximately 0.1% per annum over the next 20 years.

Topography

The Shire of Yarra Ranges can be divided into three zones, the undulating country to the west with suburban development, the forested hills to the east and the valley of the Yarra River, which runs east to west and is surrounded by farmlands. There are four major water reserves in the mountainous areas which supply drinking water for the Shire and metropolitan Melbourne: the Silvan Reservoir in the Dandenong Ranges, Maroondah Reservoir above Healesville, the smaller O'Shannassy Reservoir north-east of Warburton and the Upper Yarra Reservoir further east again.

The majority of the suburban areas are found in the western part of the Shire around Mooroolbark, Montrose and Lilydale. The Dandenong Ranges are moderately populated, especially, the Belgrave-Upwey area. Even though much of these hills are heavily wooded approximately one third of the Dandenong Ranges is given over to forest parks, the remainder being zoned for residential or agricultural purposes. Forested mountainous areas also stretch from the surrounds of Healesville in the north-central part of the Shire across almost the entire eastern section. This forms part of the Great Dividing Range. The highest point is Snowy Hill at 1380m above sea level and is located at the northern most point of the Shire. The other major geographical feature of the Shire is the Yarra River, which flows along the eastern part of the Shire and runs through the Melbourne CBD into Port Phillip Bay.

There are 1116 kilometres of sealed roads and 838 kilometres of unsealed roads crossing the Shire. Approximately 60 road bridges providing major links to townships throughout the Shire. Many of the bridges carry essential services such as water and communication cables. Electricity is supplied to all residences with natural gas covering the majority of residences.

Unique Natural Environment

The Shire of Yarra Ranges contains some of the most environmentally significant areas in the State which are a significant factor in attracting residents and tourists. The mountainous landscapes and the Yarra River valley, contain significant areas of remnant native vegetation, much of which is botanically and zoologically significant and forms an important habitat for wildlife. Council has recognised that the physical diversity of the Shire, in particular the mountainous terrain and large floodplains, also creates challenges in developing and maintaining the infrastructure and in servicing the residents to the desired levels.

Our Local Economy

There are over 6,300 businesses in the Yarra Ranges employing over 28,200 people. Economic activity in the Shire is based on tourism, manufacturing industries (in the metropolitan suburbs) and rural industries - particularly agriculture (including horticulture, floriculture and viticulture), and forestry and timber milling. By any standards the highly intensive agriculture of the primary producers within the Shire contributes significantly to the State's rural output and economy. The

Shire and in particular the 'Yarra Valley' is being promoted and is gaining local and international acceptance as an area for the production of fine food and wine. Its reputation as a food region is approaching that of Gippsland and King Island and it can hold its own with any rural wine producing area.

Over 3 million tourists visit the Shire each year (over 9,000 each day). They are attracted to the unique landscape and environment , the vineyards and wineries of the Yarra Valley and the townships and gardens of the Dandenong Ranges. Major tourist attractions include the Healesville Sanctuary, Puffing Billy Railway, larger wineries and the reservoir parks and National Parks managed by Parks Victoria. The growing cultural tourism market is catered for with the festivals and diversity offered by several of the Shire's communities. Short break visits (bed & breakfast) are increasing and the focus is now on encouraging longer stays and expanded tours to the Shire.

History of Disasters/Emergencies

The Shire of Yarra Ranges has a long history of naturally occurring emergencies including bushfire, floods, storms and landslide. Other include light plane crashes, road accidents on major highways, and outbreaks of infectious disease. The impact of these emergencies, particularly bushfires, have included loss of life and serious injury, loss of property including homes, disruption to whole communities, devastation of the natural environment and long-term rehabilitation of affected communities.

The Dandenong Ranges is recognised as one of the most bushfire prone areas in the world due to its mountainous topography, highly flammable native vegetation and climatic patterns that combine to create severe fire hazard conditions almost every year. Another factor that makes this area particularly hazardous is the combination of forest/urban environments and the number of residents and tourists. "Black Friday" in 1939 was the most disastrous bushfire ever recorded in Victoria. At Woods Point the whole town was destroyed totalling 143 houses. In Warburton, 16 men were killed, 20 houses were lost and every sawmill in the area was burnt to the ground. The second most destructive fire in Victoria was "Ash Wednesday" in 1983 when at Belgrave Heights and Upper Beaconsfield, 21 people died including 11 CFA volunteers. Approximately 300 houses were destroyed and 1800 Ha of bushland and pastures burnt out. In Warburton 13 houses were destroyed along with 41,000 Ha of forest. (Murray et al, 1995 p.228)

Major floods of the Yarra River occurred in 1891, 1904, 1909, 1923 and 1934 (the worst ever recorded). The 1934 peaks were used to determine the flood plain along the Yarra River. Minor flooding in Yarra Glen and along the Watts River at Healesville occurs on an almost annual basis. Launching Place and areas at Warburton are also susceptible to minor flooding. In Lilydale, flood mitigation works have reduced the flood prone areas adjacent to Brushy Creek and Olinda Creek. Heavy rainfall has also caused landslip events in unstable soil areas in the Shire, particularly on steep slopes around Warburton.

There is a history of significant landslips within the Shire of Yarra Ranges. The type of landslips that have occurred in the Shire include falling boulders, debris flows, slow long-term earth movements, small landslips up to the size of a residential block and large landslips involving an entire hillside. Some landslips move relatively frequently whereas others have not moved for hundreds, perhaps thousands of years.The Montrose landslip of August, 1891, involved the movement of 30,000 cubic metres of earth and rock. Damage was recorded over 1.4 kilometres and the estimated speed of the debris flow was up to 40 kilometres an hour. In comparison the 1997 Thredbo landslip displaced 2,000 cubic metres of liquefied soil (Shire of Yarra Ranges – Geotechnical Survey Report, Coffey Geosciences Pty Ltd 1999 p.18)

Storms of considerable severity (including windstorms and hail storms) have occurred throughout the Shire. These events have resulted in property damage and minor flooding. The State Emergency Service and local resources have effectively responded to these events in the past.

The Shire of Yarra Ranges has four state highways and numerous arterial roads. The traffic is a mixture of light vehicles (local and tourist), heavy vehicles (logging and other trucks), and buses (both school and tourist). In 2000 the Shire gained the unenviable reputation for the highest road toll of 26 fatalities in the State of Victoria (Source: Victoria Police statistics).

In response to growing concern the Shire has adopted a further initiative with the community in devising the Community Road Safety Strategy and the appointment of a dedicated Road Safety Officer position.

Given the combination of the Shire's topography, the history of natural disasters, the socio demographic trends in the communities, the Shire faces arguably more potential natural disasters than most other municipalities throughout the State. In addition, there is an increasing incidence of vulnerable populations and social hazards in the community, therefore, the Shire has responded to the importance in the development of the Shire of Yarra Ranges Community Risk Based Emergency Management Plan and made it a priority activity.

The hazard identification workshop

The Shire of Yarra Ranges conducted the first step of this phase in September 1999 when it held a workshop with local stakeholders and experts from all emergency services, service and support organisations, and the Shire. The purpose of this workshop was to discuss the community's vulnerable elements and identify the sources of risk.

These risks became the source data for the community consultation phase. Given the importance of emergency management to the Shire community, it was decided to design a cost effective methodology which would not just identify the information required but also raise the awareness and level of discussion within the community.

The goals of the process were to ensure the community had a range of options to contribute to the process, engage the community and to elicit the required information with some statistical rigour.

Key questions were designed which would clarify & enhance on the hazards already identified. The information required included identification and rating of likelihood of risks occurring, identification and rating of the consequences of these events, preventative and protective actions being undertaken and awareness and take up of existing mitigation activities. This was developed into a core questionnaire which could be adapted to suit different surveying processes.

Community Consultation Process

The underlying philosophy of the consultation was based on good will assurances and opportunity, the need to have statistical rigour and to ensure that information was sought by location & age to enable correlation with risk. There was a strong need to include a range of opportunities for participation to ensure consultation was broad, acceptable and would generate public discussion through good public relations and press coverage for the process. Above all there was a strong commitment to encourage a sense of ownership of the process within the community, The quantitative (statistical rigour) information included four cost effective methods to maximise the coverage across the Shire.

The telesurvey of 777 residents, conducted in March/April 2000 by a market research company, was designed to statistically indicate the total Shire view of these issues. The information was also broken

down by the four main geographical areas and by age. Four geographical areas were selected as the risks in each of those areas are somewhat different. The two age groups were chosen to see if older persons perceive the issues differently. Additional information such as breaking down the information by both age and area will enable targeting of treatments in due course on a more meaningful basis.

Face to face interviews of 424 residents took place largely on Saturday mornings in March 2000 at shopping precincts in all of the Shire's townships. They were conducted by Year 12 students from 13 of the 15 Secondary Schools in the Shire. Every township was involved with the numbers of interviews conducted weighted depending on the population. The interviews further involved the community through providing residents with an opportunity to participate on a face to face basis in their own township and an opportunity for younger residents in the Shire to participate in this process and to gain valuable work practice and life skills. It also had the by-product of engaging much larger sections of the community ie schools, the students' friends and parents and was important to achieve the awareness raising goal. Students were rewarded for their efforts with movie tickets and certificates of participation signed by the Mayor.

Volunteer Community groups play a vital part in the life of the community. **Surveying a sample of community groups** provided another method of participation and another perspective. 112 groups were surveyed and 47 responded. These groups represented all aspects of community life and were selected from all geographical areas of the Shire. This took place in March/April 2000.

To provide a final method of participation to the process the questionnaire was printed in **local newspapers**. 33 persons responded but it had the more important purpose of again providing information about the process and the awareness of the issues and process.

Risk Analysis

The objective of risk analysis is to separate the acceptable minor risks from the major risks and to provide data to assist in the evaluation and treatment of risks. A qualitative analysis was used to determine the level of each risk. Risks were identified from the responses received during the community consultation and the risks currently recognised within Shire of Yarra Ranges Municipal Emergency Management Plan. All risks were then assessed against the Australian and New Zealand Standard for Risk Management AS/NZS 4360:1999, by applying risk criteria of likelihood (Table 1) and consequences (Table 2) or impact to a qualitative risk analysis matrix.

Risk Criteria

The Municipal Emergency Management Planning Committee developed specific measures under the categories of likelihood and consequence that were relevant to the risk environments.

Table 1: Measure of Likelihood

Level	Descriptor	Description of Event
A	Almost Certain	The event is expected to occur in most circumstances (daily/weekly) – 100% probability of occurrence High level of known incidents (records/experiences) **Strong likelihood or re-occurring, with high opportunities/means to re-occur**
B	Likely	The event will probably occur in most circumstances (monthly) – 50% probability of occurrence Regular incidents known (recorded/experienced) **Considerable opportunity, means to occur**
C	Moderate	The event should occur at some time (over 12 months) – 10% probability of occurrence Few infrequent, random occurrences (recorded/experienced) **Some opportunity or means to occur**
D	Unlikely	**The event could occur at some time (2-5 years) < 2% probability of occurrence** No known incidents recorded or experienced **Little opportunity, mean or reason to occur**
E	Rare	The event may occur only in exceptional circumstances (10 years) < 0.1% probability of occurrence Highly unheard of **Almost no opportunity to occur**

Table 2: Measure of Consequence

Level	Descriptor	Description of Impacts			
		Areas of Impact			
		People	**Financial**	**Property**	**Environment**
5	Catastrophic	• Many injuries, fatalities and widespread medical attention required. • Community impact severe and lasting, not functioning without support.	• Huge $ loss ->$100m at National level, Significant/ongoing $ assistance required	• Extensive physical damage requiring extended external assistance	• Environmental disaster – significant environmental impact/permanent damage • EMA involvement • Major threat to many species and habitats
4	Major	• Extensive injuries, hospitalisation, possible fatalities, long term disability • General and widespread impact on community functioning	• Major $ loss > $10 m at State level, financial assistance required	• Significant physical damage requiring external assistance	• Some environmental impact long-term, requires help outside site • DISPLAN involvement • Threat to individual species or habitat
3	Moderate	• Medical treatment, but no fatalities • Normal community functioning with some inconvenience 24-48 hours	• Significant financial loss > $1million at Regional level	• Localised physical damage which is rectified in a routine fashion	• Some environmental impact short-term, requires outside help • EPA involvement
2	Low	• Minor injuries, no fatalities, first aid treatment required • Some community disruption for duration less than 24 hours	• Some financial $ loss < $100,000 at local level	• Some physical damage	• Small impact on environment, on site release contained immediately • Major clean up of local area required
1	Insignificant	• No injuries or fatalities, little or no personal support required	• Little or no financial loss < $10,000	• Inconsequential or no physical damage, short	• No measurable impact on environment • Minor on-site clean

		• Little or no disruption to community		duration	up required

Through the risk analysis matrix, hazards were ranked into categories of Extreme (Immediate action required), High (Senior management attention needed), Moderate (Management Responsibility must be specified) and Low (Manage by routine procedures). **.** The sources of risk for the extreme and high risks ranged from: Natural risks such as bushfire, landslip, floods; Human Behaviour risks such as robbery, assaults and drugs; Environmental risks such as water or air pollution, Technological risks such as hazardous materials; and Infrastructure risks such as road or aircraft accidents.

PHASE 3

The Decision Making and Treatment Phase

This final phase determined the actions that can be done to prevent, mitigate, accept, avoid or transfer risk, recommendations, appropriate treatment options and then devised implementation actions. Having identified extreme, high and moderate risks the next step was to devise treatment plans. The treatment plans were devised during dedicated planning days with the Municipal Emergency Management Planning Committee members and other interested parties.

A template (Table 3) was utilised for each of these risks providing a treatment plan to address the risk. Specific action plans were then compiled using this information.

Table 3: Risk Template

<table>
<tr><td>RISK:
BUSHFIRE</td><td>RISK RATING
EXTREME</td><td>ACTION PLAN No: 1
DATE COMPILED: 22/5/00</td></tr>
<tr><td colspan="3">RISK SUMMARY:

Bushfire includes FOREST, GRASS, UNDERSTOREY
Seasonal annual event, large area URBAN/FOREST interface, dispersed over the whole municipality. Long history of bushfires in area.

Those most vulnerable:
Interface residents, specifically Persons who are unable to implement an effective fire Plan eg. frail/aged not limited. Travelling public, persons employed, Emergency Service Workers, Schools/Camps, Frail aged facilities & special accommodation.
Other: Stock, general infrastructure, crops</td></tr>
<tr><td colspan="2">Can Likelihood be reduced:Yes
How:

Fuel reduction burning
Fire prevention strategy
Education – awareness/preparedness
Building Regulations
Town Planning permit approval
TFB/Fire restrictions – Municipal/State
Police fire patrols</td><td>Can Consequences and /or vulnerability be reduced:Yes
How:

Fuel reduction burning
Fire prevention strategy
Education – awareness/preparedness
Building Regulations
Town Planning permit approval
TFB/Fire restrictions – Municipal/State
Early warning
Effective Fire suppression activities
Timely response from Emergency Services & Community
Timely & accurate information to the community
Integrated Communication systems & networks</td></tr>
<tr><td colspan="3">What agency, organisation, group or person has risk management responsibilities for this risk?

Country Fire Authority, Department of Natural Resources and Environment & Parks Victoria, Metropolitan Fire & Emergency Services Board, Shire of Yarra Ranges, Residents/Business/Property owners, Utilities & Service Authorities, Department of Education, Victoria Police</td></tr>
<tr><td colspan="3">What responsibilities does the Council have to manage this risk?

Fire Prevention Strategies – development, implementation & review, (Joint) Community Education, enforcement of Fire related Legislation, Resourcing Emergency Services (response) & general Community (recovery), (Joint) Community information, Emergency Planning and Implementation</td></tr>
<tr><td colspan="3">RECOMMENDATIONS:

Review Fire Management Strategies – within the next three years or following major fire
Continue Education Programs
Continue to apply current regulatory controls
Continue to support the development of Integrated Fire Management Plan Strategy
Continue Training and Exercises for Staff and Agencies</td></tr>
<tr><td colspan="3">APPROVAL TO IMPLEMENT RECOMMENDATIONS REQUIRED FROM</td></tr>
<tr><td>COUNCIL</td><td>MEMPC</td><td>MFPC</td></tr>
<tr><td colspan="2">Following approval implementation plan developed & monitored by: MEMPC</td><td>Priority & Time Frame for implementation:
High Priority. To be implemented by 2003</td></tr>
</table>

Completing the Community Consultation Loop

The final initial stage of the process was to ensure appropriate feedback to the stakeholders and in particular the general community. Feedback was provided to the Community by through forwarding Executive Summaries of the draft paper to all Community Groups and Schools involved in the process, advertising in local papers, placing a copy of the draft plan on the Shire's website and placing copies of the document for perusal by the community at the five Shire Service Centres located across the municipality.

Review Process

The Community Risk Based Emergency Management Plan has now been incorporated into the Municipal Emergency Management Plan which has a three year action and review cycle and is audited by the Victorian State Emergency Service. Progress of the treatment actions is monitored by the Municipal Emergency Management Planning Committee at quarterly annual meetings.

Conclusion

The Shire of Yarra Ranges Community Risk Based Emergency Management Plan is an example of the Shire's commitment to a consultation process which involves the community raising its awareness of the risks it faces and enhancing a sense of ownership in the emergency management process. In a document entitled Vision 2020 the Shire identified a number of themes as a future planning reference for the community. One of these themes relates to a safe Shire in the year 2020. The guiding principles of this theme include "that residents and communities need to take a greater personal responsibility for their own safety and need to be provided with the capacity to do so"…"that the Shire has a major role in facilitating local networking between emergency service providers"…and "… that improved communication and education will reduce the risks to individuals and the community." The Community Risk Based Emergency Management Plan has provided a strong foundation to meet this philosophy.

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Authors' Biography

Norm Free is a Senior Executive Officer appointed to manage the Shire of Yarra Ranges' Emergency and Safety Planning Unit. The Unit is responsible for administering the Municipal Emergency Management Planning Committee and Municipal Fire Prevention Committee, conducts research and implements emergency management projects. Norm previously served for over twenty years as an officer with the Victoria Police Force. He holds an Associate Diploma of Arts (Police Studies) Monash University and a Graduate Certificate Disaster Management (Swinburne University).

Steve Donner was employed as the Emergency Management Co-ordinator within the Emergency and Safety Planning unit for the Shire of Yarra Ranges and was the project officer for the

Community Risk Based Emergency Management Plan. Steve is now a Senior Consultant (Safety & Emergency) with Worley Safety & Risk Management, holds an Associate Diploma of Applied Science (Fire Technology) Swinburne University and a Graduate Certificate Disaster Management (Swinburne University) and is a Graduate Member of the Institute of Fire Engineers. He is also a current serving lieutenant with a local volunteer brigade of the Country Fire Authority within the Dandenong Ranges and was previously employed for ten years as a consultant to the fire protection industry on active and passive fire systems.

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A STUDY OF NATIONAL DISASTER OPERATION CENTER WITH APPLICATION OF C4I CONCEPT

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Abstract
This paper is to design a disaster operation center on the basis of C4I concept of defense area. The center has four major functions such as data gathering, analysis and decision making, command and control, and coordination with community resource systems.

Introduction
Our present society has many problems due to rapid industrialization and urbanization. This situation is developing and has possibility to damage our environment. Seriously, the possible damage from this situation is getting bigger and may result in property loss and injure and even casualties. Also we realized the dark side effect from a industrialization and urbanization through experiences such as a tragic fall down of Sampoong department store in 1995, a sinking of Suhae ferryboat in 1993, the terrible incident of Daegu subway and a typhoon disaster named Maemi in 2003. Therefore, if there is no effective method of preventive measure which can prepare and resolve each disaster under the colligated organization of directly responsible to the President (named of National Disaster Agency), there will be incurred unpredictable of properties and casualties.

In this study, we develop a new model of disaster operation center which provide prevention and control of disaster. It will help minimize injuries and property loss and help recovering and rehabilitation from the damage. Some problem dealing with disaster control will be identified and logical solution will be presented.

Korea Disaster Management System (KDMS)
Under the current situation of time and environment, the disaster management system of our nation performs generalization, regulation and control for our national security and disaster management at the Administrative Office under the Prime Minister the Administrative Coordination Office and the Office of Reform and Planning. And the authorities of local government charges the department of disaster of civil defense, fire department and chief of prevention of disaster under the chief of management of disaster. However, it is very hard to cope with the disaster quickly because, basically, our disaster management system is independently executed according to the different types of disasters.

The result of analysis regarding to the structure and function of our disaster management systems are are follows. First, the disaster management system can not be executed synthetically and organically because each disaster is managed separately according to its type. Additionally, since most of disaster management system are constructed by various government authorities, it is not enough to cover a huge disaster by a single system. Second, because an organic cooperative and

information forwarding system has not established, a fast and effective countermeasure can not be performed in early stage of a disaster. Third, since structures and functions of a disaster management system are decentralized, measures can not be performed in a systematic, organized and cooperative way.

DMS Improvement Proposition based on Military C4I concept

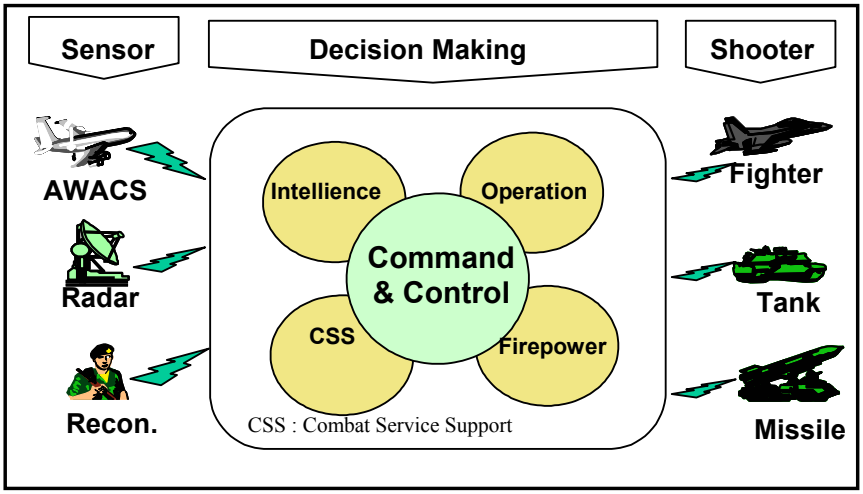
Military C4I Concept

The acronym C4I stands for Command, Control, Communication, Computers, and Intelligence and means "Our force which is equipped with C4I system and ready to battle strikes the enemy before they can strike us. The system can guarantee the victory."

> C4I : Command, Control, Communication, Computers, and Intelligence
> Concept :
> "Strike before enemy attack – guarantees the victory"

The process of military C4I shown in figure 1 is as follows: Every kinds of information gathered from Sensor system such as AWACS, radar, reconnaissance team (human intelligence resource) are processed in real-time and sent to Intelligence Section which is called as C2 in military term in headquarters. The Operation Section or C3 in military term plays the key role in quick decision making support based on processed information from Sensor system. C3 is supported by C2 and Firepower section and derives the best decision and send the result to Firepower staffs. The Firepower section operates the Shooter system and selects appropriate firepower and orders them to shoot. The decision making cycle is executed in real-time and can strikes the enemy before they can strike us. It proves to be the best battlefield support system which guarantees the victory on war.

Figure 1. Military C4I System

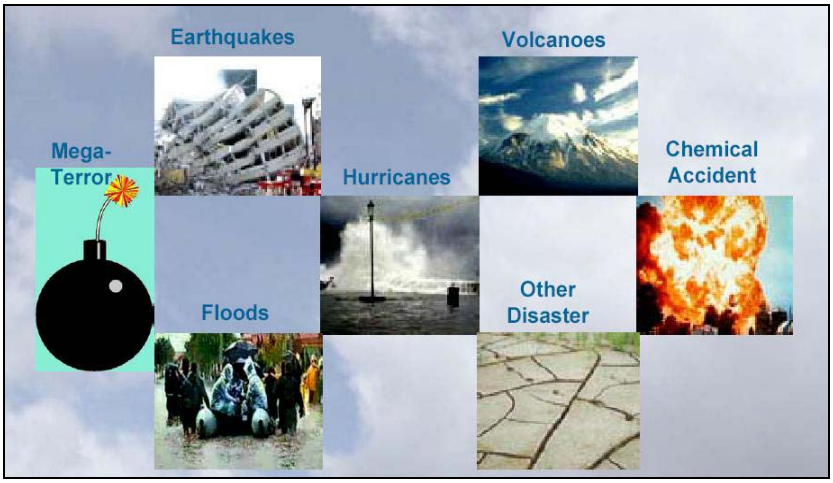


Application of Military C4I

The military C4I system was first used by U.S. Armed forces in Gulf war, has been improved through many experiments and battlefield and recognized as the best battlefield support system. It

can also be used as the most appropriate system in civilian fields, especially in disaster management. For example, huge disasters such as terror, earthquake, typhoon, flood, volcano eruptions, large scale biochemical hazard, etc can be counter measured by this system.

Figure 2. Application of military C4I

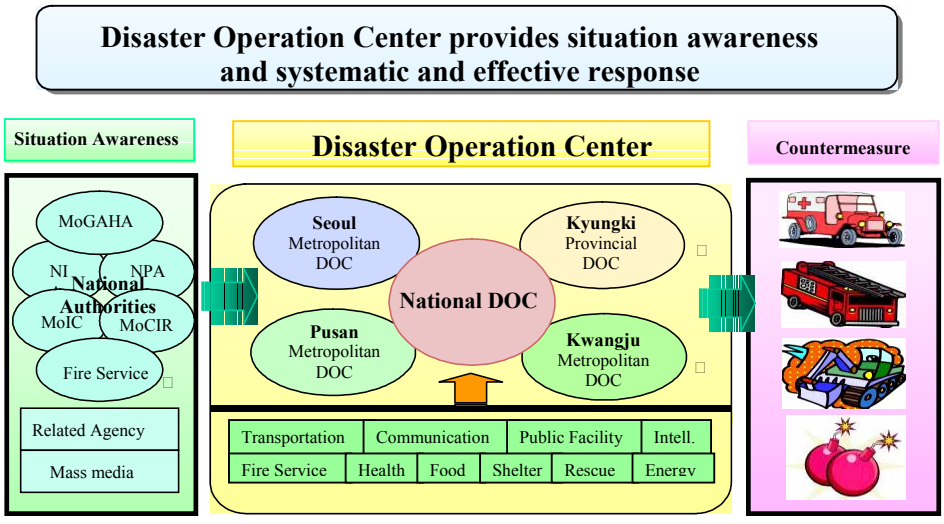


Disaster Operation Center Model

The Concept of National Disaster Operation Center

As mentioned above, the national disaster control center should be a supportive system which enables the nation to protect, countermeasure, and recover as a whole on various disasters managed by different parts of government. That is, the system should cover all the disaster managements which are controlled by different governmental posts at ordinary times. Furthermore, it should connect the disaster area with the local governments, activate the countermeasure and recovery system, and link to real time broadcasting system.

Figure 3. National Disaster Operating Concept



Video Wall of Disaster Operation Center

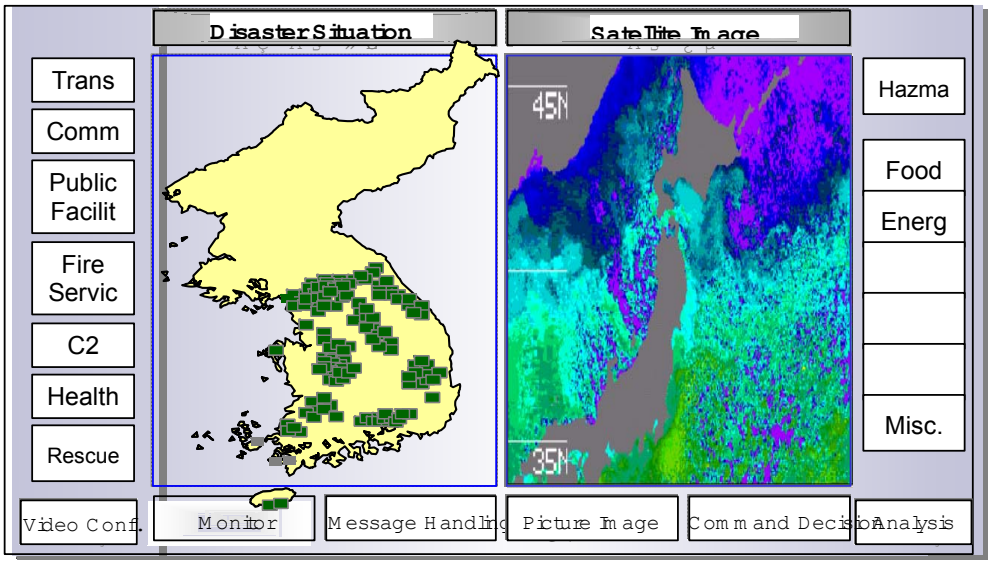
Based on this result, we suggest a model of disaster control center which plays a successful role as a disaster management system, by applying the concept of military C4I system. First, government authorities are divided into national and local authorities. Local government authorities are divided into metropolitan cities and provincial government authorities which include cities, counties, and districts. It operates as an efficient disaster management system by conducting 12 types of emergency support functions performed on the central department and the disaster management agencies in a functionally unified administrative manner.

Second, when calamity and disaster occur, using the national wide network of the disaster control center, we can synthesize these data, make a quick distribution of the analyzed data, share the information, aware and recognize the disaster situation accurately, and finally make appropriate decisions. Third, command system should be unitarily secured efficient of operation when a calamity and a disaster has been occurred. There are a central center, great sphere and rural center, and similar and related organization which have been constructed each other to cooperate. Also, they have been prevented confusion through simplification of processes of disaster information transmission.

Forth, the situation of the calamity and disasters central center and great-sphere and rural center has been exactly made an offer to condition of the stricken area to COP of disaster control center which receives images, phonetics, photos, and pictures at one time and another multiply. Finally, using a movable disaster control center it is possible to distribute image data from the affected area to every control centers and keep exact information of disaster control. Therefore, building up a synthetic disaster operation center most of national disaster authorities provide better prevention and protection of lives and properties when a disaster occurs.

The situation map of disaster operation center should be simple enough, but has to connect the disaster situation with the relevant agencies at hand. It should be equipped with digital map with GPS and GIS, connection system to link diverse disaster management systems, and the domestic document management system with efficient operation ability.

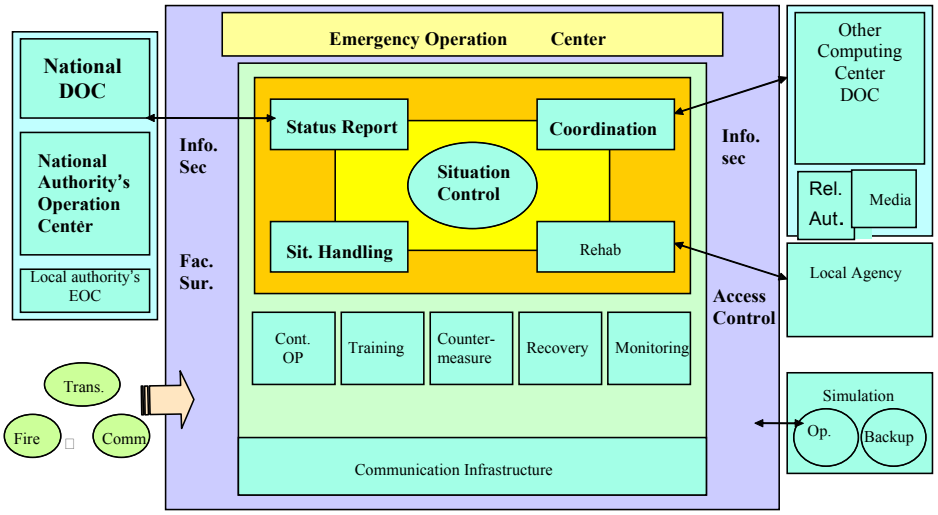
Figure 4. Video Wall on COP



Local Government Disaster Operation Center

The concept of local government DOC is similar to the central DOC concept. The difference is that the local government can recognize the disaster field more accurately and promptly with its adjacent location and therefore can provide immediate support for the field. This requires an intimate cooperation with local agency and other relevant disaster control departments**.**

Figure 5. Local Government DOC



Conclusions

The expectations of this model are as follows. First preventive management through disaster database can be possible. Second, since disaster officers monitor the situation in real time, countermeasures can be executed simultaneously. Third, all the related authorities share the damage information damage can be mitigated and minimized. Those authorities include national, local disaster operation center, and mass media. If the best countermeasures can be selected when needed, rehabilitation cost is minimized. Finally, structured analysis will be done and afterward management is performed efficiently.

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COMMUNITY RECOVERY AND NGO POLICY IN THE DEVELOPING WORLD: A CASE STUDY OF POST CIVIL WAR RECONSTRUCTION IN SIERRA LEONE

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Keywords
Recovery, Non-Government Organisations, Developing Countries, Civil War, accountability

Abstract
Developing countries experience a lack of resources, trained personnel and infrastructure that constrains their ability to cope with and recover from major disasters. Consequently, they are reliant on support from external countries, but in particular the support of non-government development and relief organisations during the processes of response and recovery. Against this background of NGO involvement, the NGOs themselves have been evolving through a process of adaptation to new responsibilities that challenge their capabilities, accountability and levels of involvement. The ten year civil war in Sierra Leone resulted in enormous displacement of the population, issues relating to the problems of re-integrating child combatants and those who were maimed and traumatised in the war, and widespread destruction of housing, service facilities and infrastructure. While its economy had been in decline for more than a decade before 1990, the war dominated all sectors of the economy, reducing Sierra Leone to the status of one of the world's poorest countries. In the face of this devastation the Government and the people are especially poorly resourced for the enormity of the reconstruction. Government policy is to encourage non-government organisations to bring funds and personnel to the nation to work in partnership towards rebuilding the country's infrastructure and serving the needs of the people. The result has been a proliferation in the number of NGOs establishing themselves in the capital, Freetown, and in a piecemeal manner in the provinces. The variety and diversity of these organisations present difficulties and contradictions in the coordination of a policy of reconstruction and recovery. While NGOs provide recovery facilities for portions of the country, most of the citizens of Sierra Leone are independently reconstructing their own communities, within a pre-existing traditional framework that is poorly integrated with the formal recovery program.

Introduction: Changing Roles in Emergency Management
In carrying out research on disasters, predominantly in a developed country situation, our main emphasis has been on mitigation and preparedness within a framework of strong governance. Many developing countries lack that governance and must rely on external support. The case study of Sierra Leone was carried out to gain experience of massive external intervention in a country where I had previously worked and researched. The complex humanitarian disaster of a civil war allowed insights into the response and recovery processes following a major crisis. Emergency Management has seen the change in emphasis from a top down hierarchical structure to a more community driven bottom up approach. While Emergency Management still requires outside providers of relief, assistance and the means to recovery, the community that is impacted in a crisis is increasingly seen less as a passive group of victims than as an active participant in a process of coping and recovery. Thus necessary parts of Emergency Management are such things as social

capital, community networks and organisations, mitigation where it is possible, or security and protection, as well as awareness, preparedness and leadership from within the affected community. In all crises, whether of natural or human origin, the affected community is a direct participant at all stages from onset of a disaster to final recovery. At the point of greatest impact of a disaster the community is at its most isolated, vulnerable and active in protecting and preserving itself (King 2001). Where a disaster develops with a more gradual onset, such as in the case of predictable natural hazards and civil wars, emergency management agencies may be involved in education, mitigation, security and relief before and during the principal crisis. However, in all events the affected community bears the primary impact, and experiences the totality of the disaster. The community, therefore, is the primary player in a disaster. It experiences every part of the event, even though it may be overwhelmed and dislocated. While the people of the impacted community are the principal victims, their knowledge of what happened (though not necessarily how or why) is greater than that of emergency managers and the providers of aid. The needs of the community exceed those of all other peripheral players and agencies, such that it is their assessments of appropriate levels of response that should direct or at least influence response and recovery.

Despite the fact that the disaster impacted community may be overwhelmed and traumatised, it will still be capable of expressing its needs and reconstructing itself. As relief and support may often be slow in coming to a disaster, the community will begin its own response and recovery long before formal agencies are present in the area. This may be termed spontaneous reconstruction in that it is not initiated by external agencies, but it is in fact a rational and necessary response to disaster. A community does not need to be empowered to begin reconstruction, as people will do it anyway because they have a greater pressure than relief agencies to meet their own immediate needs (Harvey 1998).

If the community may be expected to take action before, during and after a disaster, then community empowerment is more about how the community is involved with supporting emergency management and relief agencies than a process that must be initiated in the community. Community empowerment is more likely something that happens to emergency management and relief agencies; a change in their attitudes and emphases rather than something that must be done for or to the community. It will already be functioning in some way by the time relief comes and will continue to rebuild and recover whether or not outside agencies are involved. However this does not mean that the community is so resilient that it does not need outside help. There is an enormous gulf between coping and recovering. External agencies have organisational, financial and partnership roles and resources that enable or accelerate recovery (Keen 1998).

Post War Recovery and NGO Policy in Sierra Leone

In the complex emergency of a humanitarian crisis following state/Government collapse and civil war, outside involvement is a necessary response where devastation, disruption and insecurity are widespread. Initial contact with the victims of catastrophe is through existing external agencies, remnants of Government and a carried over experience of previous crises. Involvement of international relief agencies in complex emergencies has become a conventional international response. Alongside the large international agencies are the thousands of NGOs (Edwards and Hulme 2002), many of whom have shifted roles from development to disaster relief, and who as the complex emergency stabilises, move back into their conventional areas or into a different kind of development. Development oriented NGOs have become emergency managers without necessarily altering their development based attitudes and political agendas.

Following the end of ten years of civil war, communities throughout Sierra Leone in West Africa commenced their own recovery within the constraints of limited resources, while a similarly constrained Government developed a NGO policy to encourage and coordinate NGOs in supporting recovery. During the period immediately before and after the May 2002 general election

that theoretically marked the transition from the emergency phase of Sierra Leone's crisis to the recovery and redevelopment period, NGO projects and community recovery seemed to be proceeding in parallel, but only superficially linked to one another.

As international agencies and NGOs move into a humanitarian disaster, alongside or parallel to community activity, the involvement of central Government facilitates or directs redevelopment within a broader political framework and development strategy. A strong civil society that works with NGOs may improve the developmental aspects of relief (Harvey 1998). Civil society as a concept includes all the positive aspects of community, independent of the state and thereby the grassroots that presents a bottom up approach to development. Civil society is not totally undermined by disaster, but in the face of war it transforms and re-emerges. The Sierra Leone Government developed a NGO policy that encouraged a wide range of NGOs to become involved in community oriented development to serve the needs of Sierra Leoneans in reconstructing their settlements, economy and infrastructure after the war. It is implicit within this policy that agencies and NGOs will work alongside traditional organisations.

The Sierra Leone War and Community Response

The Sierra Leone civil war between 1991 and 2001 was a complex emergency that resulted in a range of recovery issues. In May 2002 a free and fair general election returned the incumbent president, thereby marking the end of the emergency era and the beginning of the transition from the immediate post war recovery to longer term development and reconstruction. However, the large UN military presence did not immediately disperse. Military operations and peacekeeping have continued, especially in the light of renewed fighting in Liberia close to the Sierra Leone border, and ongoing instability in Guinea.

The complexity of the war resulted in extreme dislocation, destruction and economic decline. The country is ranked poorest in the world on a range of indicators (Davies 2000, NCRRR & OCHA 2001 2002), with virtually no exports and severely reduced domestic economic activity (although the domestic market is clearly responding to the immediate post war influx of economic opportunities). The Government is impoverished and reduced to basic functions, although the public service is still in place and is capable of functioning efficiently, as was illustrated by the Electoral Commission in its organisation of the general election. The horrors and atrocities of the Sierra Leone war captured the attention of the international media. The plight of amputees and the war injured is one of Sierra Leone's many recovery issues. The involvement of child soldiers and children's participation and brutalisation during the war is another part of the broader problem of rehabilitation and reconciliation. Reconciliation with the proponents and participants of a nasty war contributes to the wider trauma that to some extent affects all Sierra Leoneans.

Displacement of the population was widespread. In 1995 the World Food Program (Keen 1998) estimated 1.5 million to be displaced and the UN (2002) estimated for the whole sub region of Sierra Leone, Guinea, Liberia and Cote d'Ivoire that 1.1 million were internationally displaced or refugees. Research in Freetown and Kono in April/May 2002 suggested that almost everyone had a story of flight or displacement, some short distance and short term (as in the 1999 battle of Freetown), but much was longer distance and longer term, while for many people displacement was multiple and included residence in neighbouring countries. Possibly most of Sierra Leone's approximately 5 million people were at some time displaced, probably losing most or all of their personal possessions, and some losing family members to violence and disease. For most of the people it was a refugee flight carried out at their own expense and organised by themselves. Returnees, back to Sierra Leone, or back to provincial places of origin, mostly organised their own journeys. There are many more ways in which Sierra Leoneans coped with the disaster of the war. Food continued to be grown, many services continued to be provided, albeit much reduced, and

houses are being rebuilt. However, there is a danger in relying too much on coping strategies, or of international agencies using coping responses as a justification for limited aid (Keen 1998).

Although many Sierra Leoneans continued to produce food, villagers fled from attacks and atrocities committed by combatants. The RUF (rebels) relied upon locally gathered food supplies, raiding villages at harvest time, forcing many people to seek temporary refuge in the bush while their homes were looted and often destroyed. The dislocation of the agricultural economy had not been repaired by 2002. While there were signs of villagers beginning to bring produce back into town, the urban population was primarily dependent upon imported food and food relief. Throughout the crisis food relief has gone into devastated parts of the country. If it did not go directly to the rebels, it supported those populations who had recently been robbed by rebel and other combatants, thereby extending and supporting the agricultural base on which they depended. The NGOs have long experience of programs of assistance in providing food aid. They are largely not able to do much in restoring people's houses, clothes, furniture and personal belongings – hardly luxuries when all has been lost. Sale of food, including food aid, is an essential coping strategy for the broader reconstruction of settlements and communities.

Many NGOs are involved in agricultural recovery, providing seeds, expertise, tools and in some cases assistance for returnees. As examples, three very different NGOs with agricultural programs are World Vision working in Kono (and many other parts of Sierra Leone), Christian Extension Services in Koinadugu (which is very predominantly Muslim), and the International Islamic Relief Organisation in Moyamba (which is much more strongly Christian) and which is also working with Moyamba people in Grafton Camp and those still displaced in the bush. These three examples all had similar aims and methods, and worked within chiefdoms and thus with and through Chiefdom Councils. By 2002 farmers had not at that time brought into cultivation the amount of land that they had formerly farmed. They were feeding themselves and beginning to expand production, but recovery had a long way to go. Peace and disarmament had been a gradual process in restoring confidence and both the willingness and ability of people to return to farming and marketing.

While the war's impact on the rural economy was devastating, the widespread destruction of cities and towns and villages is the starkest symbol of the war's extent. Some places, especially Kono and Kambia Districts, were destroyed (NCRRR & OCHA 2001 2002). Towns and even the whole city of Koidu were substantially razed. The rebel aim on the diamond fields of Kono was to make the places and diamond mines uninhabitable and irrecoverable. The rebels were also aided by ex soldiers ("sobels") and locally recruited combatants. Destruction was systematic and extensive, for example taking over four months to loot, burn and knock down Koidu, and destroying 90% of all residential buildings in Jaiama Nimikoro, even breaking up pit latrines and water pipes. Younger Sierra Leoneans reported that older people were so devastated and demoralised by the scale of the destruction that they died of broken hearts – inevitably trauma and depression coupled with malaria and other diseases.

NGOs are largely not rebuilding houses, although some have been involved with youth and community groups that are engaged in building dwellings. Tarpaulins have been supplied and extensively utilised, enabling people to survive in the ruined dwellings. Alongside many of the ruins, people are rebuilding mud and wattle dwellings, typical of village houses, and expect to expand and build something larger and more substantial as things improve. Large stores selling concrete, timber and steel had already opened in Sierra Leone's second largest city, Koidu, block houses were being constructed, damaged multi-storey buildings renovated, and mud and wattle houses built alongside ruins of which some were used for storage, kitchens and market stalls. Diamond mining had also re-commenced. Alongside the Electoral Commission one of the first re-established government offices in Koidu was the Department of Mines.

The rebuilding activity inevitably impinges upon recovery of the rural economy. If no relief agencies were present, people would undoubtedly be forced to put all of their efforts into the most basic survival needs. Instead relief support has contributed to the capability of people to proceed with rebuilding. A side effect of this is a transfer of time, effort and resources, away from agriculture towards re-housing. As basic housing and infrastructural needs are met, more time and resources will go into increased agricultural production. However, this is most likely to be a return to, at best, the level of pre war underdevelopment. The agricultural system was disrupted but not destroyed by the war. Villages continued to function not only as unwitting or unwilling suppliers of food to combatants but also as refuges from urban destruction. These were ways in which rural civil society survived and is re-emerging, weakened, but in many respects intact.

Residential buildings were the primary targets for destruction, but a great deal of physical infrastructure was destroyed as well. Roads, urban drainage systems, power and water supplies were damaged or wrecked, or otherwise left un-maintained during most of the ten years of the war. Colleges, school, clinics and hospitals were vandalised and in some cases destroyed, while the residential dwellings of institutional staff suffered the greatest damage. Despite the destruction many staff remained at or returned to their places of employment with intermittent salary payments continuing to be received. Similarly many schools, Government departments and NGOs relocated in order to keep functioning. Thus an impact of the war was a destruction, dislocation and disruption of services and facilities – an irreplaceable loss of scarce social resources. Yet alongside this loss people made courageous efforts to maintain social services and innovate lost infrastructure. This loss extended to the impact on the rural economy. In Kono District for example, as well as severe damage to roads and bridges, there were virtually no functioning vehicles by the beginning of 2002. The re-establishment of a functioning public transport system by local entrepreneurs was a necessary precursor to trade and food marketing. This essential aspect of recovery is also not a role that is undertaken by NGOs, although UNAMSIL (the UN peacekeeping force) was a crucial facilitator in making a damaged road system safe for travel and business.

On the other hand NGOs and international agencies have been active in their more traditional role of health service provision. Damaged institutions and returning staff have been supported and supplemented in the rebuilding of a basic health service. The loss of health services and clean water supplies, as well as increased malnutrition and the war in general, undoubtedly brought about a much higher disease and death rate.

Finally, the war severely dislocated traditional institutions. The 144 chiefdoms of Sierra Leone were the basis of provincial local government. The hereditary nature of Paramount Chiefs has long been a basis for conservatism and a political patronage system that contributed directly to the lack of development of Sierra Leone, and the corruption of central Government. However, the democratically elected Chiefdom Council is the basis of local development and basic infrastructure, and is an institution which includes the various town councils that fall under the jurisdiction of the chiefdom. Displacement of the population and rebel targeting of corrupt political leadership and ultimately any traditional leadership, resulted in an interregnum of governance on the part of traditional institutions. Paramount Chiefs fled from violence along with their people, although the Chiefs' destinations were often much more comfortable and secure. Warring groups of combatants conducted some kind of administration, but were never involved in development and ultimately brought about extensive destruction. They were agents of non development.

Recovery requires civil society to be working through traditional structures. The loss of leadership and dislocation of civil society was a temporary thing. As people have returned, it is to their own land (within the sense of a communal system), to pre-existing towns and villages and with their pre-existing relationship to a chiefdom and its institutions. Inevitably in those chiefdoms where the Paramount Chiefs have returned promptly, or where they remained, leadership has, at least

temporarily been, resumed, especially if the individuals have the energy and political will to exercise that leadership. In Koidu the Paramount Chiefs of Gbense and Tankoro chiefdoms were present and active as peace returned, such that the town and chiefdom councils were quickly re-established along with a structure of urban living. Residents were required to clean and de-vegetate their ruined dwellings, thereby identifying those blocks where people had not returned. If a block had not been cleaned up within a few months, it would be assumed that they were not returning and the land could be re-allocated. Koidu's land holdings were complicated where ethnic Kono residents had leased or sold urban blocks and houses to non Konos, some of whom had further sold or leased the properties. As land is re-allocated, so the process of rebuilding can be expected to speed up. Koidu was a substantial city before the war and continues to retain its central place functions, as well as its (depleted) diamond deposits.

Despite the dislocation to traditional institutions they remain after the war as a focal point for recovery and a return to a pre war state, even if they are about to experience social change. The populace led the general election with reduced chiefly participation. It is likely in the post war period that rural society will be transformed, as that is a frequent outcome of civil wars. However in the immediate post war reconstruction period the traditional institutions provided a framework for repatriation and reconstruction, acknowledged by the population, and are providing some form of leadership. At the point of commencing recovery, return to the chiefdom marks a return to the land and its resources, but implies no guarantee of a return to the colonially constructed chiefly patronage system (Fanthorpe 2002). Most of the people of Sierra Leone had to "make their own arrangements" [1] in dealing with the impacts of the war. They have not been a passive community of victims waiting for relief from the outside world. Besides, the relief and interest of the outside world was very slow in coming. Rather, the diverse communities of Sierra Leone have shown great resilience and have played an active role in facilitating their own routes to rehabilitation, recovery and redevelopment.

Partnership with NGOs

Coping unaided with disaster is not sufficient to achieve long term recovery and development. For a poverty stricken Government, support from outside organisations is necessary. Many international agencies and NGOs were already active in Sierra Leone before the war, contributing to development and social welfare programs. Many remained in Sierra Leone throughout the war, and in common with NGOs in other parts of the world, became involved in relief operations. The Sierra Leone Government embraced their participation to the extent of devising a NGO policy to coordinate and expand the opportunities they provide.

NGOs are in a complex process of their own transformation, in which some do not necessarily have a clear idea of the direction in which they are drifting, or being pushed. A weak and impoverished Government emerging from the trauma of a devastating civil war has established a development policy to use and direct this polyglot group of private and public organisations. The beneficiaries are a diverse group of largely rural communities who have at most times devised their own responses and strategies in dealing with the impact of the war. In particular they are returning to a pre war rural land and economic system that shows signs of having emerged able to function, though not necessarily sustaining the pre war patronage system. Thus community recovery and the redevelopment of the nation were linked to a policy of NGO participation. The Sierra Leone Government Ministry of Development and Economic Planning, responsible for the facilitation and coordination of all NGOs in the country (Government of Sierra Leone 2002), utilised a long history of NGO involvement in the country's development, especially the involvement of religious bodies in development activities since their initial entry into the region, predating colonial control.

[1] A phrase used by the British Government in World War 2 as advice to people bombed out during the Blitz. There was little the Government could do to help rehouse them.

The high intensity of the war in 1998 and 1999 severely disrupted all NGOs with the invasion of Freetown closing headquarters offices and resulting in an exodus of expatriates as well as displacement of many Sierra Leoneans. Before these events there had been over 500 NGOs and Community Based Organisations. This had recovered to 265 by 2002 with another 80 to 100 applications in the pipeline.[2] Immediately following the peace agreement of May 2001 the Sierra Leone Government's first role was to assist displaced people and to involve ex rebels in possible activities that would facilitate their reintegration. Two institutions were set up, the National Commission for Reconstruction Resettlement and Rehabilitation, NCRRR, which merged into its successor agency the National Commission for Social Action NaCSA, and the National Commission for Disarmament, Demobilisation and Reintegration, NCDDR. Both received inputs of donor funds and acted as donor agents. NCRRR/NaCSA focused on war affected people and communities, while NCDDR concentrated on ex combatants.

International agencies and NGOs acted as facilitators and carried out most activities on behalf of the Government. A development task force was supervised by the National Reconciliation Committee with a technical commission under the Ministry of Development. Their initial role, primarily through NGOs, was to assess areas as they were disarmed, and to prioritise needs. Provincial Recovery Committees with 12 district and 149 chiefdom committees are responsible for monitoring funds and implementing projects. Chiefdom committees are also expected to provide labour, presumably under pre war traditional arrangements. The aim was to kick start economic activities and to target recently disarmed areas.

Under the UN Office for the Coordination of Humanitarian Affairs, OCHA, team assessments were carried out under such sectors as civil security, health, water and sanitation, education, agriculture and food, shelter, child protection, transport infrastructure, population flow and general reintegration (OCHA 2001). On the basis of these assessments priority programs were identified to donors and priority districts were identified as Kambia and Kono, where the destruction had been the most severe. Meetings of donors expressed little interest in involvement in shelter and roads, which probably accounted for the greatest extent of the damage. Subsequently the UN became involved with the Sierra Leone Roads Authority in rehabilitating roads. Reconstruction of dwellings has been primarily left to individual families, although some NGOs subsequently became involved in the provision of building materials for shelter and some expertise. NGOs moved into the provinces as soon as combatants were disarmed, but their priorities were health, children, agriculture and education. These areas represent donor interests and priorities. The British Department for International Development, DFID, as a Government organisation, was particularly interested in civil restoration, although this involved community based projects that re-established infrastructure.

The policy was to ensure a flow of funded projects to the people where they were most needed. The Government priority was economic development that would push along all the other sectors of development, rather than the social welfare activities preferred by most NGOs. NGOs were urged, but not compelled, to use local suppliers of goods and services, but largely these groups of development initiators were functioning independently of one another. The duty waiver, whereby NGOs import goods and materials exempt from customs duties, was perceived by the Sierra Leone Government to have been misused by both international and local NGOs. Undoubtedly the NGOs assess their needs differently, but some of the smaller local NGOs may be borderline commercial

[2] Information on the NGO policy was supplied by the Director of the NGO unit in the Sierra Leone Ministry of Development and Economic Planning, Mr Strasser-King and from documents produced by his department and from NaCSA. Key informants were establishing NGOs during this period and provided information on the process and insight into its shortcomings. Research for this study was carried out during April and May 2002 through a series of key informant interviews and meetings in Freetown, Koidu and Jaiama Nimikoro.

ventures. Criticism from the Sierra Leone Government that NGOs spend too much of their budget on salaries and office administration, repeats criticisms made by detractors in their origin countries. There had also been complaints about the poor performance of some NGOs and a lack of information flow.

International NGOs complained about Sierra Leone Government requirements that their expatriate employees pay taxes, something the national employees cannot avoid. While many international NGOs pay their employees in their home countries and keep general accounts rather than country specific program accounts there has been no way for the Sierra Leone Government to exercise control and keep the NGO working in the country. In a troubled world, globalised NGOs can move on to another crisis if they do not like the working conditions. A further irritation was caused by NGOs bringing in extra staff, without approval from the Sierra Leonean NGO unit. Some of these were salaried, but many were volunteers who were simply supported by the NGO. On the other hand the work permit process is slow and cumbersome, and many new projects were developed in-country as new needs were identified. Thus while the policy requires that NGOs meet all of these customs duty, tax and personnel requirements many NGOs ignore details of the policy in the urgency of their focus on rapidly responding to relief needs. The international NGOs, in particular, are fairly united as a group in expressing their own goals and policy. These problems are not unique to Sierra Leone, having arisen in other humanitarian crises.

The accountability problem is even worse with local NGOs. Many do not keep proper accounts or employ accountants. There is no lower limit on their funds and some have not even accessed them. Some of these local organisations are communities or church groups, but the smallest are individuals who may be acting on behalf of a religious community locally or overseas. Some of the smallest local NGOs are little more than a sinecure for retired businessmen and public servants.

Religious groups, both Christian and Muslim, comprise about 60% of all NGOs, but a small number of high profile international organisations dominate and provide most of the relief programs. Before the NGO policy was introduced there were already about 500 NGOs in Sierra Leone. While the invasion of Freetown reduced many of these, Government policy is to try to reduce total numbers to those that are effective. NaCSA[3] not only attempts to coordinate and monitor them, but also allocates funds from international donors to individual NGO projects and programs. Inevitably the larger organisations are better equipped to apply for and to administer these funds.

NGO Roles in Complex Emergencies

NGOs active in Sierra Leone experience tensions, and accountability problems in common with activities and roles of NGOs elsewhere in the developing world. Most NGOs involved in development have evolved from a humanitarian liberal and idealistic agenda, although their performance in development had often been ineffective or patchy (Edwards and Hulme 2002). With local knowledge and local institutional organisation, development NGOs found themselves well placed to intervene in relief when states fell apart and conflict emerged (Keen 1998, Harvey 1998, Edwards & Hulme 2002), but being reliant on donors for funding many NGOs found themselves beneficiaries of increased publicity as wars and associated natural disasters developed. For professionals committed to improvement in the quality of life in developing societies, there was no choice but to become involved in relief.

[3] At weekly NaCSA coordination meetings in Freetown only 20 to 30, mostly international NGOs were represented and meetings continuously discussed the problems of poor attendance and difficulties of monitoring and coordinating organisations that failed to turn up. In the districts attendance and coordination may be better. Koidu NaCSA office meetings, for example, indicated reasonable attendance, even though, or possibly because, not much was happening.

With a change in their roles NGOs have experienced a shift in accountability. The end of the cold war took many government players, such as the USA and USSR, out of direct aid competition in the development world. Aid was both relatively reduced and channelled through international agencies and NGOs (Fowler 2002, Reno 1997). NGOs became more connected with donors who were bigger and more powerful (Edwards & Hulme 2002). Developed nation governments also exerted an influence on NGOs, adding another level of accountability upward, to the detriment of downward accountability (Edwards & Fowler 2002, Keen 1998, Edwards & Hulme a & b 2002, Hilhorst 2002). Thus NGOs are in greater danger of disengaging from direct partnership with disaster affected communities, while they serve instead the needs and agendas of host governments, private donors, donor agencies and western donor governments.

A further problem is the political naivety of NGO relief efforts that indirectly (or directly through corruption and theft) support combatants and extend or exacerbate the conflict (Fox 2001, Duffield 2001, Macrae & Leader 2001, Keen 1998). On one side NGOs have been criticised for supporting corrupt governments by providing outside funded welfare projects, while on another side they undermine those same governments by enabling combatants to stay in business (Woodward 2001), on yet another side they play into the globalisation agenda by practising privatisation of social services and international aid (Cliffe 2000, Fowler 2002, Edwards & Hulme 2002) and finally they have neglected accountability to, and partnership with, the community they exist to serve.

Against this background the development NGOs have been drawn into increasingly complex conflicts, involving many players, unclear goals, struggles for resources and in some cases associated natural disasters, and all of the outcomes of displacement, medical crises, collapse of government and destruction of infrastructure (Richards 1996). These new crises challenge all relief agencies to participate in the peace process as actively as the military organisations that are involved. The new wars of the 21st century involve a dislocation of globalisation and network connections, especially in relation to the trade in cheap arms and the migrations of refugees (Cliffe 2000). Secondly these wars create their own political economies. The commonly used term warlord economies (Reno 1997) describe a competition for resources that had formerly been controlled by the patronage system that had developed out of colonialism. Thirdly combatants change sides, and mercenaries and criminals become involved. Keen's (1998) and Bundu's (2001) accounts of the Sierra Leone war portray the confused status of Government as the role of the army changed from elected Government security force to coup leadership and then to rebel force after the elected Government was restored. Civil defence units developed as a fifth force alongside the Sierra Leone army, Revolutionary United Front rebels (RUF), mercenaries and ECOMOG (the West African/Nigerian intervention force) that had to be disarmed and reintegrated just as substantially as the rebel force. Fourthly there are no significant political goals in these new wars. The Sierra Leone rebels were attacking a corrupt government, but they had no agenda for establishing themselves as an alternative. In a warlord capacity they controlled and administered local resource development, and totally destroyed the infrastructure and towns of their primary resource, on the diamond fields, to ensure that neither Government nor any other player could regain control of that resource. While Sierra Leone's diamonds paid for conflicts in Sierra Leone, Liberia and Guinea, they only purchased light arms. The new wars are cheap wars (Keen 1998, Richards 1996) where terrorism of the unarmed civilian population is easily achieved, but the capacity to defeat the Government is insufficient.

Until the May 2002 election Sierra Leone was in a state of emergency that required humanitarian rather than development NGOs, but as many had shifted from development to humanitarian relief, it is very likely that most will shift back into development as Sierra Leone enters post war recovery and redevelopment. All the same, despite the number of organisations in the country, the Government expects a continuing shortfall in assistance. More problematically, the NGOs have

been driving an economic boom. As the immediate emergency ended, up to 20 of the 65 international NGOs could pull out, with all of the multiplier impact on the economy, especially in Freetown. The Government would be unable to fill the role that would be left by their departure and needed a transition from emergency to development in the short term, as well as a peacekeeping presence, especially as neighbouring Liberia, and the region in general remain volatile. Good governance and especially an end to corruption are vital to that transition.

The target beneficiaries and communities are that civil society that has survived the war at least superficially intact. As people have returned to their ruined towns and villages, they have engaged with the pre-existing chiefdom system and land ownership that was the basis of local Government and community, but many Paramount Chiefs are not providing good leadership, for reasons of absence, age, poor health and lack of resources, as well as the pre war conservative patronage mind set. In particular the old system of chiefdom labour is currently ineffective, so that relatively little community infrastructure is being restored by chiefdom councils. Besides, the councils themselves also have no resources. Poverty is endemic, and there is a lack of structure and logistics with which to function. Added to this are difficulties of poor communications and flow of information. Displacement and an influx of returnees have added to these constraints. Movement between communities and involvement with the people faces the problem of a severe lack of accommodation. Personal and family needs of government and provincial public servants, especially rebuilding their own dwellings, also outweigh their commitment to their jobs. The priority for citizens is to rebuild houses and restore farms and businesses. Yet that apparent self interest is probably the greatest movement of community recovery as the nation moves into the beginning of its redevelopment era.

A role of the NGOs is to liaise and work with the 'traditional', local Chiefdom councils to target and develop aid projects as facilitator and implementer. That involvement is largely not working. The local community committees exist but are neither committed nor involved with NGO efforts in many parts of the country. Thus the NGOs provide aid and relief driven by their own ideology and purpose, guided by the UN assessments, rather than as a response to community priorities.

Conclusion: Parallel and Divergent Routes on a Long Road to Development

The emergency management concepts of response and recovery are evolving from a traditional top down hierarchical control towards a partnership between emergency management agencies and impacted communities. Greater involvement of the community in dealing with its own disaster enhances the roles and effectiveness of the emergency management agencies and speeds recovery and closure for the community itself. The complex humanitarian disaster of the Sierra Leone civil war displaced a high proportion of the population, destroyed the country's economy, physical infrastructure and many of its towns and villages, and took away the Government's capability to provide services and administration. Recovery and reconstruction have had to rely on the capabilities and resources of international agencies and NGOs. To provide leadership and to attempt to control, or at least coordinate the NGO response, the Government of Sierra Leone developed a NGO policy that gives these organisations a significant level of responsibility and freedom in driving recovery and reconstruction.

The Sierra Leone experience mirrors a worldwide process of changing NGO roles in the arena of complex humanitarian disasters. Organisations that were in many instances primarily development agencies, answerable to the needs of underdeveloped communities and the generosity of private donors, have shifted into new roles of emergency management, relief and peacekeeping support. An extensive critique of these changing NGO roles draws attention to the problems of changing accountability, and increased political commitment to large international organisations. NGO accountability has shifted upwards, away from impacted communities.

Simultaneously the communities that need NGO and Government support for recovery and reconstruction have not waited for it to arrive. Throughout the crisis individuals and communities have responded at their own expense in meeting their immediate priorities. Most displacement and return has taken place outside the assistance of formal organisations. Re-establishment of farms, rebuilding of houses, and redevelopment of businesses has taken place independently and spontaneously. During the ten years of the war, communities, organisations and institutions continued to function, often severely constrained, but maintaining the skeletal structure of pre war society. Civil society was not destroyed by civil war. As the basis of peoples' lives and economies, especially in the provinces, traditional structures remained in place, even if dormant. During periods of peace and especially after disarmament had taken place, rural and urban communities functioned and reconstructed their places.

Relief agencies and NGOs with their priorities and skills encountered communities that had already begun their own reconstruction. While only too willing to accept every bit of assistance that is offered, these communities have their own priorities, structures and organisation. The civil society that they represent has its own social capital, networks and long term low level of stability that has survived the disaster of war. However, the power of central Government and of Paramount Chiefs has clearly been challenged and diminished by the war, while displacement and destruction of transport and communications has isolated communities within their own self sufficiency. The accountability of civil society has shifted downwards while the accountability of NGOs has moved upwards. Thus the partners in reconstruction, NGOs and communities, meet at points of mutual interest, while pursuing both parallel and divergent routes to recovery and re-development.

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FLASH FLOODS AND PLANNING ISSUES

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Keywords: Flash floods, flooding, regional and urban planning

Abstract

Flash floods and their impacts are identified as an increasing concern requiring attention by urban and regional planners. Flash floods are the consequence of severe precipitation events on watersheds whose hydrology has been "stiffened" by land development. Flash flood examples are given showing that they involve significant loss of life and property. Recovery costs are very large. Flash floods are characterized and their properties and impacts discussed. Health and environmental effects are also considered. Planning issues that can lead toward flash floods are identified, and required planning actions are proposed.

Introduction

Across the world floods continue to claim a large number of lives, destroy billions of dollars of resources and property, destroy critical infrastructure and cost governments large sums to save, protect and restore people to productive living and to rebuild infrastructure. These severe impacts are a concern and the number and severity of floods has been increasing rapidly. In fact, floods account for the majority of all losses of life and property damage in relation to all natural disasters. In the United States for example, natural disasters were costing an average of $40 billion USD per year during the 1990's and the moving average steadily increased through the period. By 1999 natural disaster costs in the United States had climbed to $100 billion. Of these total natural hazard event costs, 80% was due to weather and weather related natural hazard events (McBean & Henstra, 2003.) The natural disaster costs born by the property and casualty insurance industry have increased very rapidly yielding a recent situation where premiums have not been sufficiently covering payments (Newkirk 2001.) Unfortunately, these figures only account for the direct financial effects. In the period 1998 to 2001 there were 320 flood related deaths in the USA, and there are more very significant negative effects on human and ecological health whose financial impacts are as yet unquantified.

The major post flood emphasis by governments has been on rehabilitation and reconstruction with little or no effective investment in developing broad based approaches that would effectively mitigate floods (Newkirk, 2000.) When governments have invested in flood prevention, this has usually involved the development of major physical facilities (eg., dams, levees, channelization, etc.) Researchers challenge this approach (White, 1945; Newkirk, 2000.) Some have argued that in certain cases physical flood modification structures may actually have increased the rate and severity of flooding (St. Laurent, 2001.) For example, both the Tulsa and Saguenay floods were more severe due to dam overtopping or failure. Yet, citizens and their agents normally see flood modification requiring physical structure development. For example, the Insurance Bureau of Canada (2002) recommended that more flood management infrastructure should be built by

government through committing 15% of recovery expenditures to "mechanisms to prevent floods and develop a culture of mitigation."

Perhaps government reluctance to actively engage in flood mitigation is based on general fiscal constraints and a perception that mitigating against floods involves very costly and extensive physical infrastructure development. Not all government steps to reduce the frequency and severity of floods need to be expensive. Newkirk (1996) showed that changes in land development policy and very low cost alternative development design show good potential to bring about substantial reductions in storm water flows and improve storm water quality even without building retention or detention facilities. It was shown in one case that peak storm water flows could be reduced by 50% by simple site design changes (Newkirk, 1997.) Various studies have shown that the public generally perceive their flood risk as low, and, indeed, there are many anecdotal reports of a subset of citizens who actually ignore requests by authorities to evacuate in the face of a flood threat. There is a general impression that floods are a somewhat slow moving and "natural" events that just must be accommodated.

However, there has been an increase over the last two decades of a more extreme form of flood. These are rapid development floods that are often associated with extreme weather events. With the gradual increase in extreme weather events due to climate change, we have witnessed a corresponding increase in flash floods. These flood events now account for the majority of loss of life and property damage from floods and need more attention by regional and urban planners and emergency managers. The nature of flash floods, some aspects of their causes and some suggestions for planner consideration are now considered.

Flash Floods

A flash flood differs substantially from a *riverine* flood. We characterize the periodic (or seasonal chnage) flood that develops slowly over a number of days as a *riverine* flood. These floods usually have a local history and understanding; many stay well within their natural flood plain most of the time. While some *riverine* floods may cover large tracts of land and some develop into major floods, they usually are not associated with excessively high water flow rates or rapid rise of water. Accordingly there is often time for warnings to be issued and effected parties to take precautions. Most people's flood experiences have been with riverine floods. Perhaps this gives rise to the false perception that all floods are slow to develop: "floods usually occur … slowly and actions to prevent loss of life and property are usually possible." (McBean & Henstra, 2003.) On the contrary, a flash flood generally takes the citizens of a community by complete surprise. Within only a day or two or even just hours, water levels rise very rapidly – often to levels never before experienced. Because of the rapid onset, citizens and authorities are often slow to recognize and respond appropriately to the mounting dangers. Indeed, the dangers may develop fast enough that there is little emergency response authorities can do except react by allocating most resources to saving lives and some property. Many times physical infrastructure must simply be abandoned to the rages of nature

Some recent examples of significant flash floods:

Location	Year	Impact	Comments
Tulsa USA	1984	Dead: 14, Buildings destroyed: 7,000, Property damage: $180 million USD (Hunt, 1999)	Damage estimate in 1994 dollars estimated as $257 million. (McBean & Henstra, 2003)
Houston, TX	1994	Dead: 20, Damage claims:6,000 with total payment $216 million USD Spill response costs; $7 million USD	Petroleum and chemical pipelines ruptured: 8, injuries from burns and inhalations: 547 (National Transportation Safety Board, 1996)
Ft. Worth /Dallas, TX	1995	Dead: 16, Damage $900 million USD (FEMA)	
Saguenay Region, Can	1996	Dead: 10, Buildings destroyed 2,600 Damage estimate $800 million CAD. Floodwaters outside the flood plain, (Gnescoe, 1997)	Damage costs increased to $1.5 billion CAD (McBean & Henstra 2003) Additional $3.6 million CAD in Canadian Government post flood response. (Canada, 2001)
Suva, Fiji	Apr 15, 2004	Dead: 8 (11 missing) Estimated damage $16 million Fiji	(Reuters)
Corpus Christi / Pecos, TX & Mexico	Apr 24, 2004	Dead: 10, buildings destroyed or damaged 2,500 (est.) Damage estimate: unknown.	Interstate highway 20 bridge destroyed. (Gillespie, 2004)

Flash Flood Characteristics:
The following are some features and properties of flash floods developed from reviewing a number of flash flood events.

Features of Flash Floods:

- Most buildings on the flood plain inundated and destroyed.
- Buildings and structures outside of the "official" flood plain effected.
- Transportation infrastructure on flood plain destabilized, endangered or destroyed -can result in petrochemical spills.
- Oil, chemical and sewerage tanks torn out of the ground, split open and contents spilled into the water course. (Ross, 2000)
- Municipal and agricultural sewage lagoons overrun. Flood waters contaminated by sewage.
- Motor vehicles swept off flooded roads and bridges. Vehicles falling from damaged bridges. More than 50% of the flood related deaths in the USA were vehicle related. (Parker, 2002.)
- Extensive land areas eroded away. Downstream areas contaminated by eroded soil and its pollutants.
- Rock falls and landslides.

Properties of Flash Floods:

- Often little forecast lead time. Rapid development of emergency conditions.
- Intensely local in impacts.

- Flash floods usually have high velocities and are extremely dangerous. (Tulsa Library, 2004)
- Very strong water force – sufficient to roll large boulders.
- A high wall of rapidly moving debris laden water.

Impacts related to Flash Floods:
Contaminated water and human health effects are generally associated with many larger floods; but these effects are often more pronounced in flash floods and are discussed below.

Contaminated flood water:
Initial storm water flow is significantly contaminated; this yields a chemical oxygen demand greater than that of raw sanitary sewerage, and biological oxygen demand greater than the output of primary sewerage treatment plants (Bryan, 1972; Newkirk, 1995) Flash flood water is often significantly contaminated by soil, fecal material, domestic and industrial waste, chemicals and petrochemicals. Gnescoe (1997) reports on the pollutants washed up by the Saguenay Flood. The resulting water contamination can result in human health crises through contaminated ground and potable water and contaminated marine life. The intense nature of flash floods makes them quite traumatic experiences leading to some of the important human health effects discussed below.

Human health effects:
After the Easter 1998 flash floods in England, the Flood Hazard Research Center at Middlesex University conducted a study on the human health effects identifying the following perceived health effects reported by flood victims:

Table 1: Perceived health effects of flood reported by flood victims (after Tapsell, 1999)

Health Effect of Being a Flood Victim
Headaches
Sore throats, loss of voice
Chest infections
Asthma attacks
Skin attacks and cold sores
Swollen legs and hands
Stiffening of joints / pain in hands
Muscle cramps
High blood pressure
Diabetes patients found blood sugar levels erratic
Digestive problems
Allergy to mould
Panic attacks
Fainting
Acrophobia
Depression
Tiredness and lack of energy
Lethargy
Stress and anxiety

Clearly flash floods pose dangers to individuals and communities of sufficient scale and importance that planners should give priority to addressing them. We now explore two key matters that appear to contribute to the development of flash floods: climate change and stiffening of watershed hydrology.

Flash Floods: Two Contributing Matters

Climate Change impacts:

While there remains some debate as to the actual amount of climate change and the specific processes and mechanisms driving climate change, there appears to be general agreement that climate has changed over the last century and continues to change. A particular concern related to flash floods is extreme rainfall events (although rapid snow pack and glacial melts due to unusually high temperatures are also important flash flood considerations in mountainous and foothill areas.) The severity of an extreme precipitation event is critical in determining the intensity of the resulting flash flood. Jarmain (1993) notes increasing climate variability due to human impacts on the environment, and it is clear that extreme weather related natural hazard events have been increasing worldwide (Newkirk, 1999.) "Extremes of precipitation events will be quite marked." (Ross, 2000.) Total precipitation increased 10% in the United States from 1910 to 1995 and with it a [corresponding] increased frequency of flooding (Kunreuther & Linnerooth-Bayer, 2000.) Regional planners need to ensure that land developments are approved subject to their tolerance to extreme precipitation events, and that official plans have due consideration of actions to reduce human and industrial activity impacts on climate.

Stiffening of Watershed Hydrology:

Over many years of residential, commercial and industrial development, modifications have been permitted that have changed the very fundamental hydrological properties of watersheds and sub-watersheds with the result that more and more watersheds exhibit "stiff" system response. One main contributing reason for this is a long standing (but misguided) desire to have storm water essentially treated as a waste product "to be fast and efficiently moved off site." (Imholf & Annable, 1993.) The critical aspect is that many watershed systems now have very low capacitance and very high response. When such systems are exposed to an extreme precipitation input, they tend to vulnerable to flash floods. Newkirk (2000) discusses this in more detail identifying the following planning issues that contribute to stiffening watershed hydrology and/or weakening safety regulation:

.**Table 2: Planning Related Issues that Effect Predilection for Flash Floods**

Planning Issue
Excessive drainage of sites in approved developments
Artificial (low maintenance) landscapes
High density (New Urbanism) design
Private sector property development rights VS community and (especially) down stream rights
Encroachment of urban development into rural lands
Approval of Concentrated Animal Feeding Operations (CAFOs) (Newkirk, 2001)
Development and structures (of any kind) in the flood plain
Deforestation of watersheds
Out of date or inadequate definition of the flood plain extent

These planning related matters are complicated by a poor understanding of or a lack of planning considerations of civil risk (Newkirk, 2001), and the lack of a specific requirement to include risk assessment as a formal part of urban development planning (Newkirk, 2002.) It is difficult to resolve this situation while there is conflict between the various local, regional, provincial (state) and national governments and their various agencies (Wetmore & Jamieson, 1999) and the fragmentation of government authority over watersheds (Newkirk, 2001.) Unfortunately those citizens and communities at risk of floods tend to stay at risk. Platt (1999) observes that in the United States over time there are on average 2.7 claims filed for each property that experienced a flood loss.

Planning Action Required

Urban and regional planners must become more proactive in community flood mitigation (Newkirk, 2001.) All new site development should be required to practice in excess of 85% storm water retention on site. All concentrated animal feeding operations must be required to develop flood proof animal waste processing facilities. Planners need to develop a professional commitment to dealing properly with Civil Risk – in particular, ensuring a fair balancing in a watershed context between "who benefits from and who pays for" land development and its impacts. Planners need to obtain a clear understanding of the risks associated with flash flood exposure. This means they need to update their models and maps that specify the formal flood plain.

The planning profession needs a better understanding of the flash flood issue in its broad and its local aspects. Planners need to undertake local research to improve their ability to understand the cause, frequency, and likely severity (impacts) of flash floods in their region. They will need to tie this knowledge to local policy development and emergency management and response to ensure their communities and citizens are not placed at risk of flash floods.

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EMERGENCY MANAGEMENT, RESPONSE & TRAINING

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ORGANIZATIONAL LEARNING IN PROFESSIONAL VERSUS NON-PROFESSIONAL EMERGENCY ORGANIZATIONS

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Keywords:
Organizational learning, emergency management, knowledge, collective practice, training

Abstract
This paper presents results from a study of organizational learning in professional and non-professional emergency organizations. The main objective of professional emergency organizations is to carry out rescue operations, normally performed by the police, fire brigades, and medical first aid services. The objective of non-professional emergency organizations is to prevent hazards from developing into accidents, and to reduce the damages from accidents in high-risk enterprises (e.g. oil and gas industry, chemical plants, nuclear power plants). Most employees within non-professional emergency organizations have their primary work tasks in other areas than emergency management, and are rarely involved in on the scene accident situations.

Both professional and non-professional emergency organizations are well regulated by authorities and high-risk industries themselves. There are regulations, requirements, directives, and plans covering all emergency aspects in detail. Within this "regime", the emergency organizations must operate and learn in order to optimise their achievements within life saving and risk mitigation. There are multiple organizational learning activities within such organizations. The learning activities span from traditionally predefined emergency response training and drills, to informal contacts and discussions. The paper describes and compares these activities in professional versus non-professional emergency organizations. Furthermore, the paper discusses organizational prerequisites, such as priority and competence, for efficient learning in emergency organizations. Finally, areas of possible experience transfer between professional and non-professional emergency organizations are suggested.

1. Introduction

This paper is about organizational learning in emergency organizations, in the perspective of unique and comprehensive accident situations. The main objective has been to describe and compare organizational learning activities in professional and non-professional emergency organizations.

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Organizations exposed to high hazards, such as large fires, explosions or discharge of toxic substances, are expected to have high safety standards. The emergency organizations are characterized by the overall demand for high reliability due to the potential for catastrophic consequences. To some extent, high reliability can be obtained by building safety margins and barriers into constructions and other physical structures, into machines and equipment, or into operational systems and manning. However, no organization can fully design their way out of a variety of known and yet unknown hazards and risks. Therefore, they must also rely on the ability to learn from unprecedented occurrences and incidents and take proactive action. Preventing accidents and assessing risks require time-consuming activities such as experiential learning, trial-and-error under controlled conditions, risk analyses, information processing, reflection and dialogue.

To study organizational learning perspectives and practices in emergency organizations, empirical studies have been carried out within the Norwegian petroleum industry and within professional rescue services onshore. We wanted to explore how professional and non-professional emergency services organize their learning activities. What are the most common modes of learning, and what are the distinguished prerequisites for organizational learning? Are there any differences in professional versus non-professional emergency organizations' perspectives and priorities?

2. Theory

2.1 A framework for organizational learning

By organizational learning we mean processes for communication and sharing of knowledge and experience within and across organizational units (Aase, 1997). Such organizational processes may involve a series of organizational efforts such as the development of learning concepts or models, development of specific services to support learning, or implementation of methods or tools for organizational learning. An organization is thus faced with a multitude of means suitable for organizational learning, including individuals, groups, and organizational units.

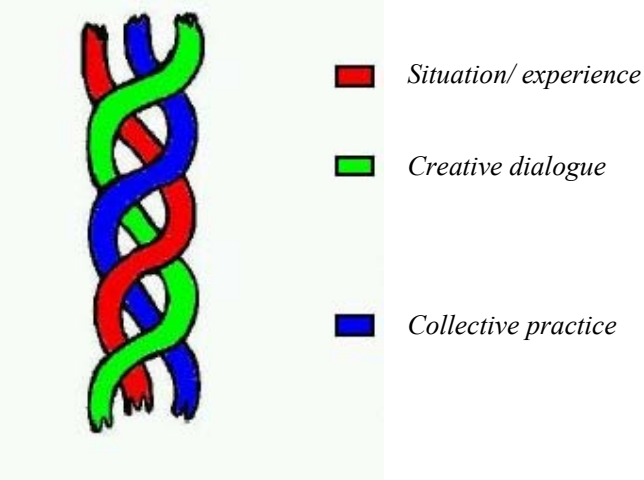
Formal means are characterized by the integration of organizational learning in written routines and documents such as databases, policies, procedures, and job descriptions. Informal means focus on the integration of organizational learning into working practice. Common examples are seminars, courses, training programs, mentoring, case studies, professional networks and social events (Pedersen et al, 2003). Formal means are typically more structured and hence easier to control compared to informal means. The content can be described as one-way explicit information. Informal means, although more unstructured and spontaneous, represents a richer[2] source of information incorporating both tacit and explicit knowledge. Informal means exceed formal tools in terms of richness and the ability to integrate and develop new knowledge. Nevertheless, a large number of studies demonstrate the prevailing preference among business managers for formal means (Cook & Brown, 1999; McDermott, 1999; Ruggles, 1998; Swan et al, 1999). Studies of the oil and gas industry show that formal repositories of experience and knowledge often fail to achieve their expected impact (Aase, 1997; Wulff, 1997). Employees find that face-to-face interaction and informal channels of experience and knowledge (e.g. personal networks) better serve their learning needs.

Knowledge and experience that can be expressed in words or numbers only represent the tip of the iceberg of the total knowledge base. Tacit and explicit knowledge exist together, and can often be hard to separate from each other. Instead of a desire to express the individual tacit knowledge explicitly, researchers suggest a shift of focus towards a collective and practice-based view on

[2] By information richness we mean the ability of information or media to change human understanding (Daft & Lengel, 1984)

knowledge and organizational learning (e.g. Cook & Brown, 1999; Wenger, 1998; Wenger & Snyder, 2000). The term collective tacit knowledge has been introduced, referring to professional communities of practice as the most important learning arenas (Swart & Pye, 2002). To illustrate the relation between tacit and explicit knowledge, processes for dialogue and reflection, and communities of practice, the triple helix model, as depicted in figure 1, can be used as a theoretical framework for organizational learning and knowledge sharing.

Figure 1. Triple helix model (based on Swart & Pye, 2002)



Situation / experience include the individual knowledge related to specific situations or experiences. This knowledge may be explicit, but not necessarily. There are a number of different descriptions related to a single situation or experience, and they will normally vary from person to person. The knowledge related to each situation may be represented in forms of picture, case, history, project, language, etc.

Creative dialogue includes an active reflection on the different descriptions of situations or experiences, either individually or collectively. In collective processes, the importance of gathering representatives with different perspectives is crucial.

Collective practice includes the follow-up of aspects from the creative dialogue, changing each individual's and/or the community's practice related to the different situations/ experiences.

When designing organizational learning activities, all three threads in the triple helix model should be included. To focus on dialogue without relating it to a specific situation or experience, or to focus on changing a collective practice without a creative dialogue, will decrease the chance of success.

2.2 The learning of emergency competence

The learning conditions within an emergency organization are often limited because of the nature of unpredictable nature emergencies or crises. In on-scene emergency activities, learning processes such as trial-and-error and experimentation cannot be tolerated due to the potentially catastrophic consequences. However, trial-and-error might be necessary in cases where uncertainty is high. Orasanu and Connoly (1993) introduce ideas of a commanding strategy on-scene, employing feedback loops, and Brehmer (1992) adds feed-forward strategies to deal with the changing situation in real-time.

Emergencies are chaotic, time critical, dynamic, and they involve physical, emotional, organizational and tactical challenges that place high demands on the employees' competence. Communication between emergency leaders and abilities to make decisions are regarded extremely critical. In addition, crises have a stochastic nature, and cannot be deterministically described in advance. Thus, it is not always sensible to train members of the emergency organization for certain behaviour in a specific scenario or in well-known environments. Their competence should be balanced in a way that they are able to both analyse the situation (knowledge-based behaviour) and respond quickly and automatically (skill-based behaviour) (Rasmussen, 1982). Extensive training could improve the employees' ability to generalise and to discriminate between events, or to recognise situations and connect them to established procedures for actions to be taken (Njå, 1998).

To handle crises which are stochastic is to prepare for the unexpected. Future crises may have causal chains that are still unknown. To prepare an organization for the unanticipated demands learning processes focusing on improvisation, simulation, and unpredictability (Weick & Sutcliffe, 2001). Employees' and organization's capacity for improvisation influences the ability to tackle situations that were not foreseen by for example designers, or not covered in operating procedures (Skjerve et al, 2004). An operator may interpret and understand a situation beyond standard operating procedures, thereby preventing potential escalation of events. To develop such proactive abilities requires the establishment of learning arenas in controlled environments, for example training, drills, tabletop exercises, or debriefs.

3. Methods

Following research assumptions have been developed to study the organizational learning perspectives and practices in emergency organizations:

> *Professional emergency organizations rely more heavily on situational and practice-based organizational learning than do non-professional emergency organizations (A1).*
>
> *Professional and non-professional emergency organizations are exposed to the same organizational prerequisites for organizational learning (A2).*
>
> *Experience transfer between non-professional and professional emergency organizations is an area of improvement that is unexploited (A3).*

Empirical studies were carried out in a regional rescue service (fire department, police and medical first aid) and an offshore oil production company, exploring employees' perception of organizational learning activities regarding emergency situations.

Study 1 in the regional rescue service (professional emergency organization) included 14 semi-structured interviews based on the same interview guide as in study 2. The interviews were extended with an emergency case, to which the employees responded to their situational assessments and hypothetical planning of related emergency response activities. The regional rescue service includes 4 municipalities covering approximately 100 000 inhabitants, and is located in the southeast parts of Norway. The interviews were carried out during a four-day stay at the fire department. The data collection also included participant observation of the daily routines and the emergency preparedness activities at the fire station. The data collection took place in 2004, and was limited to management of the operational level of the emergency organization. Informants were on-scene commanders (usually the police) and operations leaders (police, fire service and paramedics). The interviews included two operations leaders of small fire brigades on part-time basis.

Study 2 in the offshore oil company (non-professional emergency organization) included 25 semi-structured interviews, three workshops, participant and non-participant observation, and document analysis. Interviews were carried out according to an interview guide covering different aspects of organizational learning such as concept, practice, methods, tools, priority, barriers, and organizational factors. The data collection took place in a period of 10 months in 2002, and was limited to the tactical and strategic level of the emergency organization. The current emergency organization covers numerous offshore and onshore oil and gas production and processing installations involving approximately 12.000 employees. Informants were key personnel within the emergency organization in all business areas, and key personnel within the organizational learning process.

The focal area of both studies has been employees' perception of organizational learning activities within emergency and their organizational prerequisites.

4. Results

Results will be presented according to how emergencies are organized, the types of activities for organizational learning, and the specific organizational prerequisites for learning, particularly in professional and non-professional emergency organizations.

4.1 Organizing for emergency activities

Professional emergency organizations carry out rescue operations within their districts. The activity amongst the different rescue services varies both in terms of frequency and with respect to the response contents. Paramedics have a hectic work, from responses to all kinds of acute health problems to transportation tasks such as driving patients between institutions. The operational police force has a high mobility and members are constantly moving within their district. The full time fire service is on alert ready to respond on calls. They are gathered at the fire station working with technical fire fighting equipment, ensuring physical fitness, emergency response training or general maintenance work. Part-time fire-fighters are distributed across the municipality, but on call, within four minutes reach to their fire station. Part-time fire brigades are less frequently in action than the full-time service. A successful emergency response was characterized by:

- optimal co-ordination between the rescue teams, measured by the ability to ensure optimal working condition for other parties,
- the performance of the rescue work has been life saving,
- the performance is perceived as good (i.e. "we did what we could"),
- victims and bystanders express satisfaction,
- injuries on rescuers are avoided.

In cases were all three emergency services are needed, the fire brigade is usually the front line responders. The police provide information to the leader of the fire brigade, keeps the area clear and co-ordinates the rescuing work. The paramedics perform the health care priorities and activities. This cross-service activity calls for a close cooperation and the need for competence within different fields.

The objective of non-professional emergency organizations is to prevent hazards from developing into accidents and to reduce the damages from accidents within large-scale high-risk businesses. Emergency is defined as *"... the totality of technical, operational, and organizational efforts preventing a hazard from developing into an accident, or reducing the damages from the accident..."* The non-professional emergency organization consists of employees with defined roles, responsibilities and tasks. The organization exists across, and in addition to, the formal organization. Most employees have their primary work tasks in other areas than emergency

management and are rarely involved in accident situations. This requires well-prepared efforts and extra resources for knowledge sharing and emergency learning.

The focus on prevention in addition to damage reduction is clearly stated in non-professional emergency organizations. Furthermore, the importance of proactive emergency management is stressed, defining proactive in terms of "*identifying challenges and preparing for possibilities and threats through competence and comprehensive insight in activities and operation*".

The emergency organization is well regulated by authorities and the industry itself. There are regulations, requirements, directives and plans covering aspects such as plans for establishing and maintaining crisis management, risk and emergency analyses, alert notification, evacuation, rescue, damage reduction, personnel care, information services, training programmes, exercises, etc.

4.2 Organizational learning activities

In the professional emergency organization, organizational learning was not employed as a systematic activity, nor did they have formal definitions or descriptions of learning processes. However, when introduced to the term organizational learning or experience transfer, members of the emergency organizations referred to their personal experience and experiences that they communicate with others. The members distinguished between experience transfer on accident scenes and experience transfer in controlled learning processes, such as training or debriefs. On site experience transfer was regarded important in order to optimize decisions and ensure collaboration between services. Experience transfer on the scene was assessed in terms of the need for recognition in order to carry out the rescue work. The focus was more on increasing automatic behaviour than on the ability to assess complex situations.

Paramedics and police referred to informal discussions (working as teams in each emergency vehicle) as the most important activity for organizational learning, besides their personal experiences. Personal experiences were the first recollection of most of the members and especially the paramedics mentioned the long-term emotional effects of bad experiences. One paramedic said that *"we all have our skeletons in the closet"* referring to personal unsuccessful actions. The fire-fighters also mentioned personal experience related to specific situations as the most important, but also collective discussions within each brigade (10-15 persons) were appreciated. Such discussions span from formal debriefs to informal discussions of events that had occurred elsewhere.

The professional emergency members also regarded drills and training activities as important learning arenas. The full time fire brigade had one drill every shift, while the part time units had 10-12 drills annually. The police were required to carry out a 40-hour training program per year. The paramedics did not have a predefined program but mentioned ad hoc drills. The need for collective large scale systems drills, or drills in which all parties could be involved was emphasized. However, such drills were scarcely planned and performed.

Written evaluation reports, computer-based information systems, and textbooks were only mentioned by a few members who wished to increase their own, as well as the organization's, theoretical background. When plans and procedures were referred to, emergency members acknowledged their importance, but no one referred to a direct use of them on the scene. The principles of the plans were regarded as inherent parts of the emergency response.

Members of the non-professional emergency organization refer to a wide range of activities for organizational learning within emergency situations: traditional emergency response training and drills, tabletop exercises, debriefs, evaluation reports, shift overlaps, different network initiatives, informal contacts, and computer databases. Table 1 shows some of the most important

organizational learning activities, indicating their level of information richness, their collective and practice-based elements, and their proactive focus. Information richness means the ability of information or media to change human understanding. Collective practice means the ability of active participation in arenas of practices. Proactive focus means the ability to think in advance, using imaginative skills. The categorization is based mainly on the informants' statements and opinions of the different emergency activities.

Table 1. Organizational learning activities within a non-professional emergency organization (Aase & Tjensvoll, 2003).

OL activity	Information richness	Collective practice	Proactive focus
Emergency drills	High	High	Medium
Tabletop exercises	High	Medium	High
Informal discussions	High	Medium	Low/medium/high
Debriefs	High	Medium	Low
Knowledge networks	Medium	Medium	Medium
Basic emergency training	Medium	Medium	Medium
Emergency shift overlaps	Medium	Medium	Low
Evaluation reports	Low	Low	Medium
Emergency knowledge databases	Low	Low	Low

Table 1 shows that the non-professional emergency organization has a broad action repertoire within organizational learning, including variation with regards to information richness, collective practice and proactive focus[3]. The different activities include both people-to-people approaches and people-to-document approaches. Respondents refer to tabletop exercises, informal discussions, and emergency shift overlaps as the most fruitful learning arenas. Only tabletop exercises, and to some degree informal discussions, score high on proactive focus. This is due to a tendency towards training according to pre-defined accident scenarios, and a perceived lack of variation in the different emergency activities.

4.3 Prerequisites for organizational learning

In the professional emergency organization, employees referred to five different areas as being the most important prerequisites for organizational learning:

[3] For a further description of the different organizational learning activities, see Aase & Tjensvoll (2003)

- *Risk assessment and ability to abstract situations*: Emergency situations represent hazards to rescuers as well as the people involved. Proactive thinking is important to foresee possible scenario developments that could be critical. Uncertainty is an inherent feature of emerging accidents, and evaluation of risk under stress in critical situations is complicated and hard to adapt to the rescuers theoretical background.

- *Openness*: Within professional emergency organizations there is a fear of placing blame or to expose individuals or groups for criticism. The societal focus on emergencies through media is sharp and is regarded as a threat that is straining for the personnel. External evaluations of emergency operations conducted by either professional organizations, or by investigation commissions appointed by national authorities, are rare.

- *Traditions and institutional restrictions*: In spite of the common view on the importance of collective learning activities across disciplines, the different emergency services seldom performed such activities. Members of the professional emergency organization had a positive attitude to each other's competence, meaning that conflicts were scarce. Individual competences amongst the rescuers in all parties were regarded high, but variable. Economic reductions, institutional prioritizing and organizational changes were referred to as mechanisms that had worsened the situation for organizational learning. Number of drills will decrease in the future, both in the fire department and in the medical aid services. Job-rotation within paramedics was not performed as intended and informal contacts across services was reported decreasing.

- *Communication*: Communication is commonly understood as a challenge for the collective practice on scene. The police wanted to become more visible and fulfil the role as commander of the operations. No one mentioned specific conflicts, but differences in perspectives seemed to exist between the police and the fire brigade with respect to how commanding should be performed. Communication means (e.g. telecommunication) were referred to as generally bad, but economic restrictions prohibited investments.

- *Differences in competence and interests*: Even though personnel are different and have different competence levels and interests, no diversification can be done in emergency situations. This means that specializing in different fields only become useful if the specific emergency situation corresponds with the personnel on duty. The rescuer must respond to whatever situation occurs. Variation in competence was mentioned by the part-time fire brigade, referring to a vulnerability regarding to which member that showed up in an emergency situation. Also, the full time services reported that organizational learning activities directed at the command level was limited.

In the non-professional emergency organization, employees referred to three different areas as being the most important prerequisites for organizational learning:

- *Emergency priority*: Since the emergency organization is built across the formal organization, with a minimum of full-time key positions, emergency tasks are often defined as supplementary to employees' ordinary work tasks. If this priority pull is not solved, emergency learning may suffer from down prioritizing. The priority problem seems to be more distinctive among blunt-end managers than with sharp-end operators close to possible accident scenarios.

- *Emergency competence*: In the non-professional emergency organization, key personnel at different levels and in different business areas meet occasionally. In addition, most emergency members lack personal experience related to real-time accident scenarios. This

requires a basic competence level that is to be achieved through emergency training and courses. In addition, time and resources have to be set aside for cross-disciplinary knowledge sharing.

- *Variation*: Informants experience a lack of variation in the different training, exercises, and emergency drill activities in the company. Emergency drills are planned and accomplished according to an authority-regulated set of pre-defined hazards and accident scenarios. Thus, the same verification items may be used repeatedly without sufficient variation and surprise. The risk of becoming static in performing emergency drills must be overcome by continuously including elements of a proactive and strategic sort.

5. Discussion

Results from study 1 (professional emergency organization) show that the main focus of emergency members is on individual experiential learning (on the job training) based on specific situations on scene. There are few structured arenas for knowledge sharing and reflection, and informal communication is dominant. The most important challenges for organizational learning were related to proactive thinking, openness, and cross-service understanding and coordination between the three different services involved.

Results from study 2 (non-professional emergency organization) show a variety of organizational learning activities, implying a broad action repertoire with regards to information richness, collective practice, and proactive focus. Despite this variation, there seems to be a set of overall restricting mechanisms for emergency learning in the non-professional organization that are all grounded in matters of priority, resources, and competence level.

5.1 Differences in perspectives and practices

According to research assumption, A1 reported earlier in the paper, our studies have confirmed a difference between professional and non-professional emergency organizations regarding their emphasis on practical and situational learning mechanisms. This difference is easily understood based on the fact that a minority of the members of non-professional emergency organization have experience with real accident situations. Their situational experience with accidents is principally related to training scenarios. The majority of the informants in both studies were emergency managers, but in study 1 at an operational level (sharp end), and in study 2 at a coordinating (blunt end) level of accidents. Both groups deal with tactical and strategic issues in real time responses, but their working conditions are different. This methodological issue further accounts for the affirmation of research assumption A1.

To what extent the different learning perspectives and practices in the two studies contribute to an emergency performance that is able to handle complex and comprehensive accident scenarios is difficult to answer. According to the triple helix model (figure 1), all organizational learning activities should be designed with the three treads in mind: situation/experience, creative dialogue, and collective practice. Hence, the professional emergency organization should increase their emphasis on creative dialogue and collective practices across disciplines, while the non-professional emergency organization should increase their emphasis on practical and situational experience (e.g. more realism and variation in emergency drills).

5.2 Barriers to organizational learning

According to research assumption A2, our studies show variation in what is regarded as prerequisites for organizational learning in professional versus non-professional emergency

organizations. This means that employees in the two organizations had different perceptions of the challenges of emergency learning. Nevertheless, some common challenges could be identified as described below.

Both organizations claim that cross-departmental or cross-service emergency situations challenge cooperation and competence across organizational boundaries. The importance of training and drills to test and develop this cooperation should be defined as an area of further priority and development.

Both organizations express concern regarding how scarce resources, institutional prioritizing, and organizational changes may influence the competence in emergency resolution. This is an area in which further studies should be designed to document the relation between efficiency efforts and emergency performance.

Both organizations reveal tendencies towards learning in retrospect. This means that their main perspective is on planning and performing emergency activities according to recognition and pre-defined accident scenarios. In order to prepare for unprecedented accidents with unknown causal chains, proactive thinking and improvisation capacity should be prioritized. The issue at hand is how to identify and deal with uncertainty in different settings.

5.3 Experience transfer between services and organizations

According to research assumption A3, our studies identified limited activities for organizational learning or experience transfer across professional and non-professional emergency organizations. Such experience transfer across perspectives and services should be regarded as a considerable future effort in the emergency organizations. To increase the understanding of complex and comprehensive accidents, the ability to learn across perspectives and organizations is vital.

The professional emergency organization reported that on an individual basis contact with non-professional emergency organizations existed. The contact was due to mentoring or lecturing. Organizational learning between the full-time and the part-time fire brigades was not satisfactory. In-house experience transfer between members of preventive departments or non-emergency groups and the emergency organization also suffer from cultural barriers that obstruct communication. We claim that considerable improvements can be achieved in societal emergency management by establishing a closer contact between professional and non-professional emergency organizations. Differences in competences, in perspectives, availabilities to potential accident scenes and abilities in the critical first minutes of an emerging accident, should be much more efficiently utilized. A starting point could be for members in the professional emergency organizations to involve themselves in the organizational learning activities of non-professional organizations.

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PLANNING OF EVALUATION OF EMERGENCY MANAGEMENT SYSTEMS

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Keywords: System Evaluation, Emergency management, Abstraction Hierarchy.

Abstract
An emergency management system dealing with emergencies in road and railway tunnels is being developed and the system evaluation planning is discussed in the paper. The paper will include description of the type of major accidents, their frequencies and consequences, as well as means to increase the safety in tunnels. The success criteria for the evaluation is defined and discussed from the points of view of functionality, user acceptance, impact analysis, socio-economic analysis, and financial issues.

Introduction
Tunnel safety is a key issue and tunnel managers often face emergencies that demand rapid and appropriate reactions – involving complex decisions - in order to avoid catastrophes. These actions have to be effective whilst maintaining coordination between the management of the emergency and the management of the surrounding network.

In this context, SIRTAKI[2] [1] plans to respond to these needs by the development and assessment of an advanced tunnel management system that specifically tackles (i) safety issues and emergencies and (ii) the integration within the overall network management.

This strategic goal will be translated in a set of measurable, specific objectives:

1. To develop an integrated prototype of tunnel management and decision support system (DSS), including, but not limited to, emergency management. This prototype will be composed by four modules:
   a. Knowledge Basis: a learning tool that will support training, decision taking and automation of actions by applying previous experiences in emergency management and simulation of emergency situations.
   b. DSS: a smart decision support system that will help crisis managers to take decisions in emergency situations.
   c. Tunnel Management Model: a model of the tunnel that enables the integration of traditional surveillance and control systems with, on the one hand, DSS and KB and, on the other, the overall transport network.

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d. Tunnel surveillance and control system. SIRTAKI approach will not substitute traditional surveillance and control systems, but will enhance them with new capabilities, as the DSS and KB, which will make control systems more efficient.

2. To integrate and validate the SIRTAKI results in a set of test sites with different characteristics and requirements (urban/interurban, road/railway, etc.) in France, Italy and Spain.

3. To establish a methodology and accompanying guidelines to facilitate the cost-effective adoption of the project results by any tunnel operator in Europe.

Before being implemented in the various test sites to be evaluated in a pilot demonstration, the plans for the evaluation procedure has been specified.

Categories of assessment

The system will be evaluated along the lines of

- Testing of physical functioning of the system
- User acceptance
- Impact analysis
- Socio-economic analysis
- Financial evaluation

Each of these issues has been briefly outlined in the following:

Testing of physical functioning of the system

This, the most basic level of assessment, determines the technical parameters of system performance, for example the delay time of system reaction, the capacity of an information link, hardware reliability etc. It would not, however, address the impacts of the system beyond its own boundaries. The particular technical parameters to be assessed should be chosen to satisfy the decision context and the decision-makers' needs.

User acceptance

User acceptance assessment aims to estimate users' attitudes to and perception of application(s) investigated, usually based on questionnaire surveys, interviews, etc. Here, the users may be the operators who implement and operate the systems, the passengers using the service, or the drivers who buy and use in-vehicle equipment for the service.

Impact analysis

Impact assessment is the measurement or estimation of the impacts (effects) of an application, e.g. those on safety, environmental conditions or transport efficiency, for the particular target groups (drivers, system operators, society etc.) likely to be affected. Since this means determining how the indicators of assessment may have changed, a comparison is implied: either a "before-and-after" measurement, or comparison with alternative(s).

Socio-economic analysis

Socio-economic evaluation aims to estimate the "social" gains or losses (the global economic gains and losses, for all members of society) as the result of implementing an application in comparison with the existing situation or with alternative(s). The social gains (or losses) are assessed using appropriate indicators, certainly including direct and indirect costs and benefits, but also non-monetary factors if those are affected significantly by the application under study.

Financial evaluation

Where a telematics application is intended to have an effect on the capital or operating costs of a transport service, a financial assessment should be made. This is an assessment in money terms of the effects of investment in an application. Unlike cost-benefit analysis, only impacts internal to the application and its cost are considered.

Description of the type of major accidents, their frequency and consequences

In tunnels, the number of accident is often lower than in the open mainly because the road is not exposed to adverse weather conditions such as snow, ice, wind and rain.
Some statistics[3] show that accident rates in bi-directional tunnels are generally significant higher (up to 40%) than on unidirectional tunnels with separate tubes, but it is not always the case. In many tunnels, the absence of an emergency stopping lane can have a negative influence on traffic. If vehicles in trouble are unable to reach the next lay-by, they hold up traffic and give rise to traffic jams or risky diversion manoeuvres.

According to findings by the World Road Association (PIARC), the frequency of breakdowns per 100 million vehicle kilometres is as follows:

- in tunnels under rivers in urban areas, 1.300.
- in tunnels in open countryside, 300-600.
- in tunnels through mountains, 900-1.900

The frequency of breakdowns is also greatly dependent of the gradient; up to five times the number of breakdowns occur in tunnels with a gradient over 2.5% than in those without a slope.
The frequency of fires is fairly low, both on open roads and in tunnels. According to international statistics, a majority of vehicle fires are not caused by an accident, but result from self-ignition of the vehicle or its cargo, due to defects in electrical systems, engines or other reasons. However if the fires with the largest consequences are considered (fires which involved injuries, fatalities or large material damage), most of them were result of an accident (13 out of the 15 worst fires known worldwide), with the important exception of the Mont Blanc tunnel fire (which was caused by self ignition of a heavy goods vehicle).

In 1999, PIARC presented the following findings based on a survey carried out in a large numbers of countries [2]:

- Nowhere is the average frequency of fires in tunnels larger than 25 per million vehicle kilometres (number of vehicles × km).
- The frequency of fires is higher in urban tunnels than in other tunnels.
- In 40% of the tunnels included in the survey there has never been a fire.
- In certain tunnels (e.g. Chamoise, Elbe, Fréjus, Mont Blanc, Gotthard) the frequency of fires involving heavy goods vehicles is much higher than that for passenger cars.
- A frequency of 1 fire per year and up to 1 per month per tunnel was only recorded in those tunnels that are either very long or have a very high traffic volume, or both. In the vast majority of tunnels, the frequency is much lower.

Analyses of eight selected fires in European tunnels yielded the following findings:

- In most cases, only one vehicle was involved.

[3] "Studies on Norwegian Road Tunnels, an Analysis on Traffic Accidents and Car Fires in Road Tunnels".

- The most common cause was a technical defect, which in many cases led to the ignition of leaking fuel.

More than 90% of road tunnel accidents are due to non-performance of traffic norms: too much velocity, driver distraction or non-observation of signalling[4].

Most of serious accidents have been a consequence of a traffic accident, such as Saint Gotthard case. The traffic accident provokes the fire that is the immediate cause of the disaster, with the corresponding evacuation problems inside the tunnel. If the fire occurs, a lot of smoke coming from the shipped goods will be produced and high temperatures could be reached inside the tunnel.

Road tunnels versus rail tunnels

Rescue operations are difficult in tunnels, as the possibilities to reach the emergency place may be limited due to large smoke generation and heat from fires and the blockade of "entrances". Here rail tunnels give more problems than road tunnels. However, the two tunnel systems are not comparable due to their different concepts. The major reasons for accidents for the road traffic are due to human factors, which are increased by the nature of road traffic. Safety systems that are possible for the rail traffic are not applicable for the road traffic, as road traffic is driving "only on sight", safety measures are missing and the road traffic includes a high number of ignition sources. The large number of individual drivers increases the possibility of subjective and unpredictable actions. Here rescue operations needs to stress self- and assisted rescue (by e.g. fire brigades). The fuel in the cars is increasing the fire load remarkably, and there is increased likelihood that the tunnel will be blocked by the accident. Fire extinguishers are seldom placed in cars and the drivers are untrained using such devices. Furthermore, in Europe today it seems that a common citizen is very much used to and expects in getting help and therefore, most persons will wait for being instructed without taking own initiative. This is shown by the investigations of the latest tunnel accidents, which showed that people would stay in their cars waiting for the rescue personal to give advice.
The rail system with the tracks, driving by distances, its safety systems including the modern guidance and safety technique and the presence of trained personal, makes it possible to stress on measures that decreases the probability of incidents/accidents and to mitigate the consequences of such situations.

Means available to increase safety in tunnels

The following objectives have been set for attaining the optimal level of safety in road tunnels:

- Primary objective: Prevention, to prevent critical events, which endanger human life, the environment and tunnel installations.
- Secondary objective: reduction of consequences of events such as accidents and fires. To create the ideal prerequisites for
    - people involved in the incident to rescue themselves
    - the immediate intervention of road users to prevent greater consequences
    - ensuring efficient action by emergency services
    - protecting the environment
    - limiting material damage

In the event of an accident, the first ten minutes are decisive when it comes to people saving themselves and limiting damage. The prevention of critical events is therefore the number one priority, which means that the most important measures to be taken have to be of a preventive nature.

[4] D. Felipe Medaña. Dr. Civil Engineer, private communication

National Road Association recommendations

According to the Spanish Association of Roads (AEC/AETOS), the following measures must be taken in order to reduce accident and fire risk in a tunnel and mitigate their consequences:

- To avoid crashes among vehicles: adequate lighting of tunnel access, lane shutting in case of works in the tunnel, etc.
- To reduce the fire risk of trucks and hazardous goods vehicles: fuel limitations, type of insulator material in vehicles, mechanical conditions when vehicles are accessing the tunnel. For example, a thermal gate could be used for measuring this condition (Frejús case).
- To permit the electronic (through plates) identification of hazardous goods vehicles (HGV)
- To control the traffic: The crashes have become the principal cause of fires in tunnels. Reduce the speed, minimum safety distance between vehicles stopped (100 m), and though clear information and imposing penalties to offenders.
- To help the persons for escaping on their own: signalising emergency exits and escape routes. Each shelter must connect with an evacuation passageway leading to an exit.

UNECE Recommendations

The United Nations Economic Commission for Europe [3] gives recommendations for improving the safety of road tunnels that will have extensive impacts for road users, tunnel operators, governments and vehicle manufacturers.

The 43 recommendations of a group of experts, set up after the fatal accidents in the Mont Blanc and Tauern tunnels in 1999, are based on best national practices. They were due to be adopted by UNECE's inland transport committee in February 2002, after which agency's relevant standard-setting bodies will consider them for incorporation in international regulations.

The recommendations have been summarized in the following table:

Highlights of tunnel safety recommendations	
Road users ▪ Campaigns on safe driving ▪ Roadside checks of heavy good vehicles (HGV's). ▪ Regular testing of HGV drivers on safety. ▪ Common rules on transporting dangerous goods.	**Infrastructure** ▪ Two tubes on heavily-trafficked routes. ▪ International guidelines for emergency exits, ventilation, safety equipment and harmonisation of road-signing. ▪ Provision of rapid emergency access.
Tunnel operators ▪ A national co-ordinating body on safety. ▪ Safety officers for each tunnel over 1km. ▪ Regular accident drills and checks on HGVs on entry. ▪ Single control centre for tunnels straddling borders. ▪ Monitoring and enforcement of traffic regulations.	**Vehicle construction** ▪ Fire extinguishers for all HGVs and coaches. ▪ Reduction in fuel carried by HGVs and coaches. ▪ No increase in weight and size of HGVs in Europe. ▪ Annual inspections of HGVs, buses and coaches.

UNECE's transport division concluded that 95 per cent of road accidents were due to driver error. Tunnel accidents were rare but their serious human and economic costs made it important to reduce the risks further.

The Mont Blanc tunnel blaze, caused by a truck catching fire, killed 39 people in March 1999 and closed a route between France and Italy that carried about a third of all road freight leaving Italy. The consequence of this has been seen by an increase in accidents in the Frejus tunnel due to reallocation of the truck traffic.
Twelve people died in Austria's Tauern tunnel in May 1999 and 11 were killed in the Gotthard tunnel last October after fires caused by collisions between trucks.

There are about 700 road tunnels in Europe over 1 km in length, of which eight are longer than 10 km. Norway boasts the largest number of tunnels, with 203 over 1 km long. Italy has 177 tunnels over 1 km long, Switzerland 67, Austria 55, France 46 and Germany 38.

Definition of success criteria

The SIRTAKI success criteria were seen as working criteria in the sense that they should evolve incrementally until the project outcome is finally agreed upon in the consortium. However, following the second consortium workshop they were fixed and identified in relation to the final demonstration scenarios as follows:

Keywords for Success Indicators concerning the outcome of SIRTAKI

The keywords for achieving an acceptable SIRTAKI end-product are:

- relevance
  - the system must be developed appropriately as a tool for dealing with emergency situations related to accidents in tunnels from the point of view of preventing or limiting hazards and harmful influences for human beings, animals, the environment and objects, and to minimise the consequences when eliminating accident damage;
- usefulness
  - the system must be advantageous and helpful in offering a good service for the organisation for dealing timely with hazardous situations in tunnels;
- usability
  - the system must be available, easy to implement, and convenient for use of the persons responsible for dealing with the emergency;
- reliability
  - the system must be capable of being relied on and be perfectly functional at all times;
- generality
  - the system must be general in the way that it must be adaptable to the various types of tunnels incorporated in the SIRTAKI project;
- validity
  - the quality of the system must satisfy the needs of the users by increasing the positive outcome of handling a hazardous situation as compared with not having the system available, i.e. the system must result in a measurable difference in performance.

Actual Success criteria

A questionnaire for obtaining objective and measurable success criteria has been developed based on the overall success indicators: usefulness, usability, reliability, efficiency, timing, generality, validity, user satisfaction, fulfilment of user the requirements, relevance, and situation tracking. Each of these parameters has been detailed in a number of issues, and the end-users have been asked to fill in the questionnaire for each issue from the point of view of relevance of the indicator, if the parameter is measurable, and if so, how it can be measured, and finally - for parameters for which it is possible - to specify the acceptance value.

The questionnaire is shown on the following page, and the answers are indicated as a summary or average of answers related to three road tunnels and a metro tunnel.

As seen from the questionnaire the end-users have with few exceptions specified the success indicators as relevant for evaluation the SIRTAKI system. 'yes ' means that the end-users of all the sites have agreed about the relevance, 75 % that three out of four, and 50 % that two out of four have agreed. Some of the disagreement reflects the difference between the road tunnels and the metro tunnel. E.g., regarding the user requirements, these - of course - are important for all tunnels, except for requirements related to optimum routing of rescuing units (user requirement no.6), which for the Metro is set by the rails. Likewise, the requirement for air monitoring of contamination is not vital for the Metro, as no dangerous goods are expected.

SIRTAKI Success Indicators

Tunnel				
Parameters	Tunnel	relevant	measurable	
		yes/no	how	accept. value
Usefulness				
	supportive	yes	satisfied users	80%
Usability				
	system always available	yes	continously running	99%
	updatable for new equipment	yes	time tp update	< 4 hours
	easy to learn	yes	time to learn	< 4 hours
	easy to use	yes	interactive menu	
	short cuts for fulfilling frequent procedures	yes, 75%		
	recovery from mistaken actions	yes, 50%		all
	fits to known procedures	yes		
Reliability				
	number of respondencies related to number suppressed false alarms (long-term test)	yes	respond. false alarms/false alarms	< 3%
	number of respondencies related to number not-responded real alarms (long-term test)	yes	not resp./real alarms	< 2%
Efficiency				
	max number of clicks for fulfilling a procedure	yes, 75%		< 4 clicks
	max number of clicks to get a specific information	yes, 75%		< 3 clks
Timing				
	detection time	yes		1-30 sec
	decision time	yes		10-60 sec
	dispatching time	yes		30-120 sec
	RU travel time	yes		3-20 min
	on-scene time	yes		
Generality				
	adaptable to various tunnels	yes		
	transferable	yes, 75%		
Validity				
	correspondance between suggested actions and the preparedness plans	yes		100%
User satisfaction				
	supporting situation awareness	yes	identify number of warnings	
	user interface	yes	situation overview	
Fulfillment of user requirements				
1	Provision of information related to the tunnel traffic conditions and patterns	yes		
2	Provision of real time (dynamic) information with respect to the traffic conditions inside and outside the tunnel	yes		
3	Identification of possible incident through the use of Incident Detection software tools	yes		
4	Information on the air contamination level onside the tunnel	yes, 50%		
5	Notification of the emergency responder	yes		
6	Provision of optimum routes from RU locations to the incident scene and/or the incident location to the nearest medical facilities	yes, 75%		
7	Provision of the appropriate on-scene actions	yes, 75%		
8	Estimation of the incident consequences	yes		
9	Information on the lighting and air-conditioning	yes		
10	Air-conditions and physical conditions (temperature, pressure) monitoring inside the tunnel	yes, 75%		
11	Automatic message transferring via e-mail, fax or other communication mode	yes, 50%		
12	Provision of information (contact details) related to the emergency responders and other stakeholders	yes		
13	Provision of alternative evacuation plans	yes, 50%		
14	Provision of rerouting decisions	yes		
Relevance				
	consequence remedying****	yes	stat. anal. with and without SIRTAKI	
Situation tracking				
	log of actions	yes, 75%		
	debriefing/replay	yes, 75%		

User satisfaction and cost effectiveness

Similar to the questionnaire above that has been filled in before running the final test scenarios, a couple of other - but related - questionnaires have been prepared to be filled out by the operators after having executed the test scenarios in order to reveal the user acceptance of the system as well as the cost effectiveness of the system.

The user acceptance will be based on questions concerning, e.g., ease of assessing and understanding the answers provided by the system, satisfaction of proposed plans, reduction of time, mitigation of consequences from the accident, number of false or missed alarms, etc.

The cost effectiveness acceptance will be based on, e.g., cost of implementing and maintaining the system, reduction of fatalities, injuries, and property damage, reduction of tunnel operation costs, and reduction of secondary incidents, delays, etc.

Conclusion

We have four different test sites for implementing and evaluating the SIRTAKI system. The sites are divided in road tunnels and a railway (Metro) tunnel and, furthermore, the road tunnels are divided into urban and interurban tunnels. All of these types have different claims of needs for regulations and equipment for optimal operation.
Due to the different claims of the tunnels it may be difficult to compare the evaluation test sites concerning specific functionalities and procedures. Nevertheless, as the SIRTAKI approach and model will be common, but customised to each type of tunnel, it will be possible to extract generic results and to produce - based on these results - guidelines for updating existing tunnels and for constructing and choosing equipment for future tunnels.

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EVALUATION OF THE FERNY CREEK FIRE ALERT TRIAL

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Keywords: Fire alerts, warning systems, siren system

Abstract

Following the 1997 wildfire that decimated the area of Ferny Creek (3 lives lost and 33 houses destroyed) in Victoria, Australia, affected residents began a campaign to be provided with some form of warning. In response to that community's drive, supported by subsequent comments from the State Coroner, local government (the Shire of Yarra Ranges) initiated the Ferny Creek Fire Alert Trial Committee. Various warning systems were explored but the key factor challenging the committee was the lack of lead-time to provide adequate warning to the affected community therefore an alert system was the only viable solution. A siren system was devised whereby the activation of a fire unit response to a fire near the township would simultaneously activate sirens in the area thus alerting residents to the imminent threat of wildfire. Intrinsic to the project was a concentrated and carefully orchestrated community communications strategy that raised residents' awareness to their vulnerability to wildfire and assisted them in their personal wildfire survival planning. An independent evaluation of the project was conducted by the Department of Justice. The review focussed on the social factors of the project rather than the technological aspects. It examined whether the alert system increased the level of preparedness by residents and the process by which proper consistent information was disseminated to residents to enhance and reinforce appropriate behaviour in the event the siren activated. This information process involving a multi-agency approach has been labeled the "integrated warning system". The evaluation also raised issues regarding shared meanings and expectations and the concepts of risk perception and risk communication. The findings from this evaluation have much broader implications for community warnings in general.

Introduction

"*No significant benefit will be attained from research on any component of warning systems unless what is currently known and what is discovered and put to use in specific communities for preparing for specific events*"(D. Mileti, Natural Hazard Warning Systems in the Unites States: a Research Assignment, University of Colorado, USA, 1975) .

On the 21st of January, 1997, five separate fires were ignited in the Dandenong Ranges. The cause of ignition remains unknown but is considered to have been deliberately lit by person/s with malicious intent. The damage caused by the fires in short totalled a loss of three lives, 41 houses and 400 hectares of State forest. Of the five fires the most significant which attributed to the loss of the three lives occurred at a residential sub division within the township of Ferny Creek.

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The township of Ferny Creek is located on the western side of the Dandenong Ranges approximately 35 kilometres east of Melbourne, Victoria, and covers an area of 1,093 hectares. It has a population of 1,960 and a total of 680 households (National Census 1996). The specific subdivision of Ferny Creek impacted upon by the 1997 wildfire is located on the north/western aspect of the Dandenong Ranges. The topography relating to this site is unique for a number of reasons. Firstly it faces a north/westerly direction which is vulnerable to the hot and dry summer winds conducive to wildfire. Secondly this specific area comprises of a gully referred to by locals as the "Devils Chimney" which under extreme conditions forms a sub climate that funnels and concentrates the effects of the prevailing winds to support wildfire behaviour. Thirdly and most importantly is the fact the subdivision abuts the Dandenong Ranges National Park, a heavily treed forest. Past resident, previous member of the Sassafras-Ferny Creek volunteer Fire Brigade and journalist, John Schauble, identified thirty-five incidents of wildfire in Ferny Creek and surrounds since 1851 (Schauble J. Fire in the Hills Dudey Gay Printing, Ferntree Gully, Victoria 1972 Appendix 2).

The 1997 wildfire at Ferny Creek originated in forest near a roadside approximately 750 metres below the subdivision. It has been estimated that it only took between ten to fifteen minutes from the time of ignition to the point where the fire front reached homes in Ferny Creek. The Police Arson Squad report found: "…This fire progressed into the …streets without any warning. Most of the residents who were interviewed didn't know that there was a fire in that area until it was burning around their homes. Some criticism has been laid relating to the lack of warning of the impending fire however this fire was burning through Mount View Road well before the arrival of the C.F.A. and police…."(1997 Dandenong Ranges Fires Inquest Report p.15)

Following the fire local residents of the affected area began lobbying for a warning system, initially requesting an extension to the Sassafras-Ferny Creek Rural Fire Brigade siren used to alert volunteer fire fighters to attend the brigade. Many residents on that westerly aspect complained that they could not hear the brigade siren from their home. It is important to note that the brigade siren was not activated for the Ferny Creek Fire in 1997 as the appliances were away responding to another fire.

In advocating for the residents the Councillor Robyn Hale, then Mayor of the Shire of Yarra Ranges, established a formal committee with a membership including the Mayor and Emergency Management staff from the Shire of Yarra Ranges, Ferny Creek Residents, The Department of Justice, Country Fire Authority (including both regional and local brigade representation, Victoria Police (including regional and local) and an anthropologist with expertise in human and fire behaviour.

The aim of the Committee was to examine the feasibility of having a suitable fire alert mechanism in place on a trial basis for the 2000 fire season to alert Ferny Creek residents to the eminent threat of bushfire.

The Ferny Creek Fire Alert Trial Committee aimed to achieve the following objectives:

- To initiate and maintain a high degree of local resident participation in the Ferny Creek Fire Alert Trial Project and ascertain the level of need of local residents for a bushfire alert system in the trial area;
- To ascertain the feasibility of a bushfire alert system in the trial area of Ferny Creek ;
- To explore various alert systems available and identify a practical, simple, cost effective and reliable bushfire alert system;
- To achieve the installation and activation of a selected suitable alert system by 1st November, 2000;
- To conduct a full review of the effectiveness of the bushfire alert system after the end of the fire season to be completed by the 1st of May, 2001.

Issues Related to Public Warnings

From the inception of the committee it was obvious aware that the key response agencies, namely the Police and Country Fire Authority, faced a dilemma as to their role in the operation of an alert system.

The Country Fire Authority is responsible for fire suppression and community fire awareness. It had previously denied the requests of residents to install an extension of the Brigade siren system as the role of the siren was to activate brigade members to attend the brigade to respond to a call. The Country Fire Authority is not vested with a role to warn residents.

The Victoria Police is responsible for the protection of life and property and is vested with the responsibility of issuing community warnings and undertaking evacuations at the request of the controlling emergency service which in the case of fires is the Country Fire Authority. The police currently possess a mechanism known a the State Emergency Warning System (SEWS) which involves a distinctive tone being played over television and radio stations to attract attention and then following the tone a message detailing specific information is broadcast. Evidence submitted before the Corner during the inquest into the 1997 fire indicated that there was insufficient time for a response brigade appliance to attend the scene and evaluate a fire before it had already impacted upon the residents. It follows then that there would be insufficient time to provide adequate and reliable information to warn residents. There was unanimous agreement that a warning system would not meet the requirements of the Trial community.

Hence the term 'alert' and its specific connotations was applied. An alert would provide a minimum of five minutes notice to residents of the threat of an impending fire. It would and could not provide information pertaining to the extent of the threat or provide advice to residents on how to act. The alert would act as a trigger in activating residents who already were in a state of readiness and provide them with sufficient time to activate sprinkler systems, collect children or pets and prepare to defend the property. The key to an appropriate response by residents relied upon their level of awareness and preparedness.

Initial Trial Community Survey

On the 10th of August, 2000, a questionnaire was posted to the 180 landowners in the trial area to gain further input from the residents. Whilst some properties would be occupied by the registered landowners, others may be holiday homes, vacant lots or leased houses. The aims of the questionnaire were to check the level of fire awareness and preparedness of residents, to ascertain residents' viewpoints on whether an alert system was needed for the area, and, if an alert system was considered appropriate, to establish which alert option was most preferred.

A total of 114 (63%) questionnaires were returned for analysis. A high response rate was anticipated due to the high level of community awareness of bushfires in the area. A total of 96% of respondents use English as their first language thus facilitating communication strategies with this group. Over 60% of respondents indicated that they were a member of Community Fireguard. The majority of all respondents (86%) advised that they possessed a bushfire survival plan. Approximately 65% of all respondents planned to stay and defend the home in the event of a fire with the remainder either leaving early on a total fire ban day (23%) or a significant number of (12%) who made no response to this question. When asked if there was a need for a dedicated bushfire alert system in their area which might provide only ten minutes notice almost ninety per cent of respondents replied in the affirmative. This result indicated a strong desire by respondents that they would like some advance warning, however short, of an imminent fire.

Selected Fire Alert System

The committee was and remains committed to exploring all viable options for an effective and reliable alert system. Research to date including international queries via the Internet reveal that while there are numerous public warning systems there are no commonly used alert systems which are used for the short time frames intrinsic to this project. Most warning systems involve extensive lead times (at least a number of hours) in which time relevant and accurate information can be disseminated to target communities. After considerable research and deliberation the Committee agreed that a siren system was the most viable solution considering the cost, time frame for implementation and reliability.

The issue was raised regarding which individual, group or agency would be responsible for actually activating the system. The need to absolve any individual of the responsibility to activate the siren was imperative therefore a systems approach was explored. In order to provide the most timely response providing the optimum alert time focussed the Committee on the Country Fire Authority Communications Centre, referred to as VicFire.

Activating the alert system at the earliest report of an impending fire would meet this goal. The current response by VicFire to the receipt of a fire call via the emergency telephone number 000 is to enter the details of the required location into a computer system and then activating Brigade units appliances which are responsible to respond to the desired location. The computer system automatically selects the appropriate response Brigades according to the location of the fire. Software was developed defining the geographical areas where the presence of fire would threaten the Ferny Creek Trial area. Once a call to a fire was received the computer would then automatically activate the Ferny Creek Fire Alert System simultaneously with the response Brigade/s.

Communication Strategy

The Committee devised a communication strategy to ensure residents in the Ferny Creek Fire Alert Trial Area and other stakeholders had a clear understanding of the alert system and, to provide them with the tools and advice to develop a personal bushfire survival plan involving the CFA endorsed "leave early" or "stay and defend" principles. In its education to residents in high wildfire risk areas the Country Fire Authority promotes a 'leave early or stay and defend strategy'. The strategy is based on the research of fatal bushfires between 1962 and 1998 that showed over half the deaths resulted from people being caught in the open or in vehicles (Krusel, N. and Petris, S. (1992). Staying Alive: Lessons learnt from a study of civilian deaths in the 1983 Ash Wednesday bushfires. Fire Management Quarterly, 2, 1-20.). The Country Fire Authority endorses that people who are not physically or mentally capable to stay and defend their property in the face of a bushfire should leave early in the day. In the event that a person is capable to stay and defend their property then the Country Fire Authority encourages the adoption of suitable equipment and training to allow them to perform this act more safely and effectively.

Resident, Anna Marie Shew drew upon an analogy of likening the alert to a piece of a jigsaw puzzle in that it is only one component of the response to the threat of an impending fire. Other components relate to a heightened state of awareness though using the individual's senses in smelling or sighting smoke, seeking further information from a Country Fire Authority radio scanner, the electronic media, the Community Fireguard telephone tree (involving members contacting other members in a systematic manner), through the activation of a Country Fire Authority Pager or by contacting the Country Fire Authority direct.

A Shire newsletter titled On The Alert was circulated to all residents in the trial area and to local Country Fire Authority Brigades to keep everyone appraised with the progress of the Trial and to provide advice on survival plans. The newsletter was designed in a distinctive manner to attract the interest of residents. The Shire provided the broader community with information pertaining to progress of the trial though local newspapers and radio stations. The media was very supportive of the trial.

Almost 80% of questionnaire respondents indicated that they wished to attend a public meeting. A meeting was held at in Ferny Creek on the 10th of November, 2000, to disseminate questionnaire results, stress the need and provide advice on devising personal survival plans, explain the role of the alert system as one component of the personal survival plan and to gain feedback from the community. All participants were registered to identify residents from the trial area who did not attend the meeting. The community meeting provided an excellent platform to present the project to residents, answer any concerns and to provide the Country Fire Authority with an opportunity to market its survival strategies and provide assistance to the community in preparing survival plans.

Between the 13th and 30th November, 2000, Shire staff conducted personal visits to all individual Ferny Creek Fire Alert Trial residences not represented at the meeting and provided an information

package with the same information relayed at the meeting. In the event that the resident was not at home an information package was left at the address with a covering letter to contact the Shire and confirm receipt of the information.

Evaluation

A research officer appointed by the Office of the Emergency Services Commissioner, Department of Justice conducted an objective evaluation of the trial. The evaluation has included personal interviews of all Committee members regarding the process involved in the project, a follow up questionnaire to establish level of change of residents' awareness and survival planning and establish effectiveness/need for alert, and an examination of the incidence of alert activation. The evaluation had three main aims:

- "To measure the impact of the 'communication strategy' on the Ferny Creek residents' awareness and behaviour for bushfire survival and preparedness;

- To explore and evaluate the process of the fire alert trial working group's activities and communication, including community and stakeholder consultation about the fire alert system and subsequent operation of the siren;

- To evaluate the impact and consequence of the fire alert siren's development and operation for Ferny Creek Resident." (Betts R., Ferny Creek Fire Alert Siren Evaluation Report, Office of the Emergency Services Commissioner, Victoria August, 2001)

Evaluation of the Impact of the Communication Strategy

The evaluation found a high level of participation by residents at the public forum and in completing and returning questionnaires. Residents also found that the project newsletters and personal door knock beneficial. A mid-project questionnaire conducted by the researcher (involving 46 respondents) found that; "The most effective bushfire survival actions seemed to be undertaken by residents who were members of Community Fireguard; For those residents who had decided to not defend their home, (7 respondents) they may not be influenced by wither the community education material or the fire alert siren; Some concern needs to be expressed however that some residents (6 respondents) viewed the siren as a prompt to evacuate their home either as a result of 'Leave Early' message (the choice not to defend their home) or because evacuation was identified as their response to bushfire survival." (Betts R., Ferny Creek Fire Alert Siren Evaluation Report, Office of the Emergency Services Commissioner, Victoria August, 2001)

Upon the conclusion of the 2000/2001 fire season the researcher conducted another survey to which 54 responses were received. In relation to their knowledge of the siren and opportunity to comment over 70% of respondents stated they had a thorough knowledge of the siren operation and sufficient opportunity to comment. Of interest is that eight respondents were not interested in commenting, eight required further information and two had no knowledge or were aware of opportunity to comment. When questioned as to the mediums through which residents received knowledge of the system operation the responses ranged between 77% being advised through the project newsletter, 39% from friends and neighbours, 31% from local newspapers.

Half of the respondents responded that they had no dislikes of the siren system, whilst others commented on concerns regarding the number of false alarms, ownership of the system, the sound and volume of the sirens, unclear as to what action the should take after the siren activated and that the siren had no provision to advise if a threat was overcome.

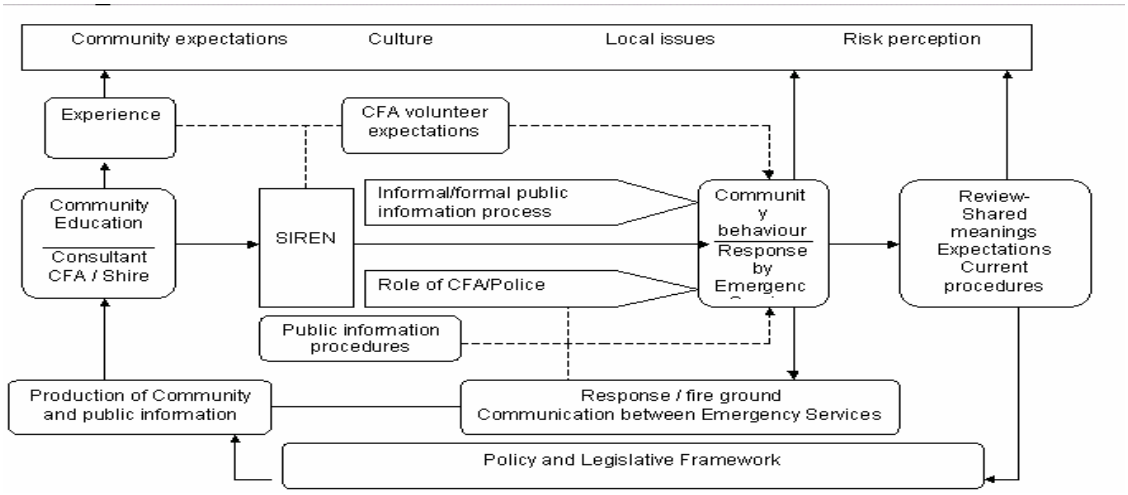
A question linking the value of the siren to the concept of safety found that 55% of respondents found that the siren had positively contributed to their feelings of safety. An examination of a response to the value of the siren to the community found that "The comparisons between self and other seemed to be important variables in understanding community residents' perceptions about safety. Examining these views from residents revealed that 20 of the 54 respondents (38%) believed the siren would be of high value to the community but they found the siren to be of little influence to their own bushfire survival actions."

One of the most concerning findings of the evaluation related to responses pertaining to the intended actions of residents upon hearing the siren. A number of respondents (16%) advised that they would evacuate upon hearing the siren, 11% stated they had no specific actions/plans and another 13% indicated they were unsure about what actions they would take. In determining whether the alert system and community education had influenced individual bushfire survival plans, almost 60% of respondents reported that both the system and education were of equal influence, 20% indicated that both the siren and education was of little or no influence to their plans, 11% reported that education was more influential than the siren and 9.5% found that the siren was more influential than the community education. (Betts R., Ferny Creek Fire Alert Siren Evaluation Report, Office of the Emergency Services Commissioner, Victoria August, 2001)

An Integrated Warning System

The evaluation discussed the Ferny Creek Fire Alert System as developing into an 'integrated warning system' whereby the focus of the project shifts from the technological aspects to the social behaviour of residents within the Trial area. Mileti described such a system as possessing three functions, threat evaluation, dissemination of warning and response to warning, each of which involves a distinct group of people respectively. (D. Mileti, Natural Hazard Warning Systems in the United States: a Research Assignment, University of Colorado, USA, 1975). The broader concept of the system includes the provision of an educative process that aims to influence appropriate behaviour by residents following activation of the system.

Such a system would also involve a collaborative and cooperative approach between official (government agencies) and unofficial systems (community groups) such as defined by Parker and Handmer (Parker, D. and Handmer J., The Role of Unofficial Flood Warning Systems Journal of Contingencies and Crises Management, Vol 6, No.1, USA., 1998).



In order to encourage appropriate behaviour the committee first has to identify factors leading to a deficiency in the information process. Such factors have been called weak links and each step in the alert activation and communication processes are currently being dissected to identify weak links and ascertain how this information dissemination can be modified and improved with a view to achieving appropriate behaviour when the siren is activated. Further surveys of residents can focus on information deficiencies and monitor the progress in the effectiveness of this process. Importantly there needs to be an acknowledgment by all involved that the integrated warning system as a process demands a collaborative and supportive approach to ensure the delivery of clear, consistent and reinforced messages to residents. Any ambiguity of intended educative messages has the potential to decrease the receiver's trust and undermines the effectiveness of the objective, i.e. to encourage appropriate behaviour.

Throughout this process is the need to acknowledge that the individual's perspectives, feelings, personal knowledge of risk and relationships with the home, community and environment all impact on their behaviour (Sime J.D. Informaive Flood Warnings: Occupant Response to Risk, Threat and loss of Place)in Handmer,J (ed.) Flood Warnings:Issuesand Practice in Total System Design, Middlesex University U.K. 1997). Regardless of all the best intentions it is arguably undeniable that some individuals will continue to behave inappropriately in a disaster situation regardless of all efforts to educate them otherwise.

Evaluation of the Working Group

The evaluation of the trial working group processes found that there was a strong acknowledgment of the leadership role provided by the Mayor, who provided opportunity for open debate and maintained the public profile of the project. The CFA and Police both expressed views that the final selection of the sirens as the system was preconceived in that it immediately met resident needs and comments made in the Coroners report and may have restricted the opportunity to other alternatives. The community representatives were very supportive of the role of local government in its leadership and active communication with the local community.

Alert System Activation and Issues

Throughout the project concerns were also raised that the sirens would be activated by calls occurring in conditions when the threat of wild fire was negligible such as during the night when temperatures and humidity are not conducive to wildfire conditions or on a rainy day. Such activations could then lead to a 'cry wolf' or false alarm syndrome which has been postulated as reducing the attention and response of the public. (E.L. Atwood and M.N. Major 'Exploring the "Cry Wolf" hypothesis, International Journal of Mass Emergencies and Disasters, USA.Vol 16,N3, 1998.) The evaluation identified the need to ensure residents were advised of the reason for an activation of the sirens to ensure that confidence in the integrity of the system was maintained.

Legal advice received during the project advised that the possibility of a failure of the system to activate due to causes beyond control also needed to conveyed to the community to ensure residents were not solely dependent on the operation of the sirens to activate their plan. If residents were not informed that the system was not infallible then there was a possibility that they could find the Shire and committee liable. Information detailing the operation of the siren and emphasising that it was not foolproof was communicated to the trial community via the Project newsletter and at a public meeting conducted prior to the 2001/2002 fire season.

Whilst Victoria experienced an unusually hot and dry summer during 2000/01 fire season no actual bushfires occurred in the vicinity of the Ferny Creek Trial Area to test the system and residents' reactions, although there were five instances in which the system was activated. All of theses activations occurred prior to the software programming being installed limiting the system to the extreme Fire Danger Index factor. Three of these incidents occurred between 11.20 pm and 8.05 am in relation to calls of a grass and scrub fire, a smoke sighting and a fence fire. Two incidents between 3 pm and 5.40 pm relating to calls of a car fire and a grass and scrub fire. Both incidents also occurred under conditions not conducive to wildfire. Some residents were observed to respond to the activations by going out to the front of their properties and checking their surroundings and then seeking further information to establish the nature of the incident.

Conclusion

Fortunately the 2000/2001 fire season was uneventful regarding the incidence of bushfires. Whilst the alert system was activated (in accordance with the activation criteria) on a number of occasions there was no threat to the Trial community. Such activations have however introduced debate on the need for a 'stand down' signal. Given the relatively quiet fire season the committee decided to extend the trial period for a further two fire seasons and conduct further surveys and evaluation at the completion of each fire season. As the committee shifts its focus from the technological aspects of the alert system to the behavioural 'integrated warning process' the opportunity for progressive surveys should provide considerable information in assessing the effectiveness of the information disseminated and its impact on the trial community.

In closing it would appear appropriate to quote the final paragraph of the Office of the Emergency Services Commissioner evaluation report which provides a very positive assessment of the project:

"Community based warning and alert systems have not been previously developed and evaluated for bushfire survival and although the research literature has identified the needs for broad thinking across multi agencies and community consultation, this project has enabled an initial analysis of a community engagement process. These discoveries and achievements have enabled this Project to be at the cutting edge of warning/alert system and community engagement development and research. This project has set in place some positive practices of community engagement and multi-agency cooperation and has also exposed the complexities which are involved in the development of a community based alert system for bushfire survival."

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RELIABILITY-SEEKING NETWORKS IN COMPLEX EMERGENCIES

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Abstract

The purpose of this paper is to identify major co-ordination challenges during complex emergencies, and discuss some theoretical implications of these challenges. The huge increase in non-governmental humanitarian organisations, in addition to the increase in military forces involved in emergency management during the last 15 years has put professional co-ordination at the top of the international humanitarian agenda. Main co-ordination challenges highlighted in recent literature illustrates the lack of authority to co-ordinate or command hampers decision-making and that the large amount of humanitarian actors hampers co-ordination due to different mandates, competition and reluctance to share information.

Seeking reliability in coordination within the high-hazard, rapidly changing environment of a complex emergency must rely on resiliency (flexibility and diversity). Flexibility and especially diversity is hard to obtain for one single multi-purpose organisation in the hostile environment of a complex emergency. Thus, a network structure is preferable for humanitarian relief operations. This structure may develop into a reliability-seeking network if the coordination is done through information sharing and mobilisation of the total network resources.

Introduction

The relatively new concept of complex emergencies[3] (or compound disasters) is primarily developed by international relief organisations and reflects new experiences made in conflict areas after the Cold War (Quarantelli 1998a). Most definitions of complex emergencies are basically political in their nature (Duffield, 1994; Melka, 1996; Albala-Bertrand, 2000; IASC, 1994; Lute, 1998; etc) and seek to support the actors defining them. The UN Office for the Coordination of Humanitarian Affairs (UN-OCHA) defines a complex emergency as "*a humanitarian crisis in a*

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[3] Due to both the political and humanitarian aspects of complex emergencies, the terms *complex humanitarian emergencies* and *complex political emergencies* are also used to describe such emergencies. When using complex emergencies for the rest of this paper, both the humanitarian and the political aspects are included.

country, region or society where there is total or considerable breakdown of authority resulting from internal or external conflict and which requires an international response that goes beyond the mandate or capacity of any single agency and/ or the ongoing United Nations country program" (IASC, December 1994). Since the fall of the iron curtain in 1989, we have seen an increased number of complex emergencies and high-tension regions/countries, especially in the Middle East and Africa, but also at the Balkans, in Caucasus, Afghanistan, etc. As a consequence, there has been a huge increase in non-governmental humanitarian organisations (NGOs) and military forces involved in management of such emergencies. Experiences from operations in places like Liberia, Somalia, Bosnia Herzegovina, Iraq, Afghanistan, etc. have highlighted consequences of poor co-ordination between military and humanitarian organisations and also between different humanitarian operations and organisations (Atkinson, 1996; Sesay, 1996; Donini, 1995; Johnson and Leslie, 2002; Minear and van Baarda, 2002; Scott-Flynn, 1999; etc.). The experiences put professional co-ordination[4] at the top of the international humanitarian agenda. Many of the challenges experienced are poorly understood and solutions are empirically developed through incremental steps and improvisation. Quarantelli (1998a), points to the fact that no disaster researchers have looked systematically into complex emergencies. According to Quarantelli, such emergencies offer a unique opportunity to study the larger context in which disasters occur. There is also a restricted amount of literature where observations from several operations are compared based on scientific methods and theory. As a consequence, theory development within co-ordination of complex humanitarian emergencies is limited, leaving a requirement for such development (Donini and Niland, 1994; Heyse, 2003; Quarantelli, 1997; etc).

This paper aims to sort out some basic conceptions in order to understand how reliability could be improved in emergency management of complex emergencies. We discuss the concept of complex emergencies and identify major co-ordination challenges as highlighted in recent literature. Based on these findings, we consider basic elements in a theoretical framework of reliability in coordination of humanitarian operations during complex emergencies.

Data are collected from a survey of documents, reports and assessments studies of emergency management of humanitarian relief operations. Furthermore, we use experiences from a twelve months stay in Sierra Leone in 2001-02, six months in Kosovo in 2001 and interviews with emergency personnel and staff members from major Norwegian NGOs.

Crises, Disasters and Complex Emergencies

During the 1990s, the academic focus has been redirected towards the (long-term) causes and consequences of crises and disasters, with more interest in political and social aspects (t'Hart 1993; Rosenthal et al. 2001). To understand crises, disasters and complex emergencies, it becomes important to understand the *conditions (causes), characteristics* and *consequences.*

Rosenthal et al. (2001:6) define a crisis as "periods of upheaval and collective stress, disturbing everyday patterns and threatening values and structures of a social system in unexpected often unconceivable ways." This definition emphasises the *threats* to the basic structures and core values of a social system. Quarantelli also emphasises the stress on social systems when studying disasters (1995, 1997, 1998a). He shows how the understanding of disasters have changed from "acts of God", to "acts of nature", to "acts of man" and finally to an "act of society" (Quarantelli, 1995). As

[4] Coordination is the systematic use of policy instruments to deliver humanitarian assistance in a cohesive and effective manner. Such instruments include strategic planning, gathering data and managing information, mobilising resources and ensuring accountability, orchestrating a functional division of labour, negotiating and maintaining a serviceable framework with host political authorities and providing leadership (Reindorp, Wiles, 2001:ii).

a consequence, disasters are no longer regarded only as "*any happening that causes great harm or damage, serious or sudden misfortune; calamity"* (Websters New World Dictionary sited Porfiriev 1998:57). Disasters are also results of *long lasting processes* calling for new perspectives on emergency planning and management. These *processes* are unfolding when different forces interact, and are not discrete events with a distinct start and termination (Rosenthal et al. 2001; Quarantelli 1998a). Rosenthal et al. describes disasters by their "un-ness". They are unpleasant, unexpected, unscheduled, unprecedented and maybe unmanageable (1989:5). The outbreak of an earthquake might come as a surprise, but not the consequences of bad planning resulting in inadequate construction of houses. Also complex emergencies are definitely "*acts of society*". They are maybe unpleasant, but they are not unexpected. As *creeping crises,* most of them are predictable in advance, but maybe not the actual timing.[5] The triggering factor, or the "agent of disaster", (Hewitt 1998) may be a political event or a natural disaster.

Disasters are often characterised as exceptional events with a huge impact on a society (WHO/EHA, 2002; Disaster Relief Homepage; Center for Research on the Epidemiology of Disasters) resulting in the need for external assistance (WHO/EHA, 2002; Center for Research on the Epidemiology of Disasters). The Centre for Research on the Epidemiology of Disasters (CRED) in Brussels, Belgium, defines a disaster as *"a situation or event, which overwhelms local capacity, necessitating a request to a national or international level for external assistance."* According to Quarantelli (1998a:263), a complex emergency can hardly be defined as a disaster. Rather, it should be regarded as a conflict situation. Dynes criticises disaster researchers due to their lack of enthusiasm for slow-onset, creeping disasters or the so-called *conflict disaster* (Dynes, 2004). The term *conflict disaster* indicates that the difference between disasters and complex emergencies might not be that big after all. Disasters or crises *may be characterised* as an occasion, event or a phenomenon (Quarantelli, 1998a). These terms are not adequate for describing complex emergencies, since such emergencies generate a flow of new crises and disastrous events which calls for *resiliency* as a basic operating strategy. Complex emergencies also distinguish themselves from disasters by the underlying factors of destructive social, political and economic processes developing over a long period of time (Melka, 1996; Lute, 1998; Albala-Bertrand, 2000), the requirement for a system wide response to handle the emergencies (Duffield, 1994) and security challenges due to a breakdown of authority in the emergency area (IASC, 1994; Lute, 1998). Conflicting political interests may develop into a complex emergency only if there are a lack of, or weak, social and political institutions capable of identifying alternative solutions.

The *consequences* of potential disasters and complex emergencies depend on the activities *prior to the disasters/complex emergencies.* The *consequences* of conflicts escalating to a complex emergency are destruction or eroding of the cultural, civil, political and economic integrity of established societies (Albala-Bertrand, 2000:5). These consequences are normally manifested in deaths due to direct violence, starvation, diseases, involuntary displacement of people (Melka, 1996:3), (armed) conflicts and even environmental breakdowns.

Due to their complexity in *causes, characteristics* and *consequences*, complex emergencies are very hard to manage. Almost by definition, there is almost no single authority with the capacity to handle them (e.g. the UN-OCHA definition referred to in the introduction). There are many actors involved (the population; local, regional and national authorities; local, maybe national and international military organisations; public and private, local and international humanitarian organisations; networks of organisations; etc). Even though most humanitarian organisations share a vague vision why they are present in the emergency area, no formally accepted superior

[5] Famine in Etiopia 1983-1984; famine in Sudan in 1998; displacement of people in West Africa the last 30 years; refugees following the genocide in Rwanda in 1994; refugees from the Iraq war in 1991, the genocide and refugees at the Balkans in the 1990s; the Afghan wars the last 30 years; etc

management or co-ordinating function normally exists. As a consequence, *reliability* in management of complex emergencies relies in most cases on co-ordination between more or less autonomous organisations intervening in the emergency.

A Survey Through Current Research on Complex Emergencies

There is much empirical information about co-ordination of humanitarian relief operations (e.g. reliefweb.org). The search for evaluations and research documents based on theoretical frameworks is however far more difficult. Several researchers call for such research (Donini and Niland, 1994; Heyse, 2003; Quarantelli, 1997; etc). In a survey through some literature on co-ordination of relief operations, only 23 out of 96 documents studied had a clear-cut theoretical framework. The theoretical frameworks listed in table 1 were the most common used, starting with the most common at the top of the list.

Table 1: ***Theoretical frameworks on emergency management of complex emergencies***

Theoretical frameworks:
Conflict resolution/Conflict management/Emergency management
Bureaucracy and network theories (organisational theory)
Learning/Organisational learning/Institutional learning
Social capital
Political science/Political economy
Social theory/Social relations theory/Cultural science
Emergent theory on relief and development
Security/Risk

The theoretical frameworks point at many of the challenges for reliability in complex emergencies. Nine of the documents (Dixon, 2001; Baharvar, 2001; Benini, 1998; Donini and Niland, 1994; Eguren, 2000; Koppenjan, 2001; Mendonca, Beroggi and Wallace, 2001; Lewer, 1999; van Tuijl and Jordan, 1999) discussed emergency management based on theories on conflict resolution or conflict management. Bureaucracy and network theories were used to discuss systems wide responses to complex emergencies (Granot, 1990; Dixon, 2001; Benini, 1998; Moore, Daniel and Eng, 2003; Utting, 2000; van Tuijl and Jordan, 1999). Emergency management, bureaucracy and network issues were also discussed empirically in many documents. Theory on learning was used to discuss improved performance in humanitarian action (Benini, 1998; Comfort, 1990; Donini and Niland, 1994; Havermans, 2002; Kruse, 1997; Van Brabant, 1997a). Inherent in the discussions about emergency management, networks and learning were the requirement for information exchange between different actors. The political dimension and the inherent focus on security were covered by theories on politics (Goodhand and Hulme, 1997; Macrae and Leader, 2000) and security (Koppenjan, 2001).

Coordination Challenges Highlighted in Recent Literature

Main challenges for emergency management in complex emergencies identified in reports, articles and assessment studies are listed in table 2.

Table 2: *Main co-ordination challenges in complex emergencies*

1. Lack of authority to co-ordinate or command hampers efficient decision-making
2. A large amount of humanitarian actors hampers co-ordination and joint efforts due to: ➢ the mandates and agendas of the different humanitarian organisations ➢ competition between the different organisations forming the humanitarian response ➢ sharing of information
3. The political aspects of complex emergencies
4. Demands from donors

Demands from donors are important for all humanitarian organisations and force them to focus their effort in directions specified in contracts with the donors. The influence of the donor organisations can therefore most of all be seen in decisions about where to run humanitarian operations and which emergencies to be engaged in. Donor organisations are normally not involved in daily field operations. We will therefore not go into more details with regards to demands from donors. The rest of the challenges highlighted in the table will be discussed in more details as follows.

Lack of authority to co-ordinate or command hampers efficient decision-making

UN-organisations[6] are today the main co-ordinators of humanitarian operations. It can however be questioned if UN-organisations are capable of conducting reliable humanitarian co-ordination during complex emergencies. Many authors argue that adequate *power of command* is required in effective humanitarian operations (Reindorp and Wiles, 2001). Effective power of command might be difficult to achieve *in* the different organisations forming the humanitarian response to complex emergencies. Power of command *between* organisations might be even more difficult to achieve. Inter-organizational co-operation is required during complex emergencies in order to meet the unusual demands of emergency response. Humanitarian organisations are however often formally structured and possess organisational cultures that hamper such co-operation. (Granot, 1990). Several reports and assessments of humanitarian action refer to the lack of authority to exercise command or co-ordination (Minear, 1998; Lautze, Jones and Duffield, 1998; Reindorp and Wiles, 2001). In their studies of co-ordination of humanitarian operations, Lautze, Jones and Duffield (1998), highlight that co-ordinating bodies must rely on the goodwill of actors over *whom they do not have authority*. Reindorp and Wiles (2001) see this "co-ordination light" as inadequate for effective co-ordination of humanitarian operations. Miles and Snow (1992) do however see the voluntarism in networks as a prerequisite for the attendance of *independent* organisations. They are supported by Quarantelli (1997) and Scott-Flynn (1999) focusing on co-ordination of resources and exchange of information instead of exercising command and control. The "co-ordination light"-model, as described by Reindorp and Wiles, might therefore be the most realistic solution in a situation where no formal authority has the absolute control, and the situation may change dramatically from day to day. In such situations, *flexibility* may be a necessity for reliable operations.

A large amount of humanitarian actors hampers co-ordination and joint efforts

The humanitarian response to a complex emergency is formed by an increasing number of actors. No single organisation has the capacity to manage such emergencies independently. The humanitarian operations in Kosovo in 2001 were conducted by more than 350 large and small humanitarian organisations. The Mozambique floods in 2000 resulted in humanitarian assistance from 49 nations and 30 international NGOs (Moore et al, 2003). Almost one hundred international organisations (and 17000 UN troops) were involved in relief operations in Sierra Leone in 2001-02.

Long-term, high-quality formal and informal relationships between humanitarian organisations are necessary for effective and reliable emergency management (Hulme and Goodhand, 2000). Absence of such relationships, make co-ordination a difficult exercise (Van Brabant, 1997b). We have the last 15 years seen an increased number of foreign humanitarian actors involved in complex emergencies. All these organisations, with their variety of mandates and agendas, are linked to different donors, ideological and/or political organisations, etc. resulting in competition between the humanitarian organisations (Reindorp & Wiles, 2001; Utting, 2000; Rigby, 2001; Bennett, 1997). The diversity of agendas or mandates may also result in less efficient emergency management, because the different actors might not fully grasp the actions of other organisations.

[6] UN-OCHA, UNHCR, UNDP, WFP, etc

Informal networks between the different organisations might therefore be important for creating a shared analysis of the environment (Lautze, Jones and Duffield, 1998; Reindorp and Wiles, 2001; Watkins, 1999). Scott-Flynn sees co-ordination as the tool to handle different agendas and mandates by sharing of information between the actors (1999).

A *diversity* of organisations with different mandates may however also be fruitful because the different organisations possess different strengths and weaknesses. They might therefore complement and overlap each other. Exchange of information between the different parts of the organisations is therefore a vital part of all efficient emergency management and of inter-organisational decision-making processes (Granot, 1990; Burkle & Hayden, 2001). The UN Integrated Regional Information Network (IRIN) for the Great Lakes Region emergency was an information-management tool during the emergency (Lautze, Jones and Duffield, 1998). The *Early Warning Working Group (EWWG)* in Ethiopia and *the Somalia Aid Coordination Body (SACB)* are other examples (Watkins, 1999). These networks increased the generation and integration of information between the humanitarian organisations. One of UNOCHA's main goals and activities are information collection and dissemination of information via websites (www.reliefweb.int), information networks (Integrated Regional Information Network: IRIN) and early warning systems (Humanitarian Early Warning System: HEWS) (ref OCHA homepage).

The political aspects of complex emergencies

Complex emergencies have both *political* and *humanitarian* aspects (Macrae and Leader, 2000; Macrae, 2002; Rigby, 2001; van Brabant, 1999; Atkinson, 1996; Munslow and Brown, 1999). Aid cannot act as a substitute for political action (Macrae and Leader, 2000). The political considerations and the underlying causes to conflicts remains a political responsibility and must be dealt with accordingly. Without solving the underlying political causes to a conflict, the emergency will remain a constant threat to the population and the impact of the effort by the humanitarian community will be limited. The complex emergencies in Ethiopia and Sudan over the last 20-30 years, the UN/NATO operations in Kosovo and the UN missions in Chyprus and Lebanon are examples of lack of or inadequate political engagement and the resulting "waste" of humanitarian effort. In solving the basic political causes for the emergency, humanitarian organisations may only play a passive role or in some cases act as a facilitator (Van Tujil and Jordan, 1999).

Reliability in Coordination: Some Theoretical Implications

This short overview has shown that both characteristics and main management challenges in complex emergencies calls for resiliency in operations and flexibility in management. How is it then possible for humanitarian organisations to seek reliability in the management of complex emergencies?

Earlier definitions of reliability focused on *the unusual capacity to produce collective outcomes of a certain minimum quality repeatedly* (Hannan & Freeman, 1984:153). This definition focuses on a capability to provide a regular output in an industrial setting. It does not grasp the requirement to handle a constant flow of unexpected events in complex emergencies. Stable output, in terms of regular supplies of relief services in such emergencies are hard to achieve due to variable working conditions. High Reliability Organisations (HROs) distinguish themselves from other organisations by their unique ability to *operate high-hazard technologies in a nearly error-free manner* (Roberts, 1990). According to Weick et al. (1999), HROs strive for reliability through processes of cognition as much as processes of production. Instead of a stable output, HROs vary their activities and maintain stability in the cognitive processes— making sense of these activities enables them to remain reliable. Weick et al. labels this strategy collective mindfulness among the organisation members.

Most HROs, however, have a very good control over the factors influencing their production activities (Vogus and Welbourne 2003). Other organisations, such as small firms operating in difficult markets, operate in high-hazard, rapidly changing complex environments. They have a very limited control over external factors influencing on their activities. Such companies appear as *reliability-seeking* organisations by remaining open and flexible to emerging information and they thereby achieve the reliability demanded by their environments through *innovation* (Vogus and Welbourne, 2003). This situation is analogue to the situation humanitarian relief organisations experience in complex emergencies. Thus, they can hardly be totally reliable in terms of stable output or failure-free performance. Instead, they can apply a reliability-seeking strategy aiming to improve all aspects of performance.

The unexpected variations in working conditions entail a requirement for resiliency in emergency management. Wildavsky defines resilience as *"the capacity to cope with unanticipated dangers after they have become manifest"* (1991:77). Resilience in emergency management is therefore displayed in *reaction, rather than in strategic vision* (Hills, 2000:117). Collingridge (1996) simply regards resiliency as keeping all options open. According to Collingridge (1996), resilience is based on flexibility and diversity. Flexibility in humanitarian operations entails openness and innovation with regards to handling of the situation in the emergency area. Most humanitarian organisations have their attention directed towards flexibility in operations. Flexibility is a key-requirement when the main Norwegian NGOs recruit their emergency personnel (Kruke 2003). Resiliency in humanitarian operations implies a joint effort that depends on flexibility also *between* the different organisations, a flexibility to sort out co-ordination challenges such as lack of authority to co-ordinate, mandate and agenda issues, competition and sharing of information between the different organisations. This joint effort formed by a diversity of organisations entails the possibility of utilising the full spectrum of knowledge and resources present in the emergency area.

Diversity and divergence entails differences in viewpoints, all emergency management functions covered and resource slack in vital functions (Schulman, 2001). Diversity is primarily related to the resources an organisation possess, the resource bases available and efficiency in resource mobilisation. The magnitude of complex emergencies entails a system wide response from networks of humanitarian actors. The networks of organisations appear as the main source of diversity. Despite all problems observed when someone tries to (or wish to) coordinate such networks, a network structure is actually strengthening the humanitarian operations. Co-ordination between these actors is therefore a prerequisite for seeking reliability in humanitarian operations. Both flexibility and diversity therefore forms a foundation for resiliency in humanitarian operations and thereby also reliability.

While resilience is the direct handling of unexpected events, anticipation about future scenarios forms the basis for emergency planning. Resiliency is the key to cope with unexpected events, but resiliency will not exist in organisations if not organised for (Boin et al., 2000). Anticipation is defined as "*prediction and prevention of potential dangers before damage is done"* (Wildavsky, 1991:77). Anticipation must however also include the realisation that *you do not know the future* and must be able to handle unexpected events. Efficient HROs know more about *what they don't know* (Weick et al. 1999). Anticipation must build on pre-emergency knowledge and through network cooperation result in contingency planning of responses to emergencies and training of vital functions. Even though some generic pre-emergency planning and cross-organisational co-ordination is taking place on a continuous basis, especially between some of the huge actors, most emergency management functions must be coordinated from emergency to emergency. That is in contrast to Quarantellis view, emphasising that emergency planning has to be generic in order to meet all requirements (1998). Many complex emergencies, the so-called "creeping crises", are not unexpected. They have a different pre-emergency phase than disasters such as the World Trade Center in 2001, hurricane Hugo in 1989, the earthquake in Bam in 2004, etc. By effective

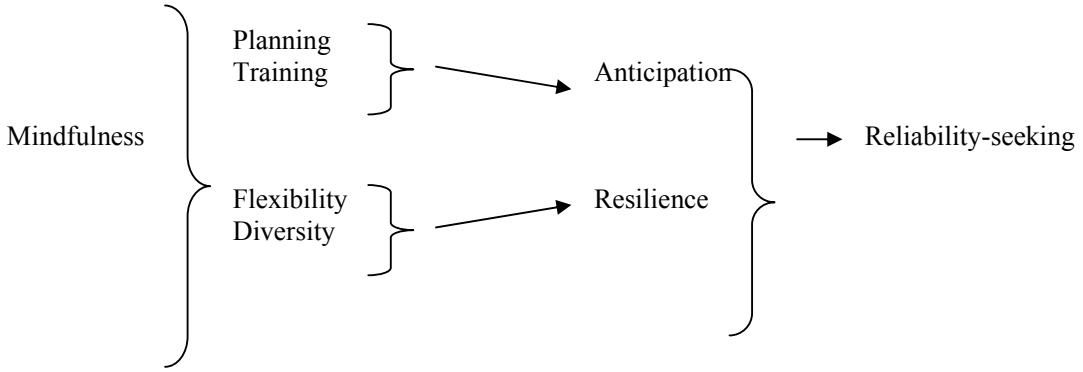
anticipation during the pre-emergency phase, it should be possible to reduce the consequences of complex emergencies and maybe even *prevent* crises turning into full-blown complex emergencies. Reliability in humanitarian operations must therefore be a mix of both resilience and anticipation.

To strengthen resilience and anticipation in reliability-seeking organisations during complex emergencies, three mindsets from *collective mindfulness* (Weick et al. 1999) are particularly important (Vogus and Welbourne, 2003):

- Reluctance to simplify interpretations: Seeking and maintaining divergent viewpoints (Schulman, 1993; Weick et al. 1999).
- Sensitivity to operations: Creating and maintaining an integrated big picture of the moment through ongoing attention to real-time information (Weick et al., 1999; Vogus and Welbourne, 2003).
- Commitment to resilience: The belief in the fallibility of existing knowledge as well as the ability to both bounce back from errors and handle surprises in the moment (Wildavsky, 1988; Vogus and Welbourne, 2003; Weick et al. 1999).

These mindsets will be important both for adequate planning and preventing the escalation of crises, but especially for flexibility and diversity with regards to the handling of unexpected events in a resilient manner. The arguments is summarised in figure 1.

Figure 1: A foundation for reliability in emergency management of complex emergencies



Many factors influence on reliability, not only the skills of the emergency managers (Hills, 2000). Reliability-seeking in humanitarian operations has much to do with the larger social context within which disasters happen (Quarantelli, 1998). Attempting to "solve" complex emergencies by humanitarian aid is not possible. Humanitarian organisations can only provide assistance to people in need, not enforce an end to political conflict. The underlying causes for complex emergencies must therefore be solved politically. Reliability in humanitarian operations is therefore dependent upon parallel political initiatives. Reliable humanitarian operations during complex emergencies are also dependent on security. One characteristic of complex emergencies is loss of structures of authority. Humanitarian organisations must be provided with a secure working environment to be able to conduct reliable emergency management operations.

Conclusion

Reliability, in terms of a constant productive output, is hardly possible in complex emergencies. In a turbulent environment where no actors control the alternating conditions, the only option for relief organisations involved is to seek for more reliable performance. A reliability-seeking strategy has primarily to build on resilience, with a narrow scope on anticipation. Resiliency implies flexibility in organisations and management, and diversity in resources and resource bases, whereas anticipation is based on planning and training activities. Both planning and training should be directed towards flexibility and mindfulness in operations.

Flexibility and especially diversity is hard to obtain for one single multi-purpose organisation in the hostile environment of a complex emergency. Thus, a network structure is preferable for humanitarian relief operations. This structure may develop into a reliability-seeking network if the coordination is done through information sharing and mobilisation of the total network resources.

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DESIGN OF EMERGENCY MANAGEMENT SYSTEM USING ITA

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Keywords: Emergency management system, information technology architecture

Abstract
Collaboration on Information Systems is very critical issue between local government and community resource systems such as hospital, fire department, and utilities etc. This problem can be solved by Information Technology Architecture (ITA), which is composed of data, application, and technology architecture with technology reference model and standard profile. Developing emergency management system requires ITA methodology. This paper is to describe design of emergency management system on the basis of ITA for local government.

1. Introduction
Disaster prevention and management is increasingly important as a state policy. The so-called 'Participation Government' is making efforts to create concrete alternatives, including an innovative disaster management system and disaster management measures in each area based on a new paradigm of disaster management, which is [composed of] Establishment of Secure Society, Strengthening of Network Society, and Creation of Environment of Effective Society. As a part of this effort, the government has set forth four principles and basic directions. First, security is elevated as an independent and unique business that is a service for the citizens. Second, investment in the disaster prevention sector is considered not as a cost, but as an investment. Third, a system of integrated and coordinated management of disasters, as well as of security management in which citizens participate, is to be established. Fourth, a specialized process of accident management and reoccurrence prevention measures is established as the principle and basic direction of management.

In order to achieve these principles of state disaster management, the government is pushing forward key business organizations that focus on establishing and developing an efficiency-maximizing disaster management system. Despite efforts at the state level for disaster prevention, systematic methods are necessary to resolve such problems as: 1) the lack of networking and standardization between systems due to each agency's independent promotion of IT business for disaster response, 2) the lack of a pre-disaster preparation system for disaster response and the under-usage of IT, 3) the lack of prompt and accurate response to situations due to control office's weak function, etc., 4) limited information sharing due to each agency's closed management of information and communication network, and 5) the inability to communicate with problematic communication areas arising in a disaster, and the general lack of emergency disaster communication.

In addition, information technology (hereinafter "IT") has begun to be recognized as a means to enhance competitiveness of organizations, as IT is developed very swiftly, and various forms of IT solutions appear every minute. The importance of effective management of IT has also begun to be highlighted. Advanced IT nations including the U.S. have already keenly recognized the necessity of the most suitable management method through rational and efficient management of existing IT

and newly-introduced IT, pursuing efficiency of management of information resources and attempting to maximize IT's expected effects through IT architecture (ITA).

In conclusion, the management system and information system for disaster prevention to be newly improved and established should be designed based on ITA/EA base structure in which the trend of new technology is reflected, and have a BCP(Business Continuity Planning) environment.

2. Change in IT Environment

Recent IT development opens a new possibility of a state emergency rescue system. Particularly, it is anticipated that Ubiquitous technology and Internet-based open architecture technologies such as Web Services will allow innovation in disaster prevention system establishment.

Particularly, Ubiquitous IT allows establishment of various systems, which can be accessed any time, recognize situations, and always intelligently and autonomously act and serve as a substitute for humans. For establishment of a disaster management information system, Korea's National Computerization Agency intends to establish a system that enables collection of real-time disaster information and a swift and accurate response by introducing the Ubiquitous concept. With this introduction of Ubiquitous computing concept, information exchange can be dynamic, and it is possible to build a field response system for disasters by establishing a comprehensive disaster management plan.

With this development of IT, disaster prevention information system can be effectively utilized, and it is possible to uniformly structure information for the businesses linked enterprise-wide by introducing Enterprise Architecture in information system analysis and design.

Enterprise architecture allows efficient information management and supports decision making to consistently drive an information system.

3. Prior Related Research and Technology

In order to build an efficient disaster prevention management system based on IT, prior related research and technology can be reviewed as follows:

3.1 Emergency Management

In general, emergency management refers to an organization's ability to handle present operational environment swiftly and efficiently in order to reduce threats to human health and safety, prevent public and commercial property loss, and minimize effects on normal activities of organizations.

As a model for this emergency management, there are step-by-step response activities, which are composed of Preparedness, Response, Recovery, and Mitigation. This step-by-step response can minimize damages through a feedback process. First, in the preparedness stage, measures to respond to disasters are to be analyzed and designed in advance through R&D (Research and Development) and the future possibility of disaster occurrence should be predicted. In the response stage, a system of common response with on-site activities should be established when disaster occurs for swift and accurate information transmission. In the recovery stage, emergency situations occurring after disaster are controlled. In the mitigation stage, disasters are reclassified by type, and appropriate prevention measures are prepared to prevent reoccurrence of disasters.

Therefore, the disaster prevention management system should minimize damages at the time of disaster by repeating this step-by-step process. For this purpose, various results of analyses and scenarios, or manuals on how to respond to disasters, classified by disaster type should be prepared ahead in the prevention and preparedness stage, and, once disasters occur, a field report should be made urgently. In addition, it is necessary to build a system that allows continuous information sharing by utilizing the Ubiquitous environment in networking information systems of disaster-related research institutes or related agencies.

3.2 Enterprise Architecture

Enterprise architecture indicates an effective utilization of information system at the scope of entire enterprise and integral structuralization of information for mutual Enterprise businesses. Its establishment allows effective information management and consistent decision-making. Successful establishment of enterprise architecture requires the designing of business architecture, data architecture, application architecture, and technology architecture.

Business architecture defines functions between necessary businesses and other related businesses. Its establishment allows clear understanding of businesses and guarantees continuity of businesses, and makes it possible to distinguish the scope of the information system. The aims of data architecture design are to provide a framework for sharing and managing the data used in the information system, as well as to offer access and functions so that data requirements are supported by the system. In the design of application architecture, related connections between businesses and units are confirmed and verified, and an applicable system is designed after the necessary application system is distinguished. Design of technology architecture is a process in which a series of services and interfaces that are commonly applied to computing, platform, and communication infrastructure is defined by distinguishing the information service necessary for task activities.

3.3 Ubiquitous Computing

The world of Ubiquitous technology aims to make 5 "Anys" (Anytime, Anywhere, Any network, Any device, Any service) possible for 5Cs, including Computing, Communication, Connectivity, Contents, and Calm. Through this, electronic space and physical space are united in one, and all inanimate objects [i.e. mechanical objects] and humans can exchange communication in real time.

Also, the Ubiquitous environment is established through the task of implanting computing and networking function in all mechanical objects. Electronic elements, which can be implanted in physical spaces, include embedded systems, wireless ID tags, subminiature precision machines (MEMS), sensors, chips, and badges. When implantation of wireless ID tags, etc. in mechanical objects and connection with a wireless network is completed, it becomes the Internet of mechanical objects, which can discriminate and exchange information in itself. Chip-type computers implanted in mechanical objects are connected to terminals through various networks and demonstrate more effective and artificially intelligent computing ability with enhancement of the function of space formation such as AR (Augmented Reality) and context awareness, which recognizes the change in the form of space.

While Ubiquitous-related reports, articles, and papers started to be published in Korea since 2002, most writings mention it is based on estimation, and the logics and theoretical foundations are weak. Currently in Korea, however, the Ministry of Information and Communication has decided to reflect the basic concept of the Ubiquitous paradigm in the 3rd Basic Plan for Promotion of Information System in order to establish Ubiquitous computing infrastructure suitable in Korea, as well as to stimulate related industries. With this introduction of Ubiquitous computing concept, therefore, it will be possible to establish an on-site response system to disasters with dynamic information exchange and establishment of a comprehensive disaster management plan.

4. Plan for Establishing a CEM (Community Emergency Management) System

Presently, the main problems of the disaster prevention system can be classified into the problems that are caused by non-systematic promotion of the information system, such as lack of standardization and network between information systems, limited information sharing due to each agency's closed operation of information communication network, problematic disaster communication areas, and absence of emergency disaster communication, as well as the problems that are due to under-usage of IT, including new technology.

The first way to solve these problems is to apply systematic information methodology such as Enterprise Architecture. Enterprise architecture indicates integrated structuralization of information for businesses related to effective utilization of information system in the scope of entire disaster prevention businesses. Its establishment allows efficient information management and decision making which enables consistent promotion of information system. The second is application of up-to-date IT which can actually support disaster prevention. In particular, next-generation technologies such as GIS (Geographic Information System), GPS (Global Positioning System), and Ubiquitous can promote and support effective response to disaster situations. For disaster management information systems such as these, Korea's National Computerization Agency also intends to introduce the Ubiquitous concept and establish a system that allows collection of disaster information in real time, for swift and accurate response. With the introduction of Ubiquitous technology, it is possible to build an on-site disaster response system by establishing a plan for dynamic information exchange and comprehensive disaster management.

4.1 Plan for Establishing Enterprise Architecture

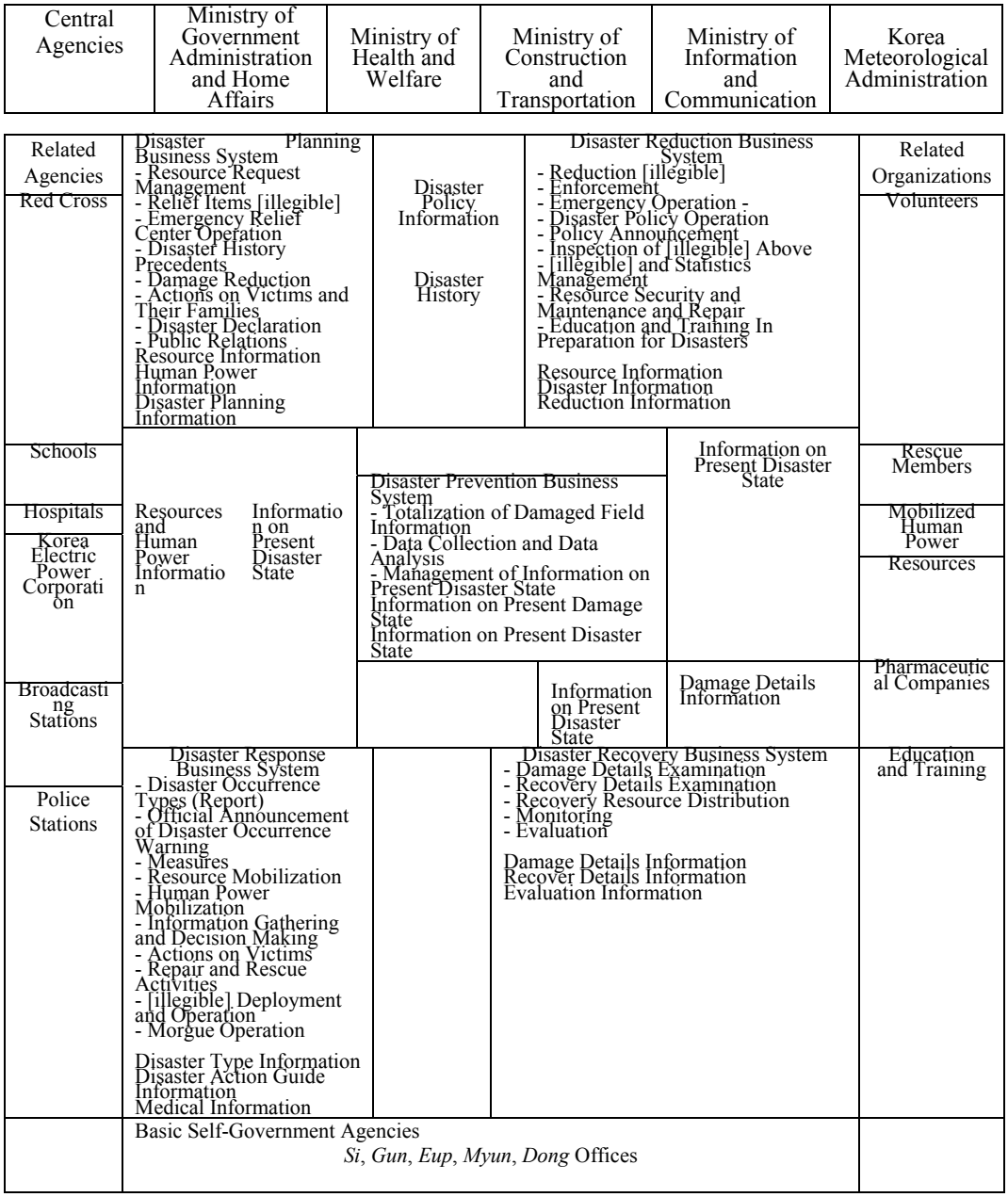
Enterprise architecture is one of the methods to promote an information system, which started in the mid-1990s in the U.S. with the name of 'Information Technology Architecture' to solve problems of connections among information systems as well as of information sharing, and its main goal is efficient IT investment. The main contents of IT architecture include set up and compliance of IT principles and standards that correspond to business motives, organization of information architecture, and the clear set up of the scope of IT operation principles and technology project.

The main elements of IT architecture are Enterprise Architecture, Technology Reference Model, and Standard Profile. For efficient realization, efforts are being made to establish IT management systems and various reference models related to business, performance, data, and service component, in addition to the existing concept of IT architecture.

The concepts of the main elements that comprise IT architecture are the following:

- BA (Business Architecture): It indicates the business area and business process of disaster prevention and defines information and information flow that accomplishes the business function. The main business function of disaster prevention can be classified into the disaster planning function (which is in charge of planning and training for disaster), the disaster reduction function (which analyzes risk factors and establishes policies), the disaster prevention function (which establishes disaster measures that can prevent disasters that occur suddenly or can be prevented in advance), the disaster response function (which is in charge of planning, as well as response and operation for disaster if disasters occur), and the disaster recovery function (post-disaster restoration). Support functions to support these main functions of disaster prevention are composed of personnel, finance, administration, etc.
- DA (Data Architecture): It indicates data for support of business function and the relations among them, and provides integrated frame of information for the entire dimension of disaster prevention business.
- AA (Application Architecture): It defines application for support of business function and data management, and provides connections between individual applications. Application for disaster prevention is composed of a disaster planning business system, a disaster reduction business system, a disaster prevention business system, a disaster response business system, a disaster recovery business system, etc. [Figure 1] is a diagram which shows relationships among these systems.

Figure 1: Model of Application Architecture



- TA (Technical Architecture): It explains hardware, system software, and structural elements of network necessary to support application.
- TRM (Technical Reference Model): It controls various structural IT elements efficiently in the process of acquirement/development and interoperability and allows interoperability, implantability, and prevention of repetitive investment by defining a conceptual framework for a commonly-used information system and common IT terms.
- SP (Standard Profile): It is a part in which standards of all ITs existing in TRM, actual methods of establishment, and dimensions are organized and allows network/data exchange service.

The vision of Enterprise Architecture can be derived from considering a strategic plan of disaster prevention management system, vision and object of Ubiquitous computing, and business requirements, etc., and its use allows derivation of direction of EA establishment. Particularly, information in the disaster sites can be immediately collected based on Ubiquitous computing, which is the next-generation technology, and analysis of these data allows design of artificial intelligence for disaster response and recovery. To design business architecture further, emergency management functions should be analyzed and reflected based on existing basic laws on disaster management and cases of advanced nations such as the U.S. FEMA (Federal Emergency Management Agency). And the entire EA should be designed by analyzing data that is currently suggested as draft plans of policies for disaster and security management policies.

A diagram such as [Figure 2] can be indicated to organize local self-government agencies' disaster prevention-related functions, and the function of each business can be defined as indicated in [Table 1].

Figure 2: Disaster Prevention Related Units of Local Self-Government Agencies

Main Functions						Support Functions		
Disaster Planning Office	Disaster Reduction Office	Disaster Prevention Office	Disaster Response Office	Disaster Recovery Office		Personnel	Finance	Administration
Disaster Planning Department	Risk Analysis Department	Emergency Prevention Department	Disaster Planning Department	Damage Recovery Department		Appointment	Annual Revenue Management	Civil Application
Training Department	Policy Establishment Department	Prevention Planning Department	Disaster Response Department			Education and Training	Tax Administration Management	Self-Government Administration Management
Trial Actual Practice Department			Disaster Operation Department			Evaluation, Award and Punishment	Accounting Management	
						Salary		

Table 1: Definition of Main Business Activities

Name	**Description**
1. Disaster Planning Office	Establishes disaster-related prevention, preparation, response, and recovery plan at the enterprise level
- Disaster Planning Department	Plans disaster-related contents
- Training Department	Finds educational content in preparation for disaster occurrence and establishes training plan
- Trial Practice Department	Is in charge of education and training of organization members based on training plan
2. Disaster Reduction Office	Analyzes risks and develops policies to minimize disaster damages
- Risk Analysis Department	Is in charge of risk analysis to minimize disaster damages
- Policy Establishment Department	Develops policies and establishes plans to minimize disaster damages
3. Disaster Prevention Office	Establish strategies to prevent disaster
- Emergency Prevention Department	Develops and establishes emergency preventive to allow emergency recovery at the time of disaster occurrence
- Prevention Planning Department	Develops and establishes preventive measures, including step-by-step action items at the time of disaster occurrence
4. Disaster Response Office	Establishes detailed strategies to which to respond at the time of disaster occurrence
- Disaster Planning Department	Continuously collects disaster information and monitors disasters to prepare for disaster occurrence
- Disaster Response Department	Applies response, escape plans, which are already established by the Disaster Planning Office, at the time of disaster occurrence
- Disaster Operation Department	Evaluates disaster response results and prepares plans
5. Disaster Recovery Office	Implements emergency recovery and post recovery at the time of disaster occurrence
- Damage Recovery Department	Prepares institutional plans, including causes and measures of disasters, and reoccurrence preventive measures

Plan for Applying Ubiquitous Technology

Currently, there are many problems in Korea's disaster management information and system building. While the state security management information system is installed in *si*, *gun*, and *gu* nationwide, it is operated only on a limited basis, in that mainly damages of natural disasters are aggregated only. In addition, although emergency rescue systems are being operated in five *si*s and *do*s mainly by fire service agencies, information is not shared well with other agencies, despite the fact that it is an information system mainly for disaster response. Thus, its function is not sufficiently utilized. Thus, these existing systems are inefficiently operated due to lack of interest in disaster management.

To solve these problems, it is necessary to establish a comprehensive information communication system that supports the entire steps of preparedness, response, recover, and mitigation. Therefore, a technology that promotes the enhancement of disaster management based on IT, as well as information sharing system through networking of each information system, is the Ubiquitous computing technology. In the Ubiquitous environment, dynamic information sharing and establishment of comprehensive disaster management plan are possible by collecting real-time disaster information in the disaster field using mobile communication devices (PDAs, cell and satellite phones, notebooks), as well as by allowing communication with related units of self-government agencies and people, using radio. In addition, it is possible to respond more promptly and accurately as well as to forecast damages and make decisions by utilizing information collected in real time.

If the age of Ubiquitous is opened with the enhancement of IT, its scope of application to disaster prevention system will also be enabled. Presently in Korea, therefore, it is necessary to establish a most suitable disaster management system that can maximize improvement of a field-focused disaster prevention system as well as its efficiency by using this Ubiquitous technology.

Conclusion

Organizations, business systems, and information systems to be newly improved under the "Basic Laws on Disasters and Security Management" should be designed and operated in a future-oriented manner by closely analyzing and evaluating (using such methods as BRM and BPM) entire existing businesses and organizations based on the basis of Enterprise Architecture. It is concluded that a systematic response to track and manage it is also necessary.

Development of IT such as Ubiquitous, GIS, and GPS provides new opportunities of development in state disaster management. At this time, the state disaster system needs to be systematically pushed forward with the application of new technology as well as application of systematic information methodology such as Enterprise Architecture.

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DIFFERENT STRATEGIES, EQUAL PRACTICE? – SAFETY MANAGEMENT IN MUNICIPALITIES

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Keywords: Safety management, safety strategy, mitigation, municipality.

Abstract
A study of two municipalities shows that *totally different organisational strategies* in safety management lead to very similar practices at the operational level. Klepp municipality is a member of Safe Communities and works with a bottom-up strategy called Mini Risk Analysis (MRA). The Time municipality uses a top-down strategy based on a rational planning approach called Risk and Vulnerability analysis (RAV). The implementation of MRA in Klepp started in 2000 and experience is growing. Some sectors adopt the tool more readily than others. Despite of very different strategies, mitigation and preparedness practices and measures at the operational level in the municipalities are very similar. Similar rules and regulations from Government shape a strict framework for safety management. Furthermore, the professionalism among street level bureaucrats is seemingly a more important guideline than organisational strategies in safety management.

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Introduction
Reports on emergency management in municipalities from the Directorate of Civil Defence and Emergency Planning (DCDEP) in Norway, focus on the top administrative level of municipalities (DCDEP 2001; DCDEP 2002). These reports lack information about how a safety strategy is implemented at the operational level. Our study is about how the operational levels do or do not implement safety strategies. The RAV model recommended by DCDEP relies on ideas from the rational planning ideal found in Banfields theory, where a top-down perspective is prevalent (Banfield 1959). Here organisations are seen as simple instruments for executing strategies made at the top level in the organisation. However, incremental planning theory and implementation literature reveals how plans and implementation of plans differ from original intentions (March and Olsen 1976) (Lindblom 1959) (Pressman and Wildavsky 1973).

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"A strategy is the pattern or plan that integrates an organisation's major goals, policies, and action sequences into a cohesive whole" p. 3 (Mintzberg and Quinn 1996). Municipalities have multiple sets of goals and policies to execute. A clear strategy may help to figure out what is relevant in the constant flow of information and demands.

In our case study we examine Time and Klepp, two municipalities with about 14 000 inhabitants. They are neighbouring municipalities located on the Western coast of Norway. The landscape is flat and there is no risk of flooding or avalanches. The municipalities are seemingly exposed to a very similar risk scenario. Klepp became a member of "Safe communities" in 2002. The same year, the municipality received the "Emergency Prize" from DCDEP partly due to the development of the Mini Risk Analysis (MRA). The MRA is a bottom-up strategy where the purpose is to reveal risks and implement appropriate measures at an early stage. It should be used at all levels in the organisation, and the aim is to ensure that all employees use it in their daily work. MRA is supposed to be the core tool in the mitigation and preparedness work. Time works with a top-down strategy through the use of ordinary Risk and Vulnerability analysis. The RAV is used to systemise the grand overview of risk factors in the municipality, and to prioritise preparedness measures based on calculations about probabilities and consequences. A further description of the RAV and MRA is found in Nilsen and Olsen (in press International Journal of Emergency Management).

Our question is: How could practice be equal, when strategies are different?

Theoretical framework

Institutionalism. Organisational inertia in strategy implementation

Bureaucracy theories explain organisations as rational systems with hierarchical structures, defined division in labour and authority, and defined procedures for execution of work tasks (Weber 1982). Strategies decided at the top level are supposed to be executed in the rest of the organisation without hesitation.

Lipsky's book "Street level bureaucracy" gives a more descriptive and contextual picture (Lipsky 1980). The street level bureaucrats are for instance teachers and social workers, and the employees who "interact directly with citizens in the course of their job". Lipsky's focus is on how the street level employees work in practice and why there are so many discrepancies from expressed policies. Explanations may be that goals are often idealised, ambiguous, multiple and diffuse. The output could be difficult to measure according to goals and also because clients would have different needs. The demand-supply dilemma is typical in the welfare bureaucracy. The shortage of resources and an insatiable need for more service supplies is a dilemma that the employees have to handle in their daily work. The street level bureaucracies may be asked to "trim the fat", but never to reduce the quality of services or affect "vital programs" and "necessary" services (Lipsky 1980) p. 39. Consequently, the street level bureaucrats need to take short cuts to be able to manage their work tasks. Time pressure may also affect safety work (Lawson 2001). These short cuts could be institutionalised over time as part of the daily practice and transformed to more and less tacit knowledge (Reason 1997)p5. Turner and Pidgeon 1997(Brown and Duguid 1991; Turner and Pidgeon 1997). Superior decision makers will often have a limited understanding about risk issues due to an administrative background (Rosness, Guttormsen et al. 2002). They will often tend to pay attention to processes and events it is easy to measure, and pay less attention to intangible issues like successful safety work which could be regarded as a dynamic process of non-events (Weick 1990).

By using Perrow's terminology as a metaphor, municipalities may be seen as loosely coupled and complex systems (Perrow 1999). The municipality is responsible for the production of a wide range of services (health, education, transport, infrastructure etc.). The complexity in work tasks is

combined with a widespread interpretative flexibility in the performance of tasks. As most service production, the coupling between different production sequences is very loose. All these factors contribute to a situation where it is difficult to discover or judge the consequences of deviations between strategy and practice.

When organisations have similar structures and practices, DiMaggio argues that there is a process of defining a "decent" practice found among institutions. This is connected to values and attitudes also present in similar organisations (DiMaggio and Powell 1991). Another hallmark is that talk and action are not connected, for instance that strategies at the top level may not influence practice in the organisation (Brunsson 1989; Røvik 1998).

All these factors (the functioning of a bureaucracy, management attention, characteristics with the production system and institutional/cultural factors) may explain why there will be a deviation and inertia between top-level strategies and practice "on the floor". But it cannot explain why the practice should appear as similar when strategies are totally different.

External forces: Laws, regulations and professionalism

The municipalities have obligations to both a central and a regional government concerning safety issues. Rules and regulations from the government are supposed to be implemented at the municipal level. Rasmussen and Svedung have developed a socio-technical model that illustrates the complexity in risk management (Rasmussen 1997; Rasmussen and Svedung 2000). Figure 1 illustrates different levels included in safety management. Rasmussen and Svedung are critical to a traditional top-down management approach in risk and safety management. Rasmussen discusses the problem of interpretation of laws and externally imposed regulations. " *In consequence, rules, laws and instructions practically speaking are never followed to the letter*"(Rasmussen 1997). p187. Although laws and regulations may be difficult to implement in exactly the same way in all organisations and at all levels, they still play an important role in structuring work tasks and priorities in all organisations concerned.

The description of the professional organisation can give rise to another explanation of why bureaucracies may act similar to the same type of problems. According to Mintzberg, organisations can be bureaucracies without being centralised (Mintzberg and Quinn 1996). This happens when work tasks are complex and a lot of decisions have to be taken in a short time. In many situations, a municipality may act as a professional bureaucracy. Similarities in performance are connected to the competence that the professional employees possess.

> "- *many of the standards of the professional bureaucracy originate outside its own structure, in the self-governing associations its professionals belong to with their colleagues from other institutions. These associations set universal standards, which they ensure are taught by the universities and are used by all the organizations practicing the profession*"(Mintzberg and Quinn 1996) P.659

When performing work tasks that is difficult to describe in detail, and when the ties to the profession is stronger than to the organisation, the professional employee will pay more attention to the professional norms than to a specific strategy implemented at the workplace.

Factors like laws and regulations, similarities in work tasks and professionalism can explain why municipalities act in a similar way, especially at an operational level. This may explain why a new strategy is very difficult to implement in operational activities. (DiMaggio and Powell 1991) (Malin 2000).

Method

It is a challenge to illustrate similarities in practice. If we look at written papers and material from both municipalities, we easily find that there are different strategies. It is more difficult to document similar practice, because most of it is not written down or easily available.

Ten core interviews were conducted in each municipality, during spring 2003. There were informants at three organisational levels:

- *Strategic level*. One politician, one chief administrative officer.
- *Tactical level*. Chief executives of health, school and planning/engineering department, the tactical emergency manager**.**
- *Operational level*. Community nurse, school headmaster, managers in kindergartens and one employee at the operational level in the planning/engineering department.

Additional interviews were conducted with teachers, assistants in kindergartens, a municipal doctor and the project leader of MRA. In addition to in depth interviews with some of the operational managers, the rest of the headmasters and managers of kindergartens in Klepp were interviewed about the use of the MRA. Supplementary information sources used were documents about RAV and MRA, municipal plans, economical annual reports, safety rules and instructions, quality systems, Health, Environment and Safety (HES) papers and written material about risk and safety regulations.
We have chosen to concentrate the presentation of empirical findings from the community nursing, kindergartens and primary schools in both municipalities.

Results

A simplified version of Rasmussens vertical model has been used to illustrate our findings in figure 1. Ministry of Justice and the Directorate for Civil Defence and Emergency Planning (DCDEP) form a common framework that all municipalities have to relate to. The county governor supervises the municipalities' emergency work. Klepp and Time are then treated individually to show their different strategies. The MRA strategy is partly implemented at the operational level in Klepp. At the operational level in Time RAV is not used.

Figure 1: Current emergency strategies and vertical management in the two municipalities

	Ministry of Justice	RAV
	The directorate for civil protection and emergency planning (DCDEP)	RAV
	County governor in Rogaland	RAV
	Klepp Municipality	
Strategic level	Politicians and top administration	MRA
Tactical level	Departments of health, education and planning/engineering	MRA
Operational level	Community nursing, schools and kindergartens.	MRA Partly

	Ministry of Justice	RAV
	The directorate for civil protection and emergency planning (DCDEP)	RAV
	County governor in Rogaland	RAV
	Time Municipality	
Strategic level	Politicians and top administration	RAV
Tactical level	Departments of health, education and planning/engineering	RAV partly
Operational level	Community nursing, schools and kindergartens.	No RAV

Municipalities are responsible for emergency planning and preparedness
In 1993, a Norwegian Parliament white paper stated the need for new tools to build societal resilience, improve safety and preparedness.

> "Risk-and vulnerability analysis could be a sufficient tool to give a more systematic examination of situations that can occur, to improve preparedness in society and our ability to handle unexpected events"(Stortingsmelding24 1993) p33.

In 1994 the DCDEP made guidelines for Risk and Vulnerability analyses (RAV) for municipalities. It was discussed whether emergency planning should be a statutory provision, but it was linked to a regulation of internal control (introduced 1992). Hence, it became the municipalities' own responsibility.

In 1998 the county governors' emergency staff got the responsibility to supervise municipalities and their emergency planning and mitigation work. As part of the supervision role, the county governor also has an education and guidance role. By 2000, 85% off all municipalities in Norway had made an RAV ((DCDEP 2000)). Time has followed this practice.

Klepp started to develop MRA in year 2000 after a period of mixed experiences when they were working with RAV analysis. They saw a need for a more contextual approach and to link emergency planning to the daily mitigation work in the municipality. A project group containing street level workers from all departments developed the MRA together. The MRA project manager had a strategy of "*being a missionary rather than a dictator"(Chief administrative officer).* When they presented MRA to the different departments, the project group had already tested it in practice and had relevant examples to show different parts of the organisation.

Practice in Klepp municipality

Strategic level

Since Klepp became a member of Safe Communities in 2002, they have worked with safety and health issues in a comprehensive way. The MRA strategy assumes that workers at the operational level will identify and take care of their own risks. This strategy was also accepted as part of the Safe Community work by the politicians and is supposed to be implemented in each core activity in the municipality.

The mayor is well informed about the MRAs. He sees a need to further inform all politicians to make them understand the main purpose of MRA activities. "*It is the politicians that make the decisions about MRA, therefore it is essential to team up with the politicians."(Mayor in Klepp at a supervision meeting with county governor).* The other politicians have only had a short brief about the MRA.

Tactical level

Klepp has a stable staff at the tactical administrative level. The department managers have been employed in Klepp between 4 and 12 years. So when the municipality reorganised in September 2002, the managers became important carriers of the organisational memory about ongoing emergency management. Personnel at the tactical level know and work with MRA. They use it in planning activities, and the department managers in planning/engineering, school and health sometimes use MRA to develop different perspectives on the same topic. For instance, MRA is used when the technical board is going to plan a road in a populated area or when making the municipal plan. At the community nursing tactical level MRA is used for instance when analysing what to do when patients are violent.

Operational level

According to the charge nurse MRA is not a concept that is used at the operational level. Instead they use similar risk assessments focusing on securing personnel and quality of services. The safety thinking is connected to MRA, but the nurses do not use the concept as it is.

The primary schools (8 schools) use MRA arbitrarily. The headmasters are all informed about MRA, but not all teachers know about it. Some schools use MRA, but the main opinion is that this is a new tool that takes time to get implemented.

In Klepp, all the ten full-time kindergartens have been asked about their MRA practice. Seven use it on a regular basis, two plan to use it in the future and one has no plans. MRA is often used when going on trips. In kindergartens the experience with MRA is that tool has contributed to a more systematic planning and increased consciousness about risk factors. They consider MRA as a useful tool in safety planning.

Practice in Time municipality

Strategic level

The RAV is a top-down strategy, decided implemented by the politicians in 2002.
The plan was that each department would make their own RAV by the summer of 2003, but that has not been done. The municipal mayor is well informed about RAV, but the other politicians are randomly informed.

Tactical level

Time municipality reorganised and introduced a new organisational set-up in January 2003. The chief executives of health, education and planning/engineering departments have been employed in Time between one and twelve years. After the reorganisation, the department managers entered new positions. They had not managed to produce department RAVs when interviewed, although they all knew about the emergency strategy and the concept of RAV. There are different opinions about using MRA. Time has not considered using MRA, as the emergency manager and chief administrative officer do not consider the municipality as mature for it. On the contrary, the chief executive of planning/engineering considers the existing quality system as satisfactory and therefore regards the use of MRA as unnecessary. "*The county governors emergency staff saw that our quality system was about the same as MRA and also contains the same safety systems as we have in our activities"(Chief executive of planning/engineering department)*.

Time has not had internal courses in RAV analysis, but political and administrative leaders have participated in external courses.

The health department chief executive tells that the RAV concept is not in use. Still the health manager feels they have reliable safety systems: *"I think we (as nurses) are fairly good in thinking about preparedness. It is in our profession, we have the education to do it"(Chief executive of health department)*. They note, however, problems related to the dilemma between a heavy workload and mindful safety management. It is a theme that is considered every day in nursing. "*This is because we have more needs than it is possible to meet"(Chief executive of health department)*.

Operational level

By summer 2003, RAV was not implemented at the operational level. RAVs from the different departments were not worked out. It was supposed to be done until summer 2002, but vanished in the wake of other tasks. Consequently, it was not possible to introduce the RAV at the operational level as long as this is supposed to be a top-down implementation strategy.

Examples of similar practice at the operational level

Community nursing at the operational level

Nurses at the operational level seem to be disconnected from the overall strategy of either MRA or RAV. At the same time, existing emergency planning and safety systems in both municipalities are quite similar. In both organisations, the staff has to adapt to rules and regulations from the government, they have HSE and quality systems built on the same logic and guidelines, and both organisations have a system of internal control built on the same governmental regulation. In addition, both municipalities have procedures for nursing based on current professional knowledge and ethics within nursing.

"Assessments visits" is an activity, which can illustrate the points above. The activity has some parallels with a risk analysis. The nurses describe experiences and reflections according to the *phenomenon* "assessment visit". Before new patients enter community nursing their home is visited by a nurse and ergonomic personnel. The patient security is considered. If there is for instance a slippery floor, the nurse requisites anti slip mats to put under rugs. They also consider if there is enough light and if technical remedies is required for the patient's health. In addition, the health personnel also consider their own working environment. If patients are heavy, a bed lift could be installed or a hospital bed could be requisitioned.

The nurses did not use safety concepts like risk and vulnerability analysis or consequence assessments or MRA, but they recognized that they did similar analyses during their "assessment visit".

Primary school at the operational level

Klepp has a written MRA that the teachers are supposed to use, but the MRA strategy is sparsely implemented in schools. A headmaster, who earlier participated in the MRA project group, trained his staff in MRA. This school actually uses MRA as a tool in their planning activities.

The headmaster at another primary school revealed another and more common practice. He said he had told the teachers about MRA, but it was not implemented at the school. A teacher at the same school knew about MRA from the newspaper. The teacher was not aware of the MRA practice, but followed the established safety rules and procedures at his school, for instance when they went on trips with the pupils etc.

All headmasters of the primary schools in Klepp had heard about MRA. They define MRA as partly implemented. They still regard the MRA as a tool for special occasions. When performing routine and ordinary activities some schools use MRA and others do not. MRA is comprehended as an additional tool for identifying risks and decide upon safety measures. They tell that "*things take time"* and therefore MRA is not yet implemented.

Teachers in Time are not supposed to use RAV at the operational level. Instead, teachers in primary schools use established guidelines for health, environment and safety (HES) improvements spinning out of governmental safety regulations. Primary schools in Time apply were very specific rules, even more than the safety rules in Klepp.

Discussion

Both RAV and MRA strategies are in use at the strategic and at the tactical level. Time was supposed to make RAV plans for the tactical level, but the departments have not done it. Thus, RAV is only partly used in planning activities in Time. The RAV strategy is not in use at the operational level at all. In Klepp, MRAs are not in use at the operational level in community nursing. In the school department the schools use MRA sparsely. In kindergartens they use MRA on a regular basis.

Different strategies

MRA is basically a bottom up strategy. When MRA is used both at the top and the bottom of the organisation it may improve communication between the levels. Some of the experiences with MRA are that it is simple and clear. The MRA project leader reports that it contributes to a more systematic approach to risk and gives a better consciousness about risk factors and safety measures (Aanestad 2001). Employees are recommended to do this analysis together to get a broader view and a common understanding of risk factors.

MRA is a tool for assessing risks in activities taking contextual "here and now questions" into consideration. MRA can be seen as *"common sense put into a system"(Klepp`s Chief officer)*. The thought behind the strategy is that it should be easy to use, understandable and make sense. The drawback with MRA is that it could be cumbersome to use. It can also seem a bit naïve in character The MRA strategy is known at the strategic, tactical and partly at the operational level.

In Time the use of RAV is known at the strategic and partly at the tactical level in the organisation. It was supposed to be implemented at the tactical level, but this has not been done, partly due to reorganisation and thereby a relocation of responsibility for emergency planning. RAV gives an

universal overview over risks factors and simplifies decisions about mitigation and preparedness instruments.

Similar practice

It seems as the institutional risk identification and safety systems established through governmental regulations, internal control systems and professional knowledge guide safety considerations in everyday work situations. Despite of different strategies, the safety practice in schools and procedures in health departments may contain so many similarities that employees in the sectors see no need for another concept or further safety procedures.

Although teachers, kindergarten managers and community nurses work in different municipalities, many challenges are the same because of similar structures and work tasks. They also carry on a profession related safety training that may overrule detailed administrative procedures. In sum, laws and regulations, existing safety procedures in the organisations and the professionalism seems to explain why practice is so similar, even when the safety strategies are very different.

Conclusions

Characteristics within the municipality bureaucracy, management attention and institutionalised modes of task performance seems to explain that overall organisational strategies are more and less ignored at the operational level, and replaced with a similar practice in different municipalities. Furthermore, the regulatory framework and systems for control (internal control) leave the street level bureaucrats with very few degrees of freedom in their daily work performance.

If good safety work is defined by external laws and regulations, embedded in the professional knowledge and ethics, and restricted by heavy work loads and management focus on efficiency, we may ask why municipalities should even try to develop and implement their own risk and safety strategies. Apparently, it has no effect. On the other hand, as long as risks and accidents subsist, there is still a room for improvements.

A bottom-up strategy as MRA may be a contribution to a more systematic and collaborative risk management and also increase the awareness of risks among all employees. But it should probably not represent a totally new way of working, but be designed as an extension to already existing practice. Seemingly, this will make it easier to implement it in a complex organisation. Still a paradox remains. Without a strong support from all management levels, a bottom-up strategy is very difficult to implement in organisations with vague goals and strong professions.

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FUTURE UK EMERGENCY MANAGEMENT FROM DISCRETION TO REGULATION - PANACEA OR LONG OVERDUE REFORM?

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Keywords: Civil Contingencies Bill, UK Integrated Emergency Management, terrorism, civil disruption, resilience, sustainable development

Abstract
There are cogent arguments that the reforms outlined in the new Civil Contingencies Bill now before Parliament, are long overdue with some existing legislation harking back to the post First World War period and much practice after the Second World War based on responses to an enemy attack. Reforms during the 80s and 90s began to recognise the need for a stronger focus on major disruptions to the community. The Civil Contingencies Bill sweeps up existing legislation and powers and repackages them. Interestingly enough, initially this was in response to a perceived need for a more focused approach to Civil Protection but is now increasingly being driven by the perception of an increased risk of a terrorist attack. The UK is no stranger to terrorist attacks, having had thirty years experience from "conventional terrorism" emanating from Northern Ireland, but the severity and form of this new threat and its intent to maximise loss of human life introduces a new dimension to emergency management. But will this new focus bring about the changes required at the local level to deal with all of the other aspects of Integrated Emergency Management, for assessment, preparedness, response and recovery from civil disruption? Is it too focused on the terrorist threat?

This paper examines the Civil Contingencies Bill, discusses the likely implications of its approach at the local level and hypotheses about the future development of Emergency Management in the UK. Is the future one of increased centralisation and direction or a continuation of perceived good practice by local responders?

Introduction
Emergency management has always been an integral part of society and has evolved to reflect the norms and experiences of the society it serves. In that sense emergency management can be viewed as a reflection of the traditions of a society. Given the range and complexity of societies (and the threats that they face) means that emergency management is often distinctive; it can be very localised, it can be voluntary, it can be professional, it can involve both professional and voluntary agencies; it can involve both public and military bodies. There is no universal model, no model that is better than another. It simply means that when looking at emergency management – its structures, roles and responsibilities, etc the observer should have an awareness of how it has evolved and the range of factors that together, give it its distinctiveness.

Background
In the UK the aftermath of World War Two had a major influence in the evolution of emergency management. Growing fears of a possible attack by a former ally led to the Civil Defence Act, 1948. This set out procedures for the public to protect themselves in the event of a nuclear attack. But at the local level, government was quite willing to let local agencies deal with emergencies.

Though local organisations were able to draw upon regional and national resources (through a designated lead government department), the planning and execution of emergency activities was left to local organisations. Central government did not feel it necessary to place a duty on them to co-operate and co-ordinate local efforts. Against this background emergency management in the UK developed in a very complex way with the responsibility to plan for and deal with emergencies being very much a local function.

This dual approach more or less remained until the eighties. At the national level, government kept its eye firmly trained on the nuclear threat with its focus on civil defence and the consequences of the outbreak of war. The little support it did offer civil society in the event of an all-out nuclear war it published in "Protect and Survive". This booklet offers guidance on how to build a shelter from a few internal household doors and other materials as a way of protecting against the aftermath of a nuclear attack. It does helpfully point out in the opening statement "everything within a certain distance of a nuclear explosion will be totally destroyed". Presumably that would include any shelters that individuals may have prepared in the four minute warning period, but does go on to say that "your own local authority will be best able to help you in war". At the local level response agencies were left to their own devices. Subordinate regulations made under the Civil Defence Act 1948, the first of which were in 1953 enabled funds to be directed towards local authorities to support their Civil Defence functions. This eventually led to the emergence of emergency planning units in England and Wales. According to Hills (1994) the hallmark of the UK approach to emergency management until recently has been to permit those central government departments and local organisations nearest to the emergency to get on with the job.

During this period that is exactly what happened. Though the response across the UK was uneven, what has emerged is a system that is able to co-ordinate response to routine emergencies. Usually led by the Police (as in many cases the scene of a disaster, for example, a fire, could be a crime scene) the emergency response system relies on the co-operation of the front-line response agencies. Post disaster recovery has become the remit of the local authority, which often acts as the emergency planning body. This is a simplified view of the reality of the UK position. In conjunction with this there have been several re-organisations of local responders boundaries and structures. This has led to confusion over who is responsible for what as the operating boundaries between different response and co-ordinating bodies has fluctuated and is likely to continue to do so. Despite these difficulties and the lack of central government direction (and many would argue, funding) the UK has developed a sophisticated system for dealing with routine civil emergencies.

By the eighties the threat of nuclear attack had receded and the UK government turned its attention to civil protection. The Civil Protection in Peacetime Act, 1986 allowed local authorities to use civil defence resources to avert, alleviate or eradicate the effects of any disaster whatever its cause, hostile attack or not. This, in effect, put in place the legislative framework to reflect what was actually happening.

In the late 1980s a number of civilian disasters (Kings Cross, 1987, Zeebrugge, 1987, Clapham rail crash, 1988, Hillsborough, 1989) pushed a review of emergency planning procedures up the political agenda. But the reviews of 1989 and 1991 concluded that there was no need to reform the current structure of emergency planning and response in the UK. The system, with appropriate lead government departments acting as co-ordinators with local services preparing plans and undertaking operations on the ground, remained in place up to the end of the last Millennium.

For a number of years prior to 31st December, 1999, concerns were being expressed that problems could occur in many technological systems when the date changed to the new millennium. Given our dependence on technology and that the date function was critical to many functions, governments throughout the world began to make plans to deal with this event. Unlike "normal"

disasters, which cannot be predicted, all parties were aware of exactly when this event would occur. The agreed strategy to minimise problems was to ensure that as many systems as possible were tested to establish if they were compliant; that is, able to recognise and respond correctly to the Millennium date change. The UK government found to its concern that it had no legal powers to direct efforts towards compliance at the local level. The best it could do to encourage organisations to become compliant was to "name and shame".

Flood events in the autumn of 2000 led to the Deputy Prime Minister (Hansard, 2000) saying that this was a wake up call for UK emergency management. The UK Fuel Blockade crisis which occurred in September 2000, certainly added weight to this call and to the recognition that a "root and branch" reform was needed. By February 2001 the process of review, initiated by the Home Office had begun. By July 2001 the lead responsibility had been transferred to the new Civil Contingencies Secretariat within the Cabinet Office. According to Smith (2001) this centralisation of the co-ordinating, advice and guidance functions could assist departments and other agencies when dealing with complex emergencies that cut across traditional boundaries, for example Foot and Mouth outbreak of 2001 involved the policy portfolios of Agriculture, Transport and Health.

Government had intimated that it regarded much of the legislation related to emergency management as archaic and inadequate; it was concerned about the need to respond to national and regional complex emergencies such as the Fuel Blockade crisis.

The intention to introduce a new legislative framework also signalled, perhaps sparked by memories of the Millennium Bug, that government recognised that it needed to have powers to direct at the local level and that it needed to ensure that a duty was imposed to undertake emergency planning. Simply put this gave the opportunity for government to codify much that was already happening at the local level and introduce new powers.

In the summer of 2001 the government launched a consultation exercise on the review, requesting responses by the end of October 2001. The review of course was much broader than responses at the local level and was intended to establish a national, regional and local framework for anticipating and responding to a range of threats. The events of September 11 introduced an added dimension to and accelerated this process. Though the UK has had extensive experience in dealing with traditional terrorist threats, September 11 introduced a form and severity of terrorism not previously encountered in the UK – a dimension where the terrorist has no concern for their own life and is intent on causing as many fatalities as possible. There had been precursors to September 11, for example the Sarin attacks in Tokyo. But September 11 raised fears that terrorism of a new kind, organised, well financed and planned, ruthless and determined, was about to be unleashed.

Present Context

At the time of writing the intentions of the UK government have become clearer. It has mapped out a legislative and capacity building programme under the aegis of UK Resilience. Resilience is a term increasingly used in reference to both civil society and the emergency services. Resilience is defined by the Civil Contingencies Secretariat, which is leading the reforms in the UK, as: -

"The ability at every level to detect, prevent, prepare for and if necessary handle and recover from disruptive challenges" (Dealing with Disaster, revised third edition).

Though resilience is common parlance, its use in the civil protection and disaster management literature reflects a trend towards a holistic and proactive approach. Resilience was widely promoted through Agenda 21 as a mechanism for strengthening the response to a range of rapid and slow onset disasters originating from natural events and anthropogenic activities. Agenda 21 (UN, 1992) cites objectives to strengthen local capacities for poverty alleviation (paragraphs 3.5-3.8),

health (paragraph 6.5), sustainable human settlement development (Chapter 7), integrated land resources management (Chapter 10), combating deforestation (Chapter 11) and drought (Chapter 12), coastal zone management (paragraphs 17.5-17.6), provision of sustainable infrastructure for waste and waste water management (Chapter 18), safe management of hazardous and toxic substances (Chapters 20 and 21), and strategies for adaptation to environmental change. Many of these objectives should be seen in the context of promoting resilience in a global sense. Resilience is a clearly stated objective of the UN Millennium Declaration (paragraphs 23 and 26).

The International Strategy for Disaster Reduction (ISDR), the successor arrangement to the International Decade of Natural Disaster Reduction (IDNDR) states its mission as: -

"The ISDR aims at building disaster resilient communities by promoting increased awareness of the importance of disaster reduction as an integral component of sustainable development, with the goal of reducing human, social, economic and environmental losses due to natural hazards and related technological and environmental disasters."

What is clear is that resilience does not imply that disasters are avoidable. It does imply that the way in which we cope with disasters is dependent on a range of factors, many of them related to the way in which we develop. Events, such as floods, are natural occurrences in a number of parts of the world. Locating a settlement in an area that is prone to flooding transforms the natural event into a hazard. In short we have developed a human vulnerability to a natural event. Resilience should be seen as the counterpoint to vulnerability, in that it recognises that floods are natural events and that any settlement construction should factor this in. The term resilience brings together the components of the disaster cycle – response, recovery, mitigation and preparedness. There are a number of definitions of resilience. Burby et al (2000) and Mileti (1999) state resilience applies to the minimisation of losses and damages when a disaster occurs and Emergency Management Australia defines resiliency as "a measure of how quickly a system recovers from failures" (quoted in Buckle and Small, 2000, 9). In both these definitions it is clear that a holistic approach to disaster prevention is advocated. Minimising losses and damages and recovering quickly both imply some level of preparedness and an anticipatory viewpoint.

Mileti (1999) suggests that there is close relation between resilience and sustainable development. This is echoed in the ISDR Mission Statement. If there is a clear link between development patterns and vulnerability to hazards then clearly the route to resilience lies in the choice of the development path. McEntire (2001) cites a number of factors that are increasing vulnerability that are related to the physical, social, cultural, economic, political and technological developments of society. This recognises that vulnerability and resilience are tied together with the ways in which a particular area develops and further recognises that disasters result from a complex mix of conditions.

Though most governments would advocate that the principle of Sustainable Development underpins their policy platforms, it should be recognised that the interpretation of this term is the key determinant. Hopwood et al 2004, map out the range of interpretations of Sustainable Development. They conclude that most governments take a weak view of sustainability and usually strive to maintain the status quo, meaning that economic interests tend to dominate.

The UK floods of 2000 are an example of where the direction of development can lead to serious consequences. Overdevelopment of flood plain areas in the UK has gone unchecked for some time. The pressure for land for housing and economic development has led to many floodplain areas being developed. In 2000 heavy rainfall in the UK saw many areas flooded with severe consequences. In the aftermath of this event many householders are finding that insurance is either impossible to obtain or the rates have become prohibitively expensive. Although planning guidance has now been issued (PPG 25, 2001) to curb development of floodplains, many existing homes will

continue to be at risk. Sir David King (2004), the UK government Chief Scientist, has claimed that the number of people at risk from flooding in the UK will double to 3.5 million by 2080.

Development trajectories will continue to produce new hazards that will present new problems for governments in that they will find it difficult, if not impossible to regulate through a legislative framework. Globalisation has both its critics and advocates (it is beyond the scope of this paper to argue the merits or otherwise of globalisation), but it does present new vulnerabilities. For example the frequency and coverage of air travel can help to propagate dangerous diseases as seen with the spread of the SARS virus. Other areas are the global dominance of one ICT operating system making it a target for hacker attacks and a vehicle for spam e-mails. This has had significant consequence for the European economy with the European Commission reporting half of e-mail traffic is spam resulting in losses of $3 billion in productivity in the last year alone (BBC, 2003). Microsoft has announced a concerted effort to reduce the vulnerability of its operating system to external interventions. This is just the tip of the global iceberg in terms of increased vulnerabilities resulting from globalisation. This is not meant as a criticism of globalisation but a recognition that it has unintended consequences. The rapid movement of capital and the ability to relocate facilities has meant that employment opportunities have been lost. In the UK the transfer of call-centres to the Indian sub-continent has impacted areas of traditional high unemployment where call centres were originally located as a spur for economic regeneration.

UK Resilience

The UK Government at all levels is now demonstrating commitment to building and improving resilience. The aim of resilience is to reduce vulnerability to disruptive challenges by anticipative pre-emption, reduction of the probability of occurrence and effective and efficient response when they occur. It also involves the design of infrastructure and the built environment in such a way as to minimise the potential effects of disruptions.

Disruptive events vary in scale, severity and complexity, encompassing everything from localised flooding through to hostile attack against the State. By its very nature, resilience is a dynamic concept, evolving to accommodate new hazards and threats. In building UK resilience, government can be seen to have identified four interrelated and interdependent strands.

Firstly organisational, the building of robust institutional infrastructure right across society with the need for collaboration both within and between levels of government, the public and private sectors and the community.

Secondly, operational, the enhancement of multi-agency co-operation, with locally led response and the full panoply of government and organisational support as required.

Thirdly, capability - a national capabilities programme is now underway to ensure that UK Government has the capacity to respond effectively and efficiently to the potential effects of massive disruptive events.

Fourthly, a legislative basis that clearly identifies the roles and responsibilities of all participatory organisations and will transform emergency management from a largely discretionary to a mandatory regime.

This new legislation comprises the Civil Contingencies Bill (CCB) 2004, now before Parliament which will become the Civil Contingencies Act 2004 and is designed to ensure that a framework exists to meet the identified challenges of the times in which we now live. Essentially in two parts, it deals with codifying and clarifying the duties of local response agencies and then a complete

overhaul and transformation of the present anachronistic emergency powers available to a UK Government.

How effective is this new regime likely to be in improving resilience? At first sight this seems a very comprehensive approach. Clear organisational structures making the process transparent, multi-agency approaches that bring together a range of expertise needed to face increasingly complex challenges, a clear audit of capabilities to fill gaps in provision and a duty throughout the UK on local responders leading to a uniform and consistent approach.

At the local level many of the proposals simply codify much that is already happening. Sections 2-4 (CCB 2004) propose new duties on local responders to undertake risk assessments, develop Community Risk Registers and promote organisational continuity, but do nothing to address the structural issues. Given the complexity of boundaries between the responders it is unrealistic to expect that the government would undertake such a massive process. Further government has committed to introduce a regional tier of government in England (Scotland and Wales already have devolved administrations) and it is unclear how this will impact emergency management at the local level. Will local services fall under regional direction or will the status quo remain? What is clear is that spatially a mismatch of boundaries between different responders will remain a feature of UK civil protection.

Many of the reforms proposed at the local level are long overdue. However, many local response organisations function effectively and have already embraced much of the proposed reform. For example, a changing approach to risk and greater community involvement (the Fire Brigade for example has been proactive in promoting prevention and has an established network of community fire stations), the imposition of a duty should promote greater uniformity of approach. The challenge will be in ensuring that capacity is uniformly developed and the proposals offer little evidence of how this will be achieved.

One of the key changes is the approach to risk. Anecdotally evidence suggests that though risk (and consequently risk prioritisation) has been based upon experience and expertise of practitioners without qualitative audit, the new duties require a written justification of the prioritisation process. It further requires the development of a Community Risk Register, which will be available for public scrutiny (Section 2 [1] [f], CCB 2004). This is a step change in approach reflecting government concern. The cleavage between government and governed about the reliability and truthfulness of "official" information and "expert" opinion and the reluctance of the citizen to accept this at face value is well established. As the Strategy Unit (2002) of the Cabinet Office states for government to effectively discharge its responsibility in communicating risks, it needs to have a track record of openness and reliability. It cites the Bovine Spongiform Encephalopathy outbreak (BSE) and the Measles, Mumps and Rubella vaccine (MMR) as examples of particularly difficult risk communications to the public. Government recognises this and sees the involvement of the public in prioritising risks as crucial to the validity and acceptability of the process. Communications is of paramount importance. How effective this two-way communication will be and how well it will act as a vehicle for strengthening resilience is difficult to judge as the media, particularly the newspapers tend to sensationalise. Perceptions indicate that public distrust is deep and both government and the local response agencies will have to work hard if they are to convince the public.

The introduction of a duty to promote continuity management (CCB 2004, Section 4) is necessary as experience in the UK has shown that many organisations fail to recover after a major incident. The Home Office (1999, p15) in their publication "Business as Usual" state that research has shown that 80% of small businesses without business recovery plans fail within one year of a major disruption. It is understood that this research looked at the aftermath of terrorist attacks on the

economic infrastructure in the UK with especial reference to the bomb that devastated the centre of Manchester in 1996. This is further supported by research by The London Chamber of Commerce and Industry. In its publication "Disaster recovery, business tips for survival, 2003" points out that many UK businesses do not have plans for recovery after an incident and in the event of a data failure 90% would go out of business.

Capabilities

Government has identified a number of areas where a national capability for disaster response should be strengthened. However it is not clear if these areas have been identified from a recognised review of the weaknesses of the UK system or are in response to the counter-terrorism agenda.

The capabilities programme is split in to three discrete areas; structural, functional and essential services. It is clear from the areas that the capabilities programme is focused upon; chemical, biological, radiological and nuclear (CBRN) terrorism, mass evacuations, mass casualties and fatalities, site clearance and infectious diseases, that the rationale is based primarily on the threat of a terrorist attack. Though the UK has had extensive experience in dealing with "conventional" terrorist attacks, these have usually had an economic focus. It can be argued that the emphasis of the capabilities programme is on the kind of terrorism that is designed to maximise casualties and fatalities. In this sense the capabilities programme is very much a response to the events of September 11, 2001. There is also the view that the command structure is based upon a militaristic model – a single chain of command that is able to appropriate resources as and when required. This is a very different approach to the local structure, where agencies have to co-operate and collaborate. Though the Police in the UK assume overall control, this is only for the duration of the incident and is predicated upon the view that the immediate area of a disaster could be a crime scene or crowd control measures may have to be implemented in the interests of public safety. These powers rest with the Police.

Concerns have been expressed around the use of emergency powers. There would appear to be sufficient checks and balances - the so-called "triple lock" (CCB, 2004 Section 20). However, who will be able to invoke them and for what duration? Safeguards are proposed that would limit the duration that emergency powers would have to be invoked and extensions would have to be approved by Parliament. (CCB, 2004, Sections 21-25).

Commentary

UK civil protection is undergoing massive changes driven by events in the wider world and the need for government to be able exercise control over responders domestically. The reforms at the local level are certainly welcome, as they will help to promote uniformity and foster closer relations between responses agencies. But the overall structure of civil protection will remain largely the same; that is government fulfilling the role of co-ordinator and offering guidance and with local agencies left to get on with the task. This raises the issue of political leadership. Unlike the USA, which has opted for central control through the Department of Homeland Security, the UK does not propose such a dedicated structure. So where will the political lead for civil protection come from? In the longer term will civil protection receive the attention that it deserves? Data does show that the frequency of natural disasters is increasing in Europe and the UK (Munich Re, 2003). Much of this has been attributed to climate change and the threat it brings of more unpredictable weather patterns, rising sea levels, new disease vectors, disturbance to agricultural systems and the impact of higher temperatures on the vulnerable in society. As Alexander (2002) points out it is the period after a disaster when there is a need to implement preventative measures that it is most likely that these will rise up the political agenda and hence attract funds and support. Alexander (2002, p57) points out that this is so predictable that

".. it may be fair to state that most advances in disaster mitigation stem from the impetus of particular catastrophes of the past, which exposed the inadequacies of efforts to mitigate and prevent them."

It may be argued that the direction of government policy should promote the wider resilience of the UK to withstand and adapt to the wider changes that climate may bring, given that its policy base is underpinned by Sustainable Development. But governments often respond to short term issues and always have one eye on pending elections. It is not unusual for governments to change direction prior to an election and that could have consequences for Civil Protection. Civil protection by its nature is an area that can easily be neglected. In UK local government emergency planning has often been the Cinderella of local services. Like insurance, something you never think of until you need it. The amount of funding for emergency planning fell from £29m in 1988-89 to just over £14m in 1997-98 (Coles 1998). There are also wide variations in the amount of additional funding provided by local authorities (LGA, 2003). The lessons to be learned are that emergency planning has fallen foul of other local political priorities and even with a clear duty will take some time for an even and consistent approach across the UK. Given the central nature of resilience to the development of the UK there is a strong argument that civil protection should be removed from the political arena or like the USA, be a separate department of government. The problem is that though the current proposals strengthen the local level, the contrast between the approach nationally and locally is marked. The opportunity to utilise central powers for other purposes exists. It could be argued that this mismatch of approaches to promoting resilience has been unduly influenced by the international terrorist agenda at the national level.

There are dangers associated with this. Local efforts have been built upon collaboration. Central efforts tend to a Command and Control model. There is a danger as Alexander (2003) points out that the ethos of civil protection could be undermined by centralism. This mix is dangerous with Command and Control likely to dominate particularly in times of crisis. But if structured properly it can offer benefits. Threats of all kinds will continue. King (2004) asserts that climate change is a greater threat than terrorism. There are many more threats such as genetically modified organisms, drugs, social dislocation, changing demographics, extremist movements, novel technologies, to mention a few, that in the longer term may undermine society. It is assumed that the horizon scanning capability existing in the Assessments Unit of the Civil Contingencies Secretariat has a broad remit that is not driven by short term political pressures and can take a long term view of such future threats. This would appear to be consistent with the government intentions on communicating risk, to be open, transparent and reliable.

Much of the UK government proposals for civil protection should lead to improvement. At the local level they codify much that is already happening but do add new duties which will drive response agencies to improve and introduce new ways of communicating with the wider public. Currently response agencies at all levels are exploring the utilisation of advances in communications technology, for example by text, picture and video using 3G mobile telephony and electronically via personal and portable computers. At the national level the fact that government has recognised that reform is needed is welcome. But it does seem that the approach, originally driven by recognition of the archaic nature of the underpinning legislation and the inability of government to direct the local level has assumed a lower priority due to the perceived need to counter the threat of international terrorism. Many of the national moves do clarify roles and responsibilities but do little to emphasise the importance of a holistic national resilience agenda.

So what is the future of UK civil protection?

At the local level the opportunity is provided for a more standards based approach with identified qualitative outcomes within a collaborative and co-operative regime, however, funding is likely to continue to be a contentious issue. There is a need for clearly identified, adequate resourcing to

deliver UK resilience. At the national level there is too great an emphasis on centralism. The incompatibility of this dual approach could well cause problems. Resilience in the face of international terrorism is an obvious current priority in the UK. But it is argued that wider considerations should not be subsumed by this single source of threat. UK resilience is a worthy ideal but unless it is woven through the policy fabric of government it is likely to be no more than a panacea unless it includes the wider agenda of vulnerabilities as cited in this paper. Government is using a variety of high profile exercises to demonstrate its commitment, for example the London Underground evacuation exercise of September 2003, but there is a danger that these could be no more than propaganda events as opposed to a real attempt to improve resilience.

McEntire, 2003, argues that we need a new paradigm for civil protection. He cites a range of approaches, each with merit and concludes by arguing that a comprehensive approach to emergency management is needed. Given the complexity of the hazards we are likely to face, driven by anthropogenic activities that are, and will continue to lead to a series of unintended consequences, then arguably civil protection should engage on a wider front. Perhaps we should no longer think of civil protection as being bound by the narrow definitions of what are considered emergencies and look to promote a broader agenda based on the range of problems faced by civil society.

However the reality is that emergency management at the local level will probably continue to be inadequately resourced and therefore unable to provide a service compatible with changing public expectations. Experience and expertise of emergency management at the local level will continue to develop over time as new threats emerge. The new duties mean that there is likely to be a more uniform and qualitatively audited approach. Nationally, the future structure of emergency management provision is much more difficult to predict.

Emergencies and civil protection are inextricably linked and it is likely that if no large event occurs in the UK, and hopefully it will not, then the wider paradigm of civil protection will become less of a priority. The new legislation will improve UK resilience in the face of emergencies of the type that have occurred in the recent past. However it is not clear whether this comprehensive regime can satisfactorily deal with the new dimension of threats in terms of scale and severity identified in this paper. Wider scale emergencies, like the recent Foot and Mouth crisis, have identified shortcomings at the regional and national levels. The national capabilities programme goes some way towards meeting those shortfalls especially in response to the perceived priority threat of international terrorism. This poses the following questions. Is the wider agenda being satisfactorily addressed? Is the present arrangement of locally based response a satisfactory paradigm for the range of threats that may be faced in the future? Is it now time to consider a different arrangement for UK civil protection and UK resilience, perhaps under the aegis of a national agency?

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SMELLING OF ROSES – DEVELOPING A MEDIA CRISIS PLAN THAT WORKS

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Keywords: risk communication, natural disasters, business continuity, media management, organisation and culture.

Abstract

While many organisations are constantly striving for greater coverage of their brands using public relations strategies, the coverage by the media can be disappointing. It is therefore ironic, that when a crisis erupts and the media comes knocking on their door, the first reaction can be 'No comment'! Every organisation has the potential to be scrutinised by the media and the public and should be prepared. A crisis media plan, as part of an organisations crisis management plan, will ensure that the agency will be able to positively build on the publicity that is generated by incidents that attract significant media interest.

This paper will examine the advantages of developing a crisis media plan, the issues involved in formulating a plan and its relationship to the crisis management plan. While this approach has been developed from experience in the emergency response environment, many of the strategies also have relevance to commercial companies.

Introduction

Public relations has been defined as "doing the right thing and getting recognised for it". However, as has been demonstrated by the unfavourable media coverage of organisations that have received widespread negative media coverage, not all publicity is good publicity. An area where this is especially true is in disaster management. A crisis could potentially damage reputations, involve the organisation in legal actions, create organisational turmoil, lose shareholders' confidence and slash market value, even if the operational side of the crisis is well handled. Throughout a crisis, community and media perceptions are often based on human emotion triggered by thoughts of risk, loss, drama and duplicity. The public does not care what turmoil the organisation is in – they want assurances that something is being done and that they are being protected.

If an organisation experiences a crisis and has a reputation for poor service, unsatisfactory industrial relations, high prices and a sinking share price, recovery from the crisis may be problematic. As the crisis unfolds, any of the affected groups will delight in attacking the organisation.

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While crises cannot always be avoided, with appropriate preparation they can be managed. An operational crisis, well handled, doesn't have to escalate to the point of becoming a public relations disaster.

Although Perrott (2001) indicates that 86 percent of major incidents were regarded as being foreseeable, many companies were not prepared to cope with a significant event. The most common reasons for management to ignore the warning signs were denial that a crisis can happen, belief in the current procedures and concerns for the effect disclosure may have on the reputation of the organisation. However, community or media attention does not have to arise from a negative incident. Media coverage of positive events can also overwhelm an organisation that is not prepared for the sudden onslaught of media attention and is not able to exploit the marketing or public relations opportunities.

Crisis Management Plan

Pollock (2002) defines a crisis as an escalating incident that poses a serious threat to the operation, viability or reputation of an organisation. The aim of the crisis management plan is to manage the resolution of the incident, the strategic issues and the implications affecting the organisation as a direct or indirect result of the initial disaster.

While many agencies have prepared business continuity plans, the media management component is often not addressed adequately. While the crisis management plan should indicate how the organisation plans to manage the public and media perception of the organisation, little attention has been devoted to the development of a comprehensive, integrated, ongoing plan that ensures that over time the agency is perceived as the authoritative voice during a crisis and emerges with an enhanced public profile.

Crisis Media Plan

What is a crisis media plan and why should an organisation develop and implement such a plan? One commonly quoted definition is that a problem becomes a crisis when it comes to the attention of the media! While it is trite to say that every crisis is an opportunity, a disaster does give an organisation access to boundless amounts of publicity that is normally very difficult to generate.

The aim of a crisis media plan is to inform the public about the incident, provide community safety actions, maintain public trust and confidence that the event is being managed effectively. It should also protect and promote the reputation of the organisation and its brands through effective public relations.

The objectives of the crisis media plan are to:

- Install confidence in the community that agencies are effectively working together in the response effort,
- Promote a positive understanding of the response, recovery and mitigation programs in place,
- Provide all target audiences with appropriate access to information about the disaster, and
- Maintain communication with those affected by the disaster.

If your organisation is not able to manage the media's demands effectively, other groups (or experts), who are quite willing to push their own interests at your expense, replace organisations that cannot respond quickly.

Benefits of a Crisis Media Plan

An effective crisis media plan will manage the information agenda through identification of the likely issues, assembly of the crisis team and development of a crisis plan, including the procedures and resources.

Perrott (2001) maintains that the benefits of developing a crisis media plan include a better understanding of the relationship between operational and communication issues, the identification of internal and external stakeholders and the development of proactive communication practices and related resources.

Good media management also means there will be sympathetic support for those affected and goodwill among the media by providing them with appropriate information and 'talent'. During a crisis, good internal communication will achieve increased staff morale and reduce negative rumours. Part of this process of achieving effective communication is to understand the expectations of the stakeholders. For instance, the media should not be regarded as the enemy, but as a significant stakeholder that can shape the perceptions of an organisation's performance during a crisis.

Contents of a Crisis Media Plan

An effective media plan should act as support plan for the operational crisis management and business continuity plans of the organisation. The policy should contain the objectives, strategies, tactics and resources necessary to implement the media plan, including details of:

- identification of various potential emergencies, the cost and consequences and the probable reaction of the media and principal stakeholders,
- clear safety messages that are easy for the public to act on as they cope with the incident,
- identification of specific audiences, including emergency workers, shareholders, political authorities, the media, the general public and affected residents,
- key corporate messages customised for different audiences,
- a media kit including media release templates for rapid customisation,
- the procedures and resources (staff and financing) for the implementation of a public info line,
- procedures to respond quickly to negative coverage (such as the placement of paid advertising),
- identification, authorisation and training of agency spokespersons,
- protocols for the management of a coordinated response from all participating stakeholders,
- policies for testing the media plan,
- procedures for the establishment, staffing and resourcing of a Media Information Centre,
- procedures for recruitment of professional media staff, including journalists, film crews, photographers and administrative support,
- development of IT and GIS systems to enable information to be quickly collated and published in formats that are immediately useful to the media and the organisation,
- access to the operational site and procedures for enforcing restrictions.

Understanding the Media Response

The changes in news technology and the demands of the public for instant and diverse stories have placed greater pressure on the media to present increasingly timely and varied information. Understanding these pressures, along with the typical phases of disaster reportage and trends in journalism, can help your organisation not only cope with media attention, but turn it to your advantage.

Media outlets - whether print, television, radio or Internet-based - are facing increasing pressure to get the story and get it fast! The days of each media outlet sending its own reporter into the field to thoroughly investigate and analyse an event are largely over. Instead, as competition for the finite "screen time" of news consumers grows and economic efficiency becomes more important, media outlets seek above all to be their audiences' one-stop shop for information. This makes the media

planner's job easier: as long as reporters obtain a steady diet of accurate, consistent news and analysis, they are unlikely to ask for more. Better yet, if the media planner is prepared to give each media outlet an individual grab, it will tend not to matter if these grabs have sameness to them. What is important is that your organisation is taking the time to meet the needs of each media outlet.

The media planner must also be familiar with trends in reportage that influence how the media will interact with an organisation in a crisis. Recent trends in the coverage of disasters indicate that:

- The media will seek comment elsewhere if you say "no comment".
- The media looks for the sensational or negative angles such as poor security or widespread panic.
- All stakeholders are influenced by the media coverage of the crisis, irrespective of the success of the operational response.
- People who want in-depth information are turning away from traditional news suppliers and using the Internet to access information from a variety of sources.
- The media will usually go with a story that has good visuals to accompany it.
- Journalists do not want to miss a story that other media are covering.
- The media will demand access to disaster sites and to key personnel.
- The media can overload operational communication systems.
- The media can cause major congestion at disaster sites.
- Victims are often disturbed by the concentrated media interest.
- Journalists tend to rely on officials or experts to make sense of the confusing amount of information.
- Journalists appreciate media conferences as places to interact and share information with each other, as well as to get 'the party line' from the organisation.
- The media won't go away until they have a story - whether you give them one or they find their own.

These same pressures to get the story in a timely way also mean that irrespective of the disaster, the media tends to operate in predictable stages:

- News of emergency. This phase is characterised by shock and a rush of activity. Media want to flock to the scene of the action, and sometimes become part of the rescue task themselves. During this stage, hard information is treated like gold!
- Causes of emergency. The media will look for simplistic explanations. They will often go to the easiest or loudest source of information, irrespective of whether that source of information is reliable.
- Stories of individual courage, either real or imagined, involving heroes and victims.
- Effect of the disaster. The media will be heavily influenced by the visual images, and may disregard larger effects that cannot easily be seen (such as damage to infrastructure).
- Safety warnings and their adequacy.
- Emergency response and its adequacy. In an information vacuum, the media may tend to report any uninformed comment they can find.
- The blame game. Find a person who feels they have been poorly treated and run their story on a current affair show. Politicians may become involved if they can see political advantage.
- The aftermath and recovery. The cost of the incident, recovery strategies and lessons learnt.

Familiarity with these pressures and trends can assist your organisation's media staff to anticipate future stories or information requirements and be prepared for requests. While the media will always decide what is news, your organisation can facilitate positive media coverage by providing the media with access to up-to-date information, a spokesperson and interesting stories.

Managing the Media during a Crisis

Obviously, it's not enough in a crisis to put out a media release or make a single statement and hope for the best. Media response must be coordinated to meet both the immediate, tactical demands of individual reporters' queries and the longer-term, strategic demands of minimising the harm to the organisation and drawing what benefits are possible out of the increased publicity.
One way that has proven to be highly effective in coordinating media response in a crisis has been the establishment of a Media Information Centre (MIC). Such a centre, which may need to operate on a 24-hour basis for at least the most intense phases of the crisis, provides a focus for media attention (minimising the chances that that focus will stray to areas you'd prefer to leave unexamined). It also provides a place to concentrate your organisation's media resources so that they communicate more effectively with each other and with management, have a clearer idea of both the overall media strategy and the day-to-day tactics of the operation's media aspects, and can more rapidly respond to any changes in the crisis situation.

Identifying and equipping the MIC is part of a comprehensive crisis media plan. A number of characteristics can contribute to its success:

1. In most cases, the MIC should be co-located with the operational centre. If there is a large-scale physical disaster, it should be located as close as to the incident as is practical and safe.
2. The MIC should be readily accessible by road with adequate parking (to allow the media access to the facility).
3. It should incorporate a large room that would be suitable as a site for media conferences. If possible, one end of the room should be on a slightly raised dais. This room will house all journalists and should have a TV, telephone lines and Internet access.
4. A large workstation area containing desks with PCs with Internet facilities should be in an adjoining or nearby room. This area will house the organisation's own media staff as well as the media staff from supporting and cooperating agencies. Depending on the degree of media interest in the crisis it may contain:
    - Mobile phone coverage,
    - Uninterruptible power supply,
    - Secure work areas, with access via identification tags (may require hiring security guards),
    - Breakout / meeting room,
    - A photocopy / work preparation area,
    - Nearby kitchen and toilet facilities,
    - A telephone switchboard,
    - Access to multiple fax distribution for disseminating media and public information,
    - Arrangements for the accreditation of external media visiting the facility,
    - Whiteboards and other recording material,
    - An incident/media inquiry/issues management logging system supported by appropriate media monitoring facilities,
    - Suitable resources such as PCs, fax machines, camera and video camera, with provision to directly upload to the organisation’s website and
    - Secretarial support.

Operation of the Media Information Centre

The critical media roles for the organisation during a major crisis will be to:

- Co-ordinate and manage all media and public safety communications.
- Provide the key spokespeople who will speak on behalf of the organisation. This may not be a media-relations professional, but could be someone with a firm grasp of operational concepts and procedures, and appropriate media training.
- Provide approval mechanisms for all public comment. It is important that the organisation has one referral point for all media enquires regarding the crisis and associated issues.
- Provide information on media coverage to all relevant stakeholders, including the board, shareholders, employees and sub-contractors.
- Develop and reach agreement with senior management on regular important messages and issues.
- Monitor media coverage of the event through a media-monitoring organisation and address all emerging issues.
- Gather intelligence from the field that is appropriate, timely and accurate.

Staffing the Media Response

Two critical roles in the Media Information Centre are that of the media manager and the spokesperson.

The media manager coordinates the communication response of the organisation and should be part of the senior management team, although not necessarily the spokesperson. The media manager will have the responsibility to ensure that both the tactical and strategic aspects of the media plan are identified and implemented.

To achieve effective communication while allowing the senior management team to deal with the crisis, a number of spokespeople may be used. The spokesperson may vary according to the seriousness of the situation; however, the senior spokesperson will normally be the CEO or a member of the senior crisis management team. Spokespeople will be briefed before each media conference and represent the organisation to the public.

Additional media staff that may be required include:

- Forward media staff. While it may appear obvious that the organisation should have access to all the relevant information about the crisis, this is not always the case. One of the critical roles for forward media staff is to track down and confirm the primary information sources.
- Professional journalists. It may be necessary to support your media staff with paid journalists. Depending on the situation, photographers and camera crew may also be useful in recording the incident. Additional staff need to be identified and briefed beforehand.
- IT and GIS staff may be needed to collate and publish appropriate data or information.

Interviews

The interview gives the organisation the opportunity to put their views across to the public, rather than answer questions asked by the media. Staff should prepare for the interview by developing a few core messages and repeat them by linking part of the question to the response. Staff should only be authorised to conduct interviews if they have had training and are familiar with the media policy.

Helpful advice includes:

- Stay objective and 'on the record' in interviews.
- Avoid saying 'no comment' as it makes you look deceitful.
- Never make a personal attack on another organisation or person.
- If possible, conduct the interview on site.
- Avoid repeating negative statements in your answers.
- Ensure you have access to current operational information, statistics and interesting anecdotes.
- Develop essential messages and stick to them.
- Show empathy with those affected by the incident.
- When dealing with the media be professional, honest and reliable.

Media Releases

A list of possible topics for media releases should be identified, including the response to the disaster, what has been done to prevent recurrence, plans for reconstruction, thanking the community and other organisations for their help, and giving support for employees. The media love unusual angles, good visuals and quantitative information. Templates can be developed that will cut down on the preparation time needed to write releases during an emergency. You should include quotes from the spokesperson and have your releases checked and authorised. While media releases are still faxed to media outlets, they can also be e-mailed directly to journalists, posted on your web site or sent via a commercial distribution organisation.

Intelligence Gathering

Surprisingly, few crisis management plans examine the need for the collection of ongoing detailed intelligence that the media require. If the agency is not able to supply the data, other stakeholders will fill the void with rumour, emotion and incorrect information.

The collection of timely, relevant and accurate intelligence and background information is one of the most difficult aspects of media management and needs to receive more attention. For the organisation to be perceived as the authoritative organisation during a crisis, there needs a system of information gathering designed to quickly present information to decision makers.

Use a forward media team to get the details of what happened at the disaster site. Using a commercial media monitoring organisation, monitor the media coverage to be able to react promptly and conduct a debrief to determine what worked and what needs to be revised.

Media Conferences

A media conference can establish an organisation as the authority in the area, especially when you can provide experts. McLean (2003) identified the major issues when organising a press (media) conference as: keep the statement brief, provide a copy of your statement, express sympathy first, do not lie, do not apportion blame.

The organisation needs to project an authoritative image with a credible message, so it will be the first contact for media during a crisis. A media conference is also an opportunity to market your organisation by the use of logos and inclusion of organisation information in the media kits.

The Recovery Phase

During the recovery phase the organisation should focus on the long-term clean up and getting the organisation or environment back to normal. The response and recovery phases will often overlap, although the recovery phase may last considerably longer.

Throughout this phase, the media interest is considerably diminished as the events have been exhaustively covered and the dramatic stories dry up. The mood of the news media may become more antagonistic, depending upon their perceptions of how well the emergency was managed, the community and political opinions, and the reactions to recovery efforts. Management of the media at this stage will require the active education of media representatives about the scope of the operation that is now contemplated and the detailed planning work that is underway.

Exercises

The operation and roles of the MIC need to be developed and tested well before a significant event occurs. Preparation, training and exercising the plan will allow the organisation to implement it smoothly. Realistic role-playing and simulation exercises will give you the opportunity to test your plan and the confidence to face the difficult issues.

Ideally, the plans will be tested in conjunction with the exercising of business continuity plans. Exercises can vary from a live-simulation exercise, simulated role-play, desktop exercise, specific contingency exercises or test preparedness of specific functions such as the Media Information Centre.

To provide the necessary pressure to make a realistic exercise, it is important that participants experience the demands that the media generate during a major event. A creditable media presence will be able to put the right questions and reflect the constant but varying pressures experienced in a major crisis through media conferences, interviews, doorstops and the constant telephone barrage to your media staff.

Regular exercises and workshops with all relevant stakeholders will be required to ensure that key personnel know what their role is, know who they will be working with and where they will be working from. Training sessions will ensure that all staff are familiar with the procedures for media coverage and reinforce the commitment of the organisation to the media plan.

Making Your Plan Community-Based

One of the keys to how well the media reports how the overall is handled is the ability of the organisation to work with the affected stakeholders or communities. Critical to this phase is a community-based communications strategy that emphasises supportive and united actions. This strategy seeks to take the event off the front pages of the metropolitan media, and to provide the locally affected communities with more direct, factual, everyday information, using regional media, who will be more interested in the long-term effects of the incident.
Community-based communications strategy should be largely prepared beforehand and would ideally:

- allow the organisation to provide no-nonsense, factual information to affected communities. It should never aim to build false hope for a speedy recovery when it is plain that a lengthy recovery phase will be required and
- allow the organisation the time to talk publicly about the successes of the operations during the crisis. There will be a need to acknowledge the valuable assistance of other organisations and the local community in the response phase.

At a tactical level, activities should be developed that highlight the organisation's response and reinforce their core messages. These activities would build on the authority of the organisation and

ensure that the media contact them if they want a comprehensive coverage of the event. Activities may include:

- With the active support of stakeholders such as councils, stress the importance of local communications, via newsletters, letterbox drops, community bulletin boards, community health centres and libraries.
- Set up community reference groups in each local government area, to provide direct feedback to stakeholders. Community reference groups, organised and chaired through the organisation and comprised of representatives of local government, key government agencies, key community, social and sporting groups, would have a charter to advise the organisation during the recovery phase.
- Provide realistic estimates on the time required to effect full physical recovery from the crisis.
- Communicate directly to the public using the organisation's website and related links to other stakeholder's websites. Information can be included on the response and recovery from the incident, using stories, graphs, photos, maps, interviews and videos.
- If you have established an info line, make sure that the operators have the latest information about the recovery activities.
- Seek strategic alliances with regional or trade media that often have a particular interest in the incident.
- Actively manage critical issues in the metropolitan, national and international media without encouraging ongoing high-profile coverage of the ongoing, devastating impacts that the event has had on the community.
- Provide for opportunities for community celebrations, thank yous and anniversary events.
- If possible, coordinating the media and public communications activities across other agencies.

Conclusion

As recent diasters have demonstrated, it is more important then ever to plan your response to a significant event to take advantage of public relations opportunities. New technology means that a journalist can film an event, edit the story and report directly from the incident site. The public is also becoming more sophisticated in their analysis of the news and more demanding of public and private institutions. These changes in the way stories are produced and disseminated, means that there are more opportunities for the organisation to manage the media response. However, with a well-tested crisis media plan, you will not only be more prepared to respond to media and community concerns, but be able to use the situation to positively promote your organisation.

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Author Biography

Peter O'Neill has served as the Marketing and Communication Manager with the NSW State Emergency Service since 1999. A former principal, he also has a Grad Cert in HR, a Grad Dip in Educ Admin, and a Masters in Emergency Management. Currently he is responsible for managing the marketing, public relations, media and community safety functions at State Headquarters, and supporting SES volunteers in community safety programs. Before his appointment to the SES, he was employed as a Regional Manager with the Cancer Council. His first major operation with the SES was the 1999 Sydney hailstorm, which occurred just a few weeks after he started in the position and resulted in

22,000 jobs completed in four weeks. The national and international media coverage resulted in over three million dollars of equivalent advertising coverage for the SES.

His research interests include behavioural change theory for emergency communication and the community safety aspects of vulnerable communities. He recently won the state Australian EMA Safer Community Award for his work in community flood safety.

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SLACK IS SAFE!?
ON THE IMPORTANCE OF ORGANISATIONAL REDUNDANCY FOR ACCIDENT PREVENTION

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Keywords: Organisational redundancy, accident prevention, organizational slack, structural and cultural preconditions, redundancy-for-robustness

Abstract
Accident prevention in organisations is often fixed on structure, technology, rules, procedures, and top-down management with focus on implementation rather than process. This may be satisfactory in stable hierarchies with sufficient resources, but may be inadequate under trying conditions where organisations are tightly coupled, and interactively complex. As organizational systems and technologies become more complex, efficiency demands involving a decrease in organizational resources that facilitate monitoring, learning and adapting, may involve an increase in accident risk (Lawson, 2001).

This paper examines the relationship between slack or organisational redundancy and accident prevention. Is it possible that the effective development of some forms of redundancy, here labelled as redundancy-for-robustness, can enhance the possibility of preventing undesired events and obstruct the development of accidents? By redundancy-for-robustness we mean *"Social interaction patterns that by providing slack enables an organisation to operate more reliably in the face of uncertainty"*. Redundancy-for-robustness can be created when individuals ask for advice, others opinion or challenge the judgement of colleagues. In the concept of redundancy-for-robustness lies a flexibility and ability to mobilize alternative resources in functions or systems important for accident prevention. Downsizing processes and decreased staffing levels might threaten redundancy-for-robustness, and thus lead to new and unforeseen risks.

Results from studies in an offshore drilling company and a regional electricity distributor will be reported, exploring employees' perception of redundancy-for-robustness. The two studies included both qualitative and quantitative methods. Preliminary results show that redundancy- for-robustness requires the existence of certain structural and cultural preconditions. Among these, the need for individuals with overlapping competence, and a structure where these individuals are able to monitor each other. It is also important that there exists a culture within the organisation that encourages such activities.

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1. Introduction

This paper focuses on the relationship between organisational redundancy and accident prevention, or the pull between efficiency and reliability. Today, change processes are often initiated to achieve cost reductions or increased efficiency. Organizations are expected to perform more and better work with fewer people. In addition, the technological development involves implementation of more complex equipment and technology. This may have severe consequences for accident prevention in organizations. Several serious accidents over the last years have been caused by time-related matters; pressure for increased production, lack of maintenance, shortcuts in training and safety activities, or overstressed people and systems (Lawson, 2001).

To study the influence of redundancy-for-robustness on accident prevention, empirical studies have been carried out within Norwegian petroleum industry and electricity distribution. By redundancy-for-robustness we mean *"Social interaction patterns that by providing slack enables an organisation to operate more reliably in the face of uncertainty"*. Both petroleum production offshore and distribution of hydro-electrical power are characterized as high-risk activities involving complex interactions between humans, technology, and organization. This setting offers a dual need for both efficiency and reliability, where redundancy-for-robustness may be seen as a vital component in preventing accidents with severe consequences.

2. Theory

Preventing accidents and assessing risks require time-consuming activities such as experiential learning, trial-and-error under controlled conditions, consequence analyses, information processing, and reflection/ dialogue. To foster such activities, organisational redundancy or slack is essential. These two concepts are consistent and refer to resources in an organisation that are in excess of the minimum necessary to produce a given level of organisational output (Birkinshaw and Lingblad, 2001). Where slack refers to the existence and function of such excess resources, redundancy theory gives additional descriptions of mechanism for managing slack.

High Reliability Organizations Theory (HRO) (LaPorte and Consolini, 1991) claim that reliable performance is achieved by building redundancy into constructions and other structures, into machines and equipment, or into operational systems and manning. Redundancy built into social systems can have two forms. First, redundancy may foster more consistent operation through duplication of systems, resources and skills. Second, productive redundancy can create an organisation that is more resilient under uncertain conditions (e.g. tightly coupled and interactively complex internal and /or external environment). Although connected, these two forms of redundancy hold different qualities. Redundancy-for-consistency involves duplicated or overlapping parts that are more or less identical in their specialised role. If one fails, the other can correct or replace it. Redundancy-for-robustness on the other hand involves duplicate and overlapping units that perform a number of tasks and functions. When needed employees can move between units and use their knowledge to solve work task in different parts of the system. "This design method is much more adaptable to changing environmental conditions and is more reliable when individual components fail. When changes in the environment require the organization to perform new functions, it has the ability to alter either its overall operation or some aspects of it to meet the new demands" (Streeter 1992, p.100). This gives an organisation an internal flexibility when dealing with uncertainty as diverse units pursue the same ends but with different means (Birkinshaw and Lingbald, 2001).

Redundancy-for-robustness can be viewed as connected to the concept organisational redundancy[2] applied within safety literature (LaPorte and Consolini, 1991; Rosness et al., 2001). Organisational redundancy is defined by Rosness et al. (2001) as "*Co-operation patterns that allow the organisation as a whole to perform more reliably than each individual"*. Organisational redundancy can be achieved when persons with overlapping competence have the opportunity to monitor and intervene in each other's performance. Robustness can be enhanced when individuals ask for advice, others opinion or challenge the judgement of colleagues.

It is thought that this form of redundancy has a latent function, as it will take place when uncertainty arises and be eliminated when the uncertainty has been resolved. Although the sporadic nature of the activity, we argue that effective redundancy-for-robustness requires the existence of certain structural and cultural preconditions. LaPorte and Consolini (1991) define organisational redundancy (e.g. redundancy-for-robustness) as overlapping competence in both a structural and cultural manner. The structural dimension includes possibility of direct observation, overlapping competence, tasks or responsibility. The cultural dimension includes capability and willingness to exchange information, provide feedback, and reconsider decisions made by one self and colleagues.

The structural dimension of redundancy-for-robustness concerns personnel's possibility of direct observation of each other's work. By the structural dimension we mean issues like workforce manning, possibilities for planning and experience transfer in work operations, possibilities for colleague overlap and feedback and sufficient time. We find our understanding of the structural dimension of redundancy-for-robustness as similar to what Streeter (1993) has labelled as auxiliary services. Streeter exemplifies this form of redundancy by referring to the use of quality circles. A quality circle establishes a cooperative pattern where employees are involved in operation of many parts of the system and meet to evaluate products or services. In this type of process employees can evaluate their work, solve problems and plan new performance.

The cultural dimension of redundancy-for-robustness concerns the capability and willingness to exchange information, provide feedback, reconsider decisions and intervene to discover erroneous actions (Rosness et al. 2001). By the cultural dimension we mean issues like desire to share diverse experiences and knowledge, possibilities to influence decisions that affect safety and quality, feedback from managers and colleagues and level of trust. This implies that for effective redundancy-for-robustness employees should interact in ways that promote the sharing of diverse perspectives and experience. Westrum (1993) has indicated that to the degree an organisation has capabilities towards a generative type, it will affect employee's abilities to interact. A generative organisation is one where information is searched for, messengers are trained, responsibility shared, "bridge-building" awarded, and new ideas welcomed. The result of a generative culture may be employees that are more aware and inquisitive of new information. The existence of such a culture depends on a requisite level of trust between its members (Schulman, 1993). Although the cultural preconditions outlined above are important factors in setting the stage for effective redundancy-for-robustness, a requisite interaction pattern is not sufficient to solve the variety of situations that may occur in a complex system. A diversity of operator perspectives and experience, which matches the complexity of the technical system, is an important part of the redundancy concept (Rosness et al., 2001; Weick, 1987).

[2] Although the organisational abilities ascribed to the concept of redundancy-for-robustness may be important for safety, it is not consistent with the wider content of the redundancy concept found in theory (see for example Landau, 1969; Lerner; 1986; Streeter, 1992 and Birkinshaw and Lingbald, 2001). We therefore suggest a refinement as shown in our theory section, where organizational redundancy is consistent with the concept redundancy-for-robustness.

We propose that to what extent an organisation has developed these structural and cultural preconditions for redundancy-for-robustness will affect its defence against organisational accidents. Rosness et al. (2001) suggest that the effect of the two dimensions on the risk level is likely to be multiplicative rather then additive. We agree with this. Redundancy-
for-robustness will not be effective if only the structural preconditions are present, or vice versa. Both a possibility for interaction, and a willingness to assess new information in the face of uncertainty are essential for effective redundancy-for-robustness.

3. Methods

Empirical studies were carried out in an offshore drilling company and a regional electricity distributor, exploring employees' perception of redundancy-for-robustness. The objective of study 1 was to get a qualitative understanding of the concept of redundancy-for-robustness. The objective of study 2 was to develop and test a measurement tool for redundancy-for-robustness.

Study 1 in the offshore drilling company included 22 semi-structured interviews, participant and non-participant observation, informal discussions, and document analysis. The data collection took place in a period of four months in 2003. Informants were drilling personnel (works manager, tool pusher, driller, derrick man, roughneck, roustabout, crane operator, electrician, mechanist) covering 6 different offshore crews at an offshore gas production platform.

Study 2 in the regional electricity distributor included an Internet based survey and informal discussions. The data collection took place during a period of two months in 2003. The sample population was all employees in the company. The response rate was 52% (n=149). The distributed questionnaire was based on earlier fieldwork, and has been used by the Norwegian Petroleum Directorate for safety climate surveys in the petroleum industry.

4. Results

Results will be presented according to the two different empirical studies.

4.1 A qualitative understanding of redundancy-for-robustness (study 1)

At the time of the data collection for study 1, the current gas production platform had excellent safety records, including their drilling activity. The drilling company had not had any loss time injuries for the last two years. The platform was often used as an example of succession for other offshore installations regarding their practical safety focus and activities. Several of these activities were related to structural and cultural preconditions for redundancy-for-robustness.

The structural dimension:

The drilling company had established several arenas and mechanisms for communication, feedback, planning, and experience transfer in work operations. Table 1 shows these structural mechanisms.

Table 1. Structural safety mechanisms

Structural safety mechanisms	Participants	Interaction-type
Offshore departure sessions	Drilling crew members	One-on-many
Safety meetings	Drilling crew members	One-on-many
Handover sessions	Off/ ongoing drilling shifts	One-on-many
Safe Job Analysis	Work operation group	Group-based
Toolbox meetings	Work operation group	Group-based
Open Safety Conversation	Tool pusher + crew member	One-on-one

Each of the mechanisms in table 1 has qualities that meet different aspects of the structural dimension of redundancy-for-robustness. Offshore departure sessions gather the entire drilling crew at the heliport before going offshore. The aim is to discuss upcoming work operations, performed work tasks since last offshore period, specific safety issues, etc. Safety meetings gather the entire drilling crew offshore once every second week with the aim of discussing safety issues. Handover sessions are overlap discussions between ongoing and off going crews. Safe job analyses and toolbox meetings are activities for planning and experience transfer related to upcoming work operations. Open safety conversations are arenas for informal discussions related to safety issues in ongoing work operations.

To establish the structural arenas or mechanisms for communication, feedback and planning does not in itself assure redundancy-for-robustness. The drilling company had to work continuously with the quality in performing the mechanisms. For example in a toolbox meeting, we identified problems with unclear communication and handover of the drilling program after the meeting had started. Issues like active listening and participation, clarity in speech, authority, and summing up were identified as important for the quality of the safety mechanisms.

In addition to the quality of structural mechanisms, a tradeoff between redundancy-for-robustness, workforce manning and time pressure was pinpointed by several of the informants:

> "In the driller position, there has always been a dilemma regarding planning and experience transfer in work operations. Particularly in the drilling periods, it has been a tradition to hand the drilling program over to us with an expectation of getting started without briefing. The focus is on completing the drilling program without problems and according to plan. In this business time is money. In periods with well overhauls this is better" (driller).
>
> "My possibilities for planning and experience transfer in work operations are satisfactorily. Nowadays we take our time. It is us who decides, and we are now participating in the discussion. This means that we are more appreciated than before. Earlier, the tool pusher just told us what to do" (roughneck).
>
> "There is only one derrick man on the crew, in addition to the assistant derrick man. Since we are the only ones in this position, we become a 'corn in the system'. If any of us drops out of work, we have to make readjustments and get new crew members sent offshore" (derrick man).

The cultural dimension:
When describing factors that were most important for their own safety, all informants referred to cultural aspects such as care, openness, trust, team spirit or fellowship, and desire to share knowledge.

"There is a positive will to share with one another! And this runs throughout the company. We must be willing to learn away our secrets because we are dependent on each other. If we were working in an individualistic manner, we would work ourselves to death" (derrick man).

"At this crew the willingness to share knowledge and experiences is excellent. Generally, it varies from crew to crew and from person to person. I have noticed this especially since I am new and not on a fixed working schedule. At other crews, some persons are strenuous to ask" (roustabout).

"We have to work as a team. Poor working environment influences safety. If work is strenuous and there are collaborative problems, it affects our well-being, which again affects the safety level" (roustabout).

"Team spirit means a lot. I want to take my colleague with me home without any injuries. As a crane operator you have a very good overview of work operations, you can observe, see different situations, let people know, and give them feedback. For instance to make colleagues aware of always having their "back free" in different lifting operations" (crane operator).

In addition to these general cultural aspects, the drilling crews had developed informal mechanisms that were collectively practiced without being specified in any written descriptions or procedures:

- Time-out or "take two"
  This practice allows crew members to "take two minutes" whenever they feel insecure, stressed or in lack of an overview of the work operations. The practice is supported and communicated by all crewmembers from tool pusher to roustabout. The "take two" practice requires crewmembers with confidence and persistency.

  "We are being told all the time that we need to take our time. We have to think things through, plan our work operations and get feedback from others. I feel no pressure, my focus is on working safe and well" (derrick man).

  "Earlier, I felt time pressure and stress in my work, but now I am more relaxed. My attitude is that I speak out if I feel the pressure. If anybody makes a fuss about something, I say that 'it will happen when it happens'" (crane operator).

  Hawk's eye
  This practice requires a crewmember to function as a "hawk's eye" in certain work operation. A hawk's eye has radio contact with all employees involved in the work operation, and her main task is to observe and follow the work operation closely without taking active an part in the operation.

  "I was hawk's eye in a crane operation. We had performed safe job analysis and worked through the procedures before going into the top drive. There were lots of straps and lots of people. Together with the crane operator, we observed that the crane pulled much harder than expected. The wire was about to pull apart, and a person was hit by a wire splint without any serious damages. The burden on the crane was 8 tons, and could have caused a catastrophe" (roustabout).

- Comrade's check

  This practice requires that crewmembers using a man rider belt are double checked by one of their colleagues with regards to the equipment (belt and bolts) before climbing the top drive. The comrade's check is now a regular routine related to all work operations including a man rider belt. The history behind the practice involves a serious accident:

  > "Two years ago I was going up in the man rider belt, but had not fixed the bolts properly. I fell four meters and landed on my knees and elbows. They were crushed. I've had numerous operations, and was absent for a long period. I still lack some vigor in my elbows, but am happy to be back at work. After the accident, we started the comrade's check practice" (roustabout)

4.2 Measuring redundancy-for-robustness (study 2)

Study 2 is an exploratory study of employee's perception of redundancy-for-robustness that focuses on the correlation between theoretical concepts. From the results (Appendix A), three

Table 2. Indexes, indicators and Alpha values

Indexes and indicators	Alpha
Perception of redundancy-for-robustness	0,73
- Statements:	
My colleagues stop me if I work unsafely	
I stop working if I find it dangerous for me or others to continue	
I report dangerous situations	
I ask my colleagues to stop work if I consider it risky	
Perception of cultural preconditions	0,84
- Statements:	
My leader appreciates me pointing out conditions that are important for safety	
My leader is engaged in safety work	
I can influence safety conditions on my workplace	
My colleagues are very concerned about safety issues	
I always know to whom I should report matters	
I seldom discuss safety issues with my work leader	
My company takes health and safety seriously	
Suggestions from safety deputies are taken seriously by leadership	
I find it uncomfortable pointing out safety rule violations	
A person can easily be considered quarrelsome if he or she points out dangerous conditions	
Perception of structural preconditions	0,73
- Statements:	
I have the necessary competence to perform my work safely	
Accident information is used effectively to prevent repetition	
Staffing in sufficient to attend to safety issues in a good way	
Communication between me and my colleges often fail such as dangerous situations may arise	
My lacking knowledge of new technology can sometimes result in increased accident risk	
My opinion is that the company has a to high safety focus.	
I am sometimes forced to work in a way that threatens safe practice.	
Accident or incident reports are often glossed over	
Because of reorganisation I am not working as safe as before	
In practice production is considered to be more important than safety	
Insufficient cooperation between different companies often lead to dangerous situations in my work	

indexes that express the perception of redundancy-for-robustness, perception of cultural preconditions for redundancy-for-robustness and perception of structural preconditions for redundancy-for-robustness were constructed (Table 2). Our index construction is based on a theoretical interpretation of the concepts, and the qualitative data presented above. Table 2 shows a high *Cronbach´s Alpha* (above 0,70) for each of the three indexes.

Table 3 shows the correlations between indexes. We found statistically significant correlations ($p < 0,01$) between "Perception of cultural preconditions" and "Perception of redundancy-for-robustness", and between "Perception of structural preconditions" and "Perception of redundancy-for-robustness". This means that the more positive employees perception is of cultural and structural preconditions the better they score on the index "Perception of redundancy-for-robustness".

Table 3. Correlation matrix of indexes

		Redundancy-for-robustness	Cultural preconditions	Structural preconditions
Redundancy-for-robustness	Pearson correlation			
	Sig. (2-tailed)			
	N			
Cultural preconditions	Pearson correlation	,518(**)		
	Sig. (2-tailed)	,000		
	N	142		
Structural preconditions	Pearson correlation	,377(**)	,685(**)	
	Sig. (2-tailed)	,000	,000	
	N	142	138	

** Correlation significant at 0,01 (2-tailed).

5. Discussion

Results from study 1 document the existence of a series of structural and cultural mechanisms that may contribute, directly or indirectly, to the safety level at the gas production installation. This is consistent with what Rosness et al (2001) found in their study of an offshore petroleum production platform, indicating that operators and maintenance personnel had established extensive organisational redundancy. Study 1 also confirms the relation between structural and cultural preconditions for redundancy-for-robustness, indicating that the quality of structural safety mechanisms depends heavily on the existence of several cultural aspects.

The results from study 2 show a significant statistical correlation between employee's perception of cultural and structural preconditions and their perception of redundancy-for-robustness. Our results therefore support the connections indicated in theory. We also found correlation between the perception of cultural preconditions and the perception of structural preconditions. This supports the relation between the two dimensions found in study 1.

Methodologically it is worth taking into account that our index construction is based on statements (Appendix A) that all correlate statistically. Index constructions will therefore generally result in a high Alpha value. The reliability of the index construction in this study is therefore based on our interpretations of the theoretical concepts. It is important to point out that a high Alpha value is a requirement for use of indexes, theoretically based or not. Despite of this, the correlations between indexes and theoretical concepts are not unreasonable. Most of the statements illustrate aspects

described in theory, and were therefore considered adequate for investigating the perception of redundancy-for-robustness.

As indicated in the theory section, redundancy-for-robustness can be a vital part of organisations defence against accidents. The role of redundancy as both a proactive safety measure and an emergency management tool is not illustrated by our results. We only indicate employee's perceptions of the theoretical concepts, and have not yet performed any incident analyses or other cause/effect relation studies.

5.1 Future research needs

We suggest that the theoretical framework outlined in this paper needs further elaboration, both regarding the relationship between redundancy and risk, and the consistency of the redundancy concept with earlier research[3]. Concerning the relation between redundancy-for-robustness and risk we propose further studies of the connection between different accident causation models (Turner and Pidgeon, 1997 and Reason, 1997), and the effect of redundancy-for-robustness as a risk reducing or emergency management tool. In addition, there is a need to clarify, possibly extend, and test the factors included in the structural and cultural dimensions. Our studies form a basis for design and empirical testing of a questionnaire that can be used in a wide range of organisations. In combining this work with qualitative research, such as anthropological studies or accident analyses, our aim is to highlight the risk reducing properties of redundancy. This will help organisations develop risk-reducing capabilities and create indicators for preconditions that may be threatened when organisations initiate staff reductions or downsizing processes.

5.2 Conclusion

We have outlined a possible theoretical conceptualisation of the risk reducing properties of redundancy in social systems. By distinguishing between redundancy-for-consistency and redundancy-for-robustness we achieve a further refinement, and thereby a clarification of the concept. We believe that redundancy-for-robustness is vital for the safety and emergency management in complex and tightly coupled systems. Results from our studies suggest that redundancy-for-robustness requires the existence of certain structural and cultural preconditions. Among these, the need for individuals with overlapping competence, and a structure where these individuals are able to monitor each other. It is also important that cultural mechanisms within the organisation encourage such activities. Among these, trust, team spirit, and a will to share knowledge.

The implications of this work for emergency management are significant. Both the causal chain leading to an accident or its consequences are seldom routine. We therefore believe that an essential part of organisations emergency management capabilities lies in its capability to handle uncertainty. For this redundancy-for-robustness is essential.

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Appendix A

Table A.1, Percentage of assorted values, means and standard deviations for ”negative” statements

(1=Do not agree at all, 5=Totally agree)

	Do not agree at all (=1)	Partly disagree	Either agree or disagree	Partly agree	Totally agree (=5)	Mean	Standard deviation
Communication between me and my colleges often fail such as dangerous situations may arise	57,70	24,80	12,10	4,70	0,70	1,66	0,91
My lacking knowledge of new technology can sometimes result in increased accident risk	49,00	21,50	13,40	13,40	2,70	1,99	1,19
I seldom discuss safety issues with my work leader	45,60	18,80	20,10	8,10	6,70	2,11	1,26
I sometimes break safety rules to get the job done quickly	43,00	24,80	13,40	14,10	4,70	2,13	1,37
My opinion is that the company has a to high safety focus.	49,70	15,40	16,10	9,40	9,40	2,13	1,37
I am sometimes forced to work in a way that threatens safe practice.	45,60	18,10	12,10	19,50	4,00	2,18	1,30
Accident or incident reports are often glossed over	25,50	15,40	41,60	12,80	4,70	2,56	1,14
Sometimes I keep on working even if I am tired	25,50	23,50	17,40	26,20	7,40	2,66	1,31
My workplace is often untidy	21,50	26,20	23,50	21,50	6,70	2,66	1,23
Because of reorganisation I am not working as safe as before	30,20	11,40	30,90	12,10	13,40	2,66	1,39
In practice production is considered to be more important than safety	24,20	18,10	30,20	19,50	8,10	2,69	1,26
Insufficient cooperation between different companies often lead to dangerous situations in my work	20,10	18,80	36,90	19,50	4,70	2,70	1,14
I find it uncomfortable pointing out safety rule violations	22,80	20,10	23,50	20,80	12,80	2,81	1,34
A person can easily be considered quarrelsome if he or she points out dangerous conditions	17,40	26,20	25,50	18,80	12,10	2,82	1,27
Insufficient maintenance has resulted in poorer safety	14,10	14,10	28,20	26,80	16,80	3,18	1,27

Table A.2, Percentage of assorted values, means and standard deviations for ”positive” statements

(1=Totally agree, 5=Do not agree al all)

	Totally agree (=1)	Partly agree	Either agree or disagree	Partly disagree	Do not agree at all (=5)	Mean	Standard deviation
I stop working if I find it dangerous for me or others to continue	67,10	21,50	10,10	1,30	0,00	1,46	0,73
A work place with good health and safety conditions means a lot to me	67,10	20,80	8,70	0,70	2,00	1,49	0,85
Safety has first priority when performing my job	57,70	30,90	9,40	1,30	0,70	1,56	0,77
I have easy access to necessary personal protective equipment	65,80	16,80	12,10	2,00	3,40	1,60	1,01
I use mandatory personal protective equipment	49,00	36,90	12,80	1,30	0,00	1,66	0,75
I report dangerous situations	55,00	26,80	15,40	2,00	0,70	1,66	0,86
I have the necessary competence to perform my work safely	51,70	34,90	8,10	1,30	4,00	1,71	0,97
I have received sufficient safety training	51,70	30,20	14,10	3,40	0,70	1,71	0,88
My company takes health and safety seriously	49,70	32,90	10,70	4,00	2,00	1,75	0,95
I ask my colleges to stop work which I consider risky	44,30	30,20	22,80	2,00	0,70	1,85	0,89
Dangerous work operations are always thoroughly reviewed before they are started	45,00	30,90	16,10	5,40	2,70	1,90	1,03
My leader appreciates that I point out conditions that are important for safety	42,30	22,10	30,20	4,00	1,30	2,00	1,01
My leader is engaged in safety work	37,60	27,50	28,90	4,70	1,30	2,05	0,99
I can influence safety conditions on my workplace	39,60	26,80	22,10	5,40	5,40	2,09	1,15
I am stopped by my colleges if I work unsafely	32,20	34,40	25,50	4,00	2,70	2,10	1,00
Suggestions from safety deputies are taken seriously by leadership	32,90	20,10	36,90	4,70	3,40	2,24	1,08
My colleges are very concerned about safety issues	20,10	40,90	32,90	4,00	2,00	2,27	0,90
Accident information is used effectively to prevent repetition	24,20	37,60	24,80	8,70	3,40	2,29	1,04
The safety deputies do a good job	14,10	37,60	38,90	4,00	5,40	2,49	0,97
I always now whom in the organisation I should report to	28,20	29,50	14,80	20,10	7,40	2,49	1,29
Staffing in sufficient to attend to safety issues in a good way	20,80	23,50	20,10	26,20	9,40	2,80	1,29
It is easy for me to find demands and procedures important for my work	10,10	36,20	27,50	14,10	12,10	2,82	1,17

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TRAINING AN OFFSHORE EMERGENCY PREPAREDNESS ORGANIZATION ON LAND, A CASE STUDY

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Keywords: emergency preparedness training onshore, offshore, communication

Abstract
The emergency preparedness organization of one of the Norwegian offshore oil and gas installations was carried out in the autumn of 2003. A large-scale training exercise onshore was created at one of the most known emergency preparedness training centers in Scandinavia. This paper presents an evaluation of this specific onshore exercise, including lessons learnt and recommendations. A discussion on advantages and disadvantages of the large-scale onshore training compared with the weekly offshore (on the installation) training is also presented, with focus on the way the team leaders elaborate strategies for limitation of hazards and consequences during stressful emergency situations.

The large-scale exercise has been planned to include different hazards and events on several sites of the training facility during the same simulation, in order to keep high uncertainty levels and maintain the surprise moment intact. Some of the simulations have revealed problems in the way information about the events, hazards and actions has been issued and propagated, causing misunderstanding of the real situation from the emergency preparedness management's part and therefore, resulting in wrong strategies and actions for hazard limitation. The consequences of these misunderstandings could be fatal during similar real events on the installation.

Introduction
The members of the emergency preparedness (EP) organization on one of the largest installations in the North Sea (called in this paper Installation H), carries out several types of training exercises and courses, both offshore and onshore. These are personalized for each emergency preparedness function and are prepared by both operational leaders and safety officers on Installation H and by the external professional trainers of major training centers in Norway as well as in other countries. Every second year, a large-scale training exercise is organized onshore, as a measure planed for better preparedness on the installation. This large-scale training exercise is set in addition to the weekly emergency preparedness training exercises hold offshore.

While the weekly training sessions offshore are exercises that sometimes involve only few of the emergency preparedness teams, the large-scale training exercises onshore include all emergency preparedness teams, and they simulate some of the hazards and events that are hard to practice on a hot platform, such as gas explosions and hydrocarbon fires.

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The evaluation of the emergency preparedness training included two processes. The first one, documented in this paper, is based on the observations on the site, formal and informal interviews as well as the evaluation of the documentation set for the training for the days of the training sessions. The second one consisted in a survey that included 97,5% of the participants to the training session, and it will be documented later, in another document, as soon as the data are statistically processed.

This paper documents the observations made during the emergency preparedness large-scale training session for Installation H at one of the most known EP training centers in Denmark, on the 17th and 18th September and 7th and 8th of October 2003.

Since the number of the Installation H's employees who have emergency preparedness responsibilities is high (based on the three shifts for normal operations), the emergency preparedness training at the training center (called in this paper TC) in Denmark has been planned to be carried out on two different sessions: on the 17th and 18th of September and on the 7th and 8th of October, each of them including about half of the Installation H's emergency preparedness organization.

Both EP training sessions were planned similarly: the first day of the training was set mostly for theoretical and practical exercises for the specific emergency preparedness teams, while the second training day included three large-scale simulations that included all the emergency preparedness teams. The large-scale exercises have been planned by the Survival's trainers to cover different hazards and events on several sites of the training facility during the same simulation, in order to keep high uncertainty levels and maintain the surprise moment intact. Actors were hired in for the simulations and wore make-up and other effects, in order to create a more realistic picture of the situations and possible injuries during real events.

This paper presents shortly the background for the training sessions, including a short description of the TC in Denmark, the method for analysis and data collection as well as the structure of the training sessions. The discussion in this paper focuses on the day two of the sessions, since the simulations organized during this day included all the emergency preparedness teams and revealed some of the non-conformities from the installation H's requirements for action times and assumed pre-set reactions from the team members. The exercises revealed communication problems that caused misunderstanding of the real situations. This misunderstanding was created mostly between the emergency preparedness teams' leaders and the management team's members, resulting in some cases in wrong strategy formulations and actions for hazard limitation. The consequences of these misunderstandings could be fatal during similar real events on the installation.

A discussion on advantages and disadvantages of the large-scale onshore training compared with the weekly offshore (on the installation) training is also presented, with focus on the way the team leaders elaborate strategies for limitation of hazards and consequences during stressful emergency situations.

Abbreviations

DSHA	defined scenario for hazards and accidents
EP	emergency preparedness
EPO	emergency preparedness organization
EPT	emergency preparedness team
EPM	emergency preparedness management
FFT	fire fighting team
GA	general alarm system
HES	health, environment and safety
NPD	Norwegian Petroleum Directorate
OIM	offshore installation manager
OSC	on scene commander
PA	personnel alert system
TC	training center (in Denmark)
SO	safety officer

Background

The TC chosen for the large-scale simulation is an international fire, rescue and training center, which offers standard and special courses within fire and rescue ashore, at sea and in the air. The center employs highly qualified personnel with experience within various areas, including fire fighting, sea rescue, first aid, and psychology and working management.

The TC has specially-designed buildings, modules and other facilities that are used during the simulations. The smoke, heat or noise (sirens, screams, etc) provided by the TC created a sense of realism during the training exercises. Training for combat of high-pressure gas fires is one of TC's specialties.

The training of Installation H's EPO has been planned by the TC's instructors to include all the EPTs and most of the major DSHAs for the installation. Day one of the training was prepared for theoretical (first part of the day) and practical exercises (mostly after lunch) for the specific emergency preparedness teams. Each of these teams (with specific functions within EPO) has been therefore trained for the day two, for the large-scale simulations, by the TC's qualified trainers. The practical exercises were organized and supervised by the TC's trainers and post-training feedback was given to the participants. A site visit of the training center's facilities was also given to the EPTs, for a better understanding of the modules used in the next day's large-scale simulations.

Day two of the training session included three large-scales simulations that involved the whole EPO:

1. Fire in one of the modules (M20), over several floors, where people were trapped and injured (heavily burned).
2. Explosion with subsequent fire in the living quarter (M10 and M12). Several people were injured and some of them in a state of shock. Chemicals and several gas bottles (of unknown contents) were placed in the area.
3. Explosion with subsequent process fires, spread over the process module area, a large fire by a pressurized gas tank, subsequent fires, spread over the nearby module. People were injured by the explosion (in the process area) as well as the fires (in the near-by module).

Preparations for the large-scale training

The TC's trainers have visited Installation H and have been acquainted with the EP plans, procedures and measures defined for the organization. This for better understanding of the requirements set by the oil and gas firm's and Installation H's management, as well as the organizational culture on the installation (during normal operations as well as under training).

A designated room with respective telephones, boarding tables and radios, where EPM could muster, was established previous training. The TC's instructors tried to reproduce the EP center on Installation H. The GA and PA were also established in the room, as it is on Installation H. Several actors were hired in to act as they should have been injured employees on installation H, due to the hazardous events.

Installation H- Training offshore

Training on Installation H is planned by the SOs in collaboration with the area leaders for the modules and DSHAs planned to train on. Every week a drill is organized onboard. Every second week a general alarm is activated and people without EP functions muster in the lifeboats, while the EPO trains on specific hazards and events planned for the respective week. The other weeks are used for the so-called 'dry' training, organized mostly for the EPM.

Method and data collection

The evaluation of the large scale training exercise has been based on observation on the site during the EP exercises and simulations, on formal and informal interviews, as well as an audit of the requirements set by the oil and gas firm that Installation H is a part of for the emergency preparedness training (offshore as well as onshore) and installation H's own requirements to its EPO and EP training.

The oil and gas firm in case owns several onshore and offshore installations (including installation H) in Norway, as well as in other countries. The offshore installations are of different sizes and types, and the firm has established a set of procedures, rules and regulations for all of these, not only for emergency preparedness issues, but also for normal operations. The firm's HES and quality management system includes guidelines for the organization and planning of the EP. Some of the procedures, requirements and rules for EP are set on a general basis; other ones are tailored for the specific installation. In the case of Installation H, the requirements set for the training sessions, the quality and quantity of the training exercises, etc, is described in one of the firm's procedures, while the actual plan for the training and the content of the exercises organized for the Installation H's EPO is set by the 'local' procedures (tailor on the installation and part of the local HES and quality management system).

Given the existing procedures for organizing EP training, the first part of the evaluation of the large-scale training session was based on the conformities and non-conformities to the requirements set on both firm's level and on the local level. The times that different EPTs used for mustering, communication to the EPTs' management (or to the EPM), for the decision making and action was carefully monitored and compared with the requirements set by the procedures and EP analysis and EP plans.

The evaluation of the training exercises has been also based on formal and informal interviews, pre-training, after each of the exercises during the first day of the training sessions, after each of the large-scale simulations as well as post training, after several months. The people interviewed represented different age groups and functions (both during normal operations and EP functions). At least two members of each of the EPTs were interviewed during the training sessions, and at least one several months after. All the members of the EPM were interviewed informal during the training sessions.

Discussion

The management regulations (NPD, 2001a), that apply for all oil and gas companies operating on the Norwegian sector of the North Sea, require that EP measures should be defined and presented in the EP analysis for the respective installation. The common understanding for the EP is in itself a

concept related to the actions that are to be initiated after an accident, by the EP management and the EPO on the installations. The actions, as well as other measures for EP are dimensioned primarily as a function of the possible consequences for a particular set of hazards. The mix of independent operational, organizational and technical measures are set in order to keep the hazards at an acceptable level of control.

Within Installation H's EPO, some of the measures and procedures set for the DSHAs are well understood and followed as defined in the EP analysis and plan for the installation, while some other DSHAs are not as well understood, and therefore, wrong decisions and acts result due to these. Both sessions (the one in September as well as the one in October 2003) uncovered the need for better understanding of the EP procedures, as well as the reasons for their existence as they are.

Organizational flaws that affected the EPO's performance during the large-scale training
During the first session, organized on the 17th and 18th of September, defined as Session A, the information on the location of the modules in relation with the geographical points, was not comprehended as it should been by either the EP teams in the area and the EP management in the control room. The lack of information on the drawings (geographical points) created misunderstandings during the first exercise of the day 2 and was signalized during the feed-back meeting at the end of the exercise. The drawings over the facility's area were improved by October's session, and the participants of the Session B were better informed over the location of the modules.

This issue affected negatively the reaction and mustering times for the EPTs. On Installation H, smoke and the blockings one some of the escape ways due to accidents might create some confusion for some of the employees with normal operations responsibilities, but it should not represent any problem at all for the personnel with EP functions.

Since the TC is not equipped with as many radios as Installation H is, during the large-scale exercises, the use of the radios, as well as the channels was faulty. There was a lack of information on the use of channels from the TC's instructors in the beginning of the simulations, as well as from the EPM that decided to shift over different channels during the emergencies. The information on the change of the channels did not reach to all the radio holders. These facts created misunderstanding both during Session A and B. Some of the EPT' leaders required help during the simulations, without being heard by either the EPM or other EPT' leaders.

Another issue can be related to the room prepared by the TC for the EPM. All the members of the EPM had mustered in the same room, the team responsible with communication included. On the installation the communication between the installation and external EP actors is provided in different rooms, one situated in the living quarters, the other in one of the utility modules. Only when the mustering in the designated EP room on Installation H is not possible, the EPM musters in the radio room. Since the communication and the EPM mustered in the same room at the TC's facilities, unnecessary high levels of noise in the room were observed. The noise created some frustration for the people present, and the simulation of the communication between the EPM and the radio operator was therefore not simulated and trained on as it should.

The large-scale sessions showed that the communication between the members of the same EPT was for most of the time as it should, but the communication between the EPTs' leaders and OSC and between OSC and EPM did not function as it is planned. Some of the misunderstandings could be explained by the lack of familiarity with the geographical placement of and designated names for the modules at the training facility, as well as with the lack of communication equipment (radios) and channels. However, at the end of some exercises, the differences between the number of the injured on-site, during the simulated DSHAs and the number on the boards in the EPM room

showed that faults in communication cannot explained only by the shortage in radios and channels, or 'territorial' local knowledge.

The following list presents the events that uncovered the lack in communication.

1. Some of the EPT leaders took some 'short-cuts', forgetting to whom they should report the hazards and events and their development. These 'forgot' to inform OSC and informed directly the EPM. The OSC has informed on the situation by the EPM, while the EP plans for communication flow are set the other way around.
2. The change in use of channels was not comprehended by all the users during the exercises, and this fact was not uncovered during the combat and rescue operations. In one of the exercises, the nurse has been requiring the requisition of a helicopter for the injured personnel in the hospital without being heard of anybody else, and also several minutes after the training session ended.
3. The possible existence of chemicals in the area was not flagged out during the early exercises.
4. Information on the correct number of the persons found/missing during the search and rescue work the status and on injured persons was delayed unnecessary on several occasions. This affected the mustering time for both the nurse and the stretchers to the accident site. The time between the information was sent to the appearance of the first aid team was too long compared with the set time requirements in some of the simulations.

Beck states that 'where everything has become controllable by the product of human efforts, the age of excuses is over' (Beck, 1997). Most of the issues in the previous list were pointed out only during the feedback meetings at the end of each exercise, by the trainers at the TC, as well as different members of the emergency preparedness teams. However, the long-term effects of the feedback, as well as the experience from the training in itself are disputable. Except for the observer, nobody has taken written notes on the 'lessons learnt'. Informal interviews several months after the training sessions uncovered that the personnel's evaluations of the personal experiences from the training onshore were mostly connected to the social activities post training, and not so much on the 'lessons learnt' and 'how should we improve ourselves' issues.

Perrow affirms that "the frightening is that we don't know; events that are out of control. Great events have small beginnings" (Perrow, 1984). The time limitations set for the emergency preparedness are based on experience, on previous drills on the installation, as well as the authorities' requirements. The concerned on the unconformity to the pre-set time requirements for the mustering was not flagged out by either the TC's instructors, or by the members of the EPM. Considering the fact that the location of the modules at the TC is different compared to the one on Installation H, this issue (unconformity to the time requirements) can be disputable. Is it any point at all to train onshore at all? Why should one consider the time requirements at all as definite while there is no resemblance at all between the modules of the training facilities and the ones on the offshore installations?

Recommendations - Installation H's EPO

Some of the recommendations are directed to the EPM and SOs responsible with the planning of large-scale training sessions, the others are directed to the members of the EPO.

1. Training within communication is essential. It is assumed that all personnel involved in the EPO are familiar with their functions during an emergency, and that they have been trained on the specific area of responsibility. During Session B, one of the exercises uncovered that the OSC decided to overlook the reports from the search and rescue team leader on the possibility of several fires in the module, as well as possible existence of chemicals in different areas of the module, and issued a strategy based on the initiating DSHA. It is recommended that a program of informal evaluation of the reaction of each of the members with line responsibility

should be considered to be implemented, in order to be sure that everybody has understood the communicational lines during emergencies as well as the need for collaboration in establishing strategies for combat. This recommendation applies especially to those that are in the combat areas during an emergency, such as team leaders and OSC.

2. Some of the strategies formed during the simulations, especially the ones on the fire fighting in the process area, showed a lack in the understanding of the real hazards on the site. Some of this can be explained by the unfamiliarity with the process area as it is at the TC. It is uncertain if the understanding of the hazards during a real situation on Installation H is as good as it should. It is therefore recommended to re-evaluate some of the EP exercises that the EPO members carry out offshore, in order to find out if EPTs' members are trained on strategies for combat fires in the areas where the potential of build-up of hazards and risks exists.

3. Training in dealing with chemicals should be integrated in a higher degree during large-scale EP simulations. This is not only the actual handling of the chemicals, but also for the strategy formulation based on the collaboration processes between different EPTs and EPM during complex events. Dealing with chemical spills is from before a delicate issue, combining this with fires in the areas and wrong strategies for combat could result in a considerable increase in the number of injured people, also members of EPTs.

4. Some of the exercises uncovered the lack of involvement from some of the alarm and search and rescue team's members in the basis first aid activities, such as controlling the pulse and cooling down the injured found in different areas or taking initiative for alerting the respective EPT's leader or OSC on other hazardous events in the area.
   - During the Session A's first exercise, one of the first found person injured was heavily burnt, with his eyes closed and silent. Nobody took any action at all to establish if that person is breathing or not, neither tried to chill down the areas burnt in any way. It took over 5 minutes before someone signalized the need for the nurse, 7 minutes before someone actually checked out the condition of the injured and 15 minutes before the nurse and the first aid team came.
   - The same lack of involvement was showed also by one of the fire fighting teams during the second exercise of Session B. The team members, including the leader, have observed that a fire on the second level in one of the modules was not been extinguished, as it was reported by the search and reaction team. The last team 'forgot' to search all the floors of the modules, and assumed that everything was ok after searching only the first floor of the module, where the initial fire was indeed extinguished.

"The risk of a major accident occurring on the Norwegian shelf is rising. The development in the number of undesirable incidents linked to gas leaks, kicks and damage to load-bearing structures provides the major cause for concern" (NPD, 2002). Explosions followed by fires that can treat the installations' structural integrity. Some explosions in process or drilling areas might cause the impairment of the passive, fixed fire fighting systems. The subsequent fires can be so large that the fire fighting crews on the installation cannot control the situation. The effect of such fire could be similar to the ones after the Piper Alpha accident in 1988, where 167 people died. The lack of good strategies for management and planning of emergency preparedness situations has been on of the explanations of the high number of deaths and injured (Cullen, 1990 and Paté-Cornell, 1993).

The lack of involvement presented over cannot be explained by the lack of specifications for actions or inaction for each of the DSHAs in the existing EP procedures ('no unnecessary risks should be taken') or by bad management from the team leaders' part. It is recommended that further training on the way the hazards are signalized will focused on the issue of involvement. EPTs' members should take a more active part in the evaluation of the situations, the redundancy in

the decision-making should be made an active process and the need to flag out the hazards in different areas should not be only a matter of line responsibility, but also a matter of common sense.

Recommendations – for trainers and management at the TC

Since this document might be presented also to some of the TC's trainers, it is chosen to include here some of the recommendations that could contribute to a better planning and enhance the quality and safety of future large-scale simulations.

The following recommendations include recommendations for both the first and the second day of the sessions and are mentioned in order to minimize the repetition of the lacks flagged out at the TC and influence the TC's internal improvement process. Some of the recommendations are directed to the management of TC, supposedly responsible with the quality control and management of the TC's facilities, and the others to the TC's instructors.

1. The number of the participants during the first day of Session A was not known by the TC's instructors previously, due to a misunderstanding between Installation H's SOs, the organization that actually booked the training session and the TC. This created frustration from the TC's instructors' part. For example, the number of the members of the search and rescue team to participate to the training exercises and simulations during Session A was assumed to be around fifteen and was over twenty. It is therefore recommended that future training is planned more carefully and in direct collaboration between TC's instructors and Installation H's SOs, without the involvement of intermediary organizations or firms that could cause misunderstandings.

2. Facing gas fires is difficult, not only because of the size of the blaze the fire fighting teams have to contend, but also because of the communications difficulties, due to the noise that can be up to 120 decibels (caused by the escaping gas through leaks). And it was therefore chosen that the fire fighting team would train on these types of fires at a special gas terminal located one hour drive from the TC's facilities. An internal misunderstanding within TC's organization caused a lack of instructors present at the gas fire-fighting terminal when some of the FFT's members arrived. This caused frustration and a considerable time delay. Finally, one of the instructors showed up, but this only to demonstrate how a gas fire looks like. No exercises have been carried out by the people present at the terminal, due to the lack of time. This issue influenced negatively the way the members of the FFT perceived the training on the gas field. Some of the comments at the end of the day sounded like: 'we did not come to the TC in Denmark to hear how powerful gas fires are and how much noise they create; we came here to do things'.

Better planning of the training of larger groups should be a part of TC's contingency plan. It is recommended that misunderstandings like the ones presented will be minimized as much as possible in the future. However, both of these issues were not only solved by October, but the new plans were better than the original ones (the ones on Session A). During Session B, the organization of the training within fire fighting on the gas terminal training facility included several exercises where the fire fighting team had the opportunity to combat and put out gas fires and the whole arrangement was impeccable.

3. The number of portable radios has been under-dimensioned compared with the equipment on the installation. This fact, combined with the misunderstanding caused by the use of channels, has created frustration from some of the course's participants. It is therefore recommended to obtain more relevant equipment for the future training sessions.

4. During day 1 of Session A, while demonstrating methanol fires to the search and rescue members, the observer (the author of this paper) walked around very near to the demonstration area (only few meters) without any kind of protection gear, except the helmet, in order to evaluate the reaction from the TC's instructors. None of the three trainers present to the demonstration reacted to this action. The issue was discussed the day after, and the explanation was given by the fact that the TC's safety procedures do not include the requirement of fire-resistant clothing for the visitors, only the use of helmet is mandatory. It is recommended that the procedures are reviewed, in order to include the requirement to use fire-resistant clothing also for visitors during the inspections while fires are simulated in the area.

5. During Session A, the weather was nice and warm. Since the fire fighting gear and the smoke diving masks are also warm, and the exercises require a lot of physical effort, water or other liquids should be provided closer to the area were the training is carried out. This applies both the area set for the smoke diving and the gas terminal training facility. Some of the members of the fire fighting team complained on the lack of liquids in the vicinity, especially during the smoke diving drills. Some beverage and food was indeed provided in the breaks between the exercises, in given areas, but the breaks were organized hours between each other. It is recommended that water and other beverage is provided in a higher degree than before.

Recommendations to TC's trainers

During day 1 of Session A, during the exercise set for use of smoke diving equipment, one of the participants entered a room full of smoke without having opened the valve for air on his equipment. Due to the heat, smoke and lack of oxygen he came out of the module after some minutes without his helmet and mask on grasping after air. Though he and the team members are responsible to check own equipment during an emergency on the installation, it is considered that the employees' well being at the TC's facilities is also the responsibility of the instructors. It is impediment that safety issues are not only mentioned theoretically, but also checked out during the exercises.

A similar event occurred during the large-scale simulation number 1 of Session 2, when one of the people involved in fire fighting in M10 came out of the module almost collapsing. The lack of air was explained firstly by the closed valve possible due to the person's movement and the rather large fire-fighting outfit. The main reason was found out to be the lack of the oxygen in the bottle. It is disputable if this lack is because of the unplanned long duration of the fire fighting session (maybe the time that took to control the fire was longer than expected due to spreading to other areas) or because of the ineffective control of the air bottle's pressure previous exercise.

1. It is recommended therefore to establish procedures that control more efficient the bottles' capacity during the exercises that are longer than planned.

During day 2 of Session B, simulation 3, one of the trainers has forgotten to remove the can used to ignite some of the fires. This can, full with burning liquid, has tipped over, due to strong wind. Members of the fire fighting team that were involved in extinguishing high-pressure fires in the process area were not aware of the uncontrolled fire just behind them, caused by the spill from the can, since they concentrate on the fires in the front of them. Due to the observers in the area, the 'unplanned' fire was quickly extinguished and nobody was injured. However, the trainers should carry out several safety checks in the future, in order to eliminate the risk that the course participants are injured.

2. It is recommended that the procedure for controlling and monitoring during the training exercises be revised, in order to minimize the hazard of accidents during simulations.

Conclusions

Modern risk awareness is not about one's own experiences or the current statistical risk picture of deaths and injuries, but about an uncertain future. Fear and anxiety of these threats are a great challenge for risk management even though the probabilities for such events may be microscopic (Hovden, 2003). Training can prepare offshore installations for all dimensioning accidents and the EP organization and its management for the decision making process during stress. In case the combat of an event or the efforts to delimit the hazards are unfruitful, the organization is prepared to evacuate to other installations, on vessels in the area, or, in the worst case, to the sea, using the survival boats.

Training at the Danish TC showed that while most of the emergency preparedness plans and procedures are dimensioned to the risks, the way the EPO is not usually as planned, due to the personal differences and experience that some of the EPTs' members have. Wrong decisions and strategies could be issued during stressful situations, but the main reason is obviously the poor communication or the wrong input. Defining what the priority list consists during a hazardous situation at a certain development time is more or less based on the considerations that on-scene-commander takes, mostly based on given information from the other employees.

Knowing the installation and its contents within the modules (here the focus is particularly on chemicals) at each given time, does not require only a continuously update, but also, in some cases, redundancy. The information that the area responsible has at the time of the hazard can be not different with the real picture that some other operational teams might have (for example maintenance personnel).

Lupton (1999) affirms that it has been found that people are likely to be concerned about the risks that are close to them, that risks that are seen as rare but memorable tend to be overestimated while those that are considered common and less serious are underestimated. Risks that are perceived as familiar or voluntary are considered more acceptable and less likely to happen than those that are perceived to be new or imposed. The large-scale simulations showed the need for an emergency preparedness based on understanding the risks and hazards on the installation, as well as on a systematic evaluation of these, for establishing the right strategies for combat of fires and explosions, as well as for a structured communication between the teams' members, their team leaders, the on-scene-commander and the EPM.

Most of the large-scale simulations have shown that some of the communications issues do not work as they should and that the strategy-making processes are lack full. The command lines are sometimes understood too strictly, and the lack of initiative could create not only misunderstandings locally, but also a wrong picture of the real situation in the EP centre. The EPM bases its decisions not only on correct assessment of the situations, the structured flow of information, but also in an constant evaluation of what is feasible and what is not, based on the feedback and collaboration on the formation of a strategy for combat from the EPT's leaders.

It is hard to affirm that the value of the training onshore is more valuable than the ones offshore. Moreover, one could never assess the training onshore in the same way it is assessed offshore. The evaluation process uncovered the social aspect of training onshore. There is seldom possible to organize social arrangements that include so many of the Installation H's employees. The after-training activities contributed to team building and knowing ones' colleagues better, and this result in strong personal bounds between people.

The trust in the EPO's members' performance during catastrophes and the sentiment of fellowship are actually the most important factors that will keep people alive during accidents. The EP training onshore shows that some organizational factors were not in place, but the training uncovered the

existing trust between the EPTs' members. Some of the people have never met before, due to the normal operations shifts, but the strong bound between these was once more cemented by the training session, by the large scale simulations. Therefore, one could affirm that the large-scale simulations and other onshore exercise are not valuable only from an EP perspective, but also from an organizational, cultural and social one. It is recommended that all EPO for offshore installations should periodically organize this type of training exercises.

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THE CONSTRUCTION OF CHINA EMERGENCY SYSTEMS AGAINST MAJOR INDUSTRIAL ACCIDENTS

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Abstract
In order to reduce accident damage, China government has taken a great deal of measures to improve its ability for major industrial accident prevention and emergency management. China has witnessed a series of regulations and rules such as Work Safety Regulations of the People's Republic of China issued and executed for work safety and major industrial accident emergency responses, in which the construction emergency system responsibilities of the governments of different levels were clearly defined. In addition, this law also defined in detail construction emergency systems responsibilities of the different enterprises and communities.

In this paper, we introduce the basic emergency measures for major industrial accidents and its future developments. The basic situations of work safety in China are analyzed in section 2, the construction of emergency system for major industrial accidents is presented in section 3, and the main regulations for emergency system construction are introduced in section 4. The current research status of emergency systems in China is introduced in section 5. The future developments of emergency system against major industrial accidents are discussed in section 6.

Introduction
With acceleration of economy development in China, various emergencies due to natural, technological and human factors rise up one by one. Accidents of such kind often cause serious deaths and injuries and huge property losses, and become serious threats to living quality of residents and safety of people's lives and properties. Breakout of severe acute respiratory syndrome (SARS) in 2003 is an example. Therefore, Governments of every level and all enterprises in China should take all possible and feasible measures to improve their capabilities in responding to various possible emergencies and strengthen their emergency response abilities to assure public security [1].

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