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

IMPLEMENTING A COMMUNITY RISK MANAGEMENT PROGRAMME IN THE PACIFIC

Alan Mearns[1] & Roger Jones[2]
South Pacific Applied Geoscience Commission (SOPAC)

Keywords: Pacific, South Pacific, community risk, public safety risk management, advocacy

Abstract

Earlier disaster management activities in the Pacific had followed the traditional approach in focussing primarily on natural and man-made ***hazards*** and on developing capacity for preparedness and response to ***events***. This was the approach of early internationally-sponsored programmes, which assisted many island countries in developing national and local disaster management plans and supported the establishment of National Disaster Management Offices (NDMOs) as key agencies. However, these activities gained only limited support from national governments and levels of community vulnerability have not decreased significantly.

In 2000, responsibility for such activities was accepted by the South Pacific Applied Geoscience Commission (SOPAC), a member of the Council of Regional Organisations of the Pacific. SOPAC's small Disaster Management Unit (DMU) developed a new approach based on risk management concepts and principles. An early initiative of the DMU was the commissioning of a community risk management tool based on the recently-adopted Australian/New Zealand risk management standard, AS/NZS 4360 (CHARM, 'Comprehensive Hazard And Risk Management').

Trials and initial application of this tool rapidly demonstrated that disaster management programmes needed to be integrated with a wide range of national policies encompassing issues in the areas of sustainable development, sustainable living, poverty alleviation and environmental management. New approaches were needed.

In early 2003, the importance of SOPAC's community risk management activities was recognised by the establishment of the Community Risk Programme as one of the three key SOPAC programmes, with the goal of reducing community vulnerability and improving disaster management through hazard mitigation and disaster management activities. The Programme's three key component elements address Strengthening Resilience to Disasters, Mitigating the Effects of Hazards and Mainstreaming Risk Management.

[1] Manager, Community Risk Programme
SOPAC South Pacific Applied Geoscience Commission
Private Mail Bag, GPO, Suva, Pacific Islands
Tel: +679 338 1377 Fax: +679 337 0040

[2] Member, SOPAC High Level Advocacy Team and
Director, TEM Consultants Pty. Ltd.
PO Box 142
Mount Macedon, Victoria 3441, Australia
Tel: +613 5426 1496 Fax: +613 5426 1496

The paper briefly outlines the history of the Programme before detailing the concepts, principles and methodologies employed in ensuring a comprehensive and integrated approach to community risk management.

Introduction

In recognition of the regional need to reduce the impact of disasters and in the interests of promoting sustainable development, the Pacific Forum at its meeting held at Madang in Papua New Guinea in 1995 adopted the following regional vision statement:

> 'Vulnerability to the effects of natural hazards, environmental damage and other threats will be overcome.'

The vulnerability to natural hazards of Small Island Developing States, such as those in the Pacific, is well documented, and their capacity to reduce that vulnerability is affected by a number of factors including political will, policy coordination problems, a relatively small public sector capability and a limited resource base. In addition, the 'tools' available to such states to assist them in reducing that vulnerability have largely been the outcomes of studies undertaken in the 1980s and 1990s under the auspices of such regional agencies as the Asian Development Bank and the Pacific Islands Development Programme, with their emphasis on structural disaster mitigation and non-structural disaster preparedness programmes (e.g., ADB 1991; Carter 1984)

As a result, disaster reduction activities in the Pacific have generally followed the traditional approach in focussing primarily on natural ***hazards*** and on developing capacity for preparedness and response to ***events***. This was the approach of early internationally-sponsored disaster management programmes, which assisted many of these states in developing national legislation and national and local disaster management plans, and supported the establishment of National Disaster Management Offices (NDMOs) as key agencies.

However, these activities have generally gained only limited support from national governments and donor organisations, while the agencies themselves have often been under-resourced and unable to secure inter-agency support. While a report on regional activities during the International Decade for Natural Disaster Reduction 1990-2000 (SPDRP 2000) was suggesting that 'In all respects, there has been a significant and purposeful shift from disaster response, relief and rehabilitation – that is, the post-disaster phase – towards planning, mitigation and disaster reduction in the pre-disaster phase', the same report was highlighting heightened vulnerability to natural disasters in many Pacific Island countries. There have been many instances both during and after the IDNDR decade in which existing disaster management arrangements and plans have proved to be inadequate, to have been ineffectively applied or to have simply been ignored in government and community responses to disaster events.

In consequence, levels of community vulnerability in many countries of the region have not decreased significantly. Clearly, a new approach has been needed if the vision of the Pacific Forum is to be achieved.

A New Approach – Initial Steps

In 1998, responsibility for regional disaster management activities was accepted on behalf of the Pacific Forum by the South Pacific Applied Geoscience Commission (SOPAC), and this responsibility was effectively transferred to SOPAC from other regional agencies in 2000.

The choice of SOPAC as the 'home' for this function was a quite logical one. It was established in 1972 as a UN Development Programme Regional Project for the assessment of deep-sea minerals and hydrocarbon potential in the Pacific. It is now an intergovernmental, regional organisation with a membership of 16 island states and territories (plus Australia and New Zealand) dedicated to

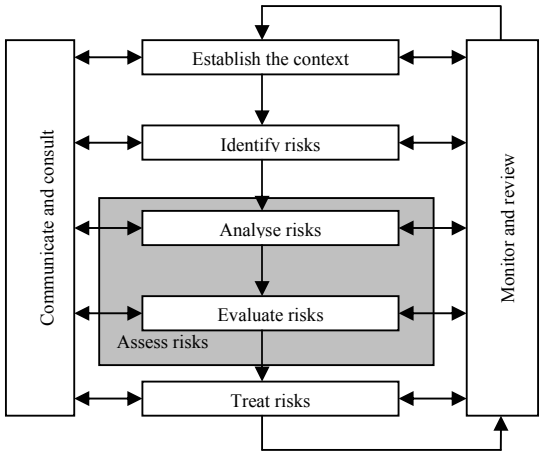
providing geological services to promote sustainable development in the region. It is a member of the Council of Regional Organisations of the Pacific (CROP), and in recent years its mandate has been extended to coastal protection and management, water, sanitation and energy.

As a result of a study commissioned by SOPAC (SOPAC, 2000), a small Disaster Management Unit (DMU) was established within SOPAC in the same year. The SOPAC study identified a need to replace the conventional disaster management model, with its focus on response and recovery, by 'a more holistic approach, wherein the processes of hazard identification and mitigation, community preparedness, integrated response effort, and recovery are planned for and undertaken contiguously within a risk management context' (emphasis added).

The 'risk management context' referred to derived from work which had been undertaken in Australia, at the request of the then National Emergency Management Committee, to adapt a recently-adopted national risk management standard (Australian/New Zealand Standard AS/NZS 4360:1995 – Risk Management) to emergency and disaster management requirements. Auspiced by the national emergency management agency (Emergency Management Australia), this work resulted in the publication of an 'Emergency Risk Management – Applications Guide' (EMA, 2000) based on the risk management processes prescribed in AS/NZS 4360. A similar approach had been taken by the government of the Australian state of Queensland in its publication 'Disaster Risk Management' (QDES, 1999), and both approaches informed the SOPAC study.

At Figure 1 is an overview of the basic risk management process prescribed in AS/NZS 4360:

Figure 1: The Basic Risk Management Process (from AS/NZS 4360:1999)



As a result of this study, SOPAC's DMU undertook the development of a draft disaster management manual based on the risk management approach. The draft was trialled in inter-agency workshops in Kiribati, Vanuatu and Tonga arranged by National Disaster Management Offices and facilitated by the DMU, and subsequently published as 'Regional Comprehensive Hazard and Risk Management (CHARM) – Guidelines for Pacific Island Countries' (SOPAC, 2002a). CHARM has now been endorsed by a number of national governments in the region, and is progressively being adopted and applied in the remainder with workshops and other assistance being provided by SOPAC.

In February 2001, in a parallel development, a regional workshop was held in Fiji to develop a strategy to give effect to a recommendation in the SOPAC study that the DMU should undertake advocacy functions to promote the benefits of risk management within national development

strategies. Subsequent in-country CHARM workshops have contained an advocacy element involving high-level briefings and discussions with ministers and senior officials.

Early Problems

Regular reviews of in-country CHARM and advocacy activities in 2001-2002 identified a number of problems in the attempted implementation of the new approach.

Using the respective National Disaster Management Offices (NDMOs) in arranging in-country CHARM workshops and monitoring post-workshop activity was proving less than satisfactory. The effectiveness of many of the NDMOs in this role tended to be limited by their lack of political salience, inter-agency contact and resources. Allocation to an inappropriate ministerial portfolio, inadequate and junior-level staffing or prior ineffective performance were often contributing factors in this lack of effectiveness, resulting in the Offices often being excluded from the mainstream decision-making process and working in isolation (the 'silo' phenomenon, not unknown elsewhere in respect of specialist disaster management agencies). It had become apparent that continuing with this 'bottom-up' in-country approach to introducing new practices and processes, and hoping to influence senior decision-makers through an advocacy function using the same arrangements, would not achieve the desired programme outcomes.

In addition, experience with the new CHARM risk management process model was demonstrating some inadequacies in the model itself. The standard on which the model had been based was designed primarily for use by single organisations in managing risks specific to those organisations (the 'context'); in adapting the basic AS/NZS 4360 risk management process model, the full implications of the multi-organisational, multiple-risk 'context' of the disaster management task, and in particular the resultant needs for high-level political direction and for extensive inter-agency consultation and coordination, appeared not to have been properly recognised. Further, there proved to be a difficulty with the risk treatments promoted in CHARM, in its emphasis on the two-decade-old 'prevention/mitigation, preparedness, response, recovery (PPRR)' essentially-linear paradigm as the primary treatment. This tended to de-emphasise the importance of the standard's risk treatment options of 'risk avoidance', 'reducing likelihood', 'reducing consequence', 'risk transfer' and 'risk retention' (the latter involving planning and preparedness for treating residual risk), and seemed to some to imply a claim for ownership of the risk management process by disaster managers. It was becoming evident that while disaster management specialists needed to have input into all steps in the public safety risk management process, their primary responsibility lay in the area of 'risk retention' treatments – planning and preparedness for the management of those residual risks which were not amenable to full treatment through the other options.

However, these two problems – the first concerned primarily with delivery mechanisms for the DMU programme, the second concerned with a perceived fault in the programme's process model – fed into but were rapidly overtaken by a more fundamental problem: that of the broader relationship between the DMU programme and other regional and national programmes.

The origin of the DMU organisation and programme lay in the original 2000 SOPAC project study entitled 'Risk Management, Institutional Strengthening & Capacity Building', whose primary goal was stated as 'to strengthen national disaster management programming capacities …'. In general terms, the study saw the national NDMOs as the primary 'institutions' requiring strengthening and capacity building, and 'disaster management programming' was construed largely in terms of the traditional PPRR paradigm of prevention/mitigation, preparedness, response and recovery. As the CHARM programme rolled out in 2001-2002, however, the delivery and process problems already referred to began to raise issues concerning the validity of some of the SOPAC study's assumptions and directions. In particular, it was becoming obvious from the CHARM workshops that responsibility for risk management in a whole range of risks which bear on public and community safety lie beyond the remit of NDMOs and even of the ministries to which such offices are allocated.

Over the same period, SOPAC itself had been tasked by the Pacific Forum to develop regional strategies in areas such as sustainable development (SOPAC, 2002b), poverty alleviation (SOPAC 2001a) and environmental management (SOPAC, 2002c) and such strategies were being progressively published. Inevitably, there is considerable overlap between the risk management goals of such regional strategies when applied at national level and the national disaster reduction/disaster management goals of the DMU programme.

In a climate in which risk management was being seen increasingly as an integral part of good management practice over a wide range of national policies, strategies and programmes, the DMU programme was in danger of becoming a 'silo' in itself.

Rethinking the Programme

Many of these problems were identified in the course of a CHARM 'Stakeholder Workshop' held in June 2001 in the Kingdom of Tonga, and later in that year a Planning Workshop was held in Fiji to review the existing programme and its advocacy component. This workshop resulted in the establishment of a High Level Advocacy Working Group to assist in giving better effect to one of the sought outcomes of the original SOPAC 2000 study:

> *A three-year regional advocacy strategy to promote the benefits of risk management among politicians, policy makers and non-traditional donor agencies will have been developed, implemented and review every six months.*
>
> SOPAC, 2000 – Output 4.1

The Workshop suggested a number of specific activities which could be undertaken under a specific Advocacy Programme with the following goal and objective:

> Goal
>
> Adoption by national governments of a comprehensive and integrated risk management policy designed to reduce vulnerability, enhance community resilience and achieve sustainable development.
>
> Objective
>
> To obtain highest-level national commitment to and support for the integration of disaster reduction and response strategies into national development policies and plans.'

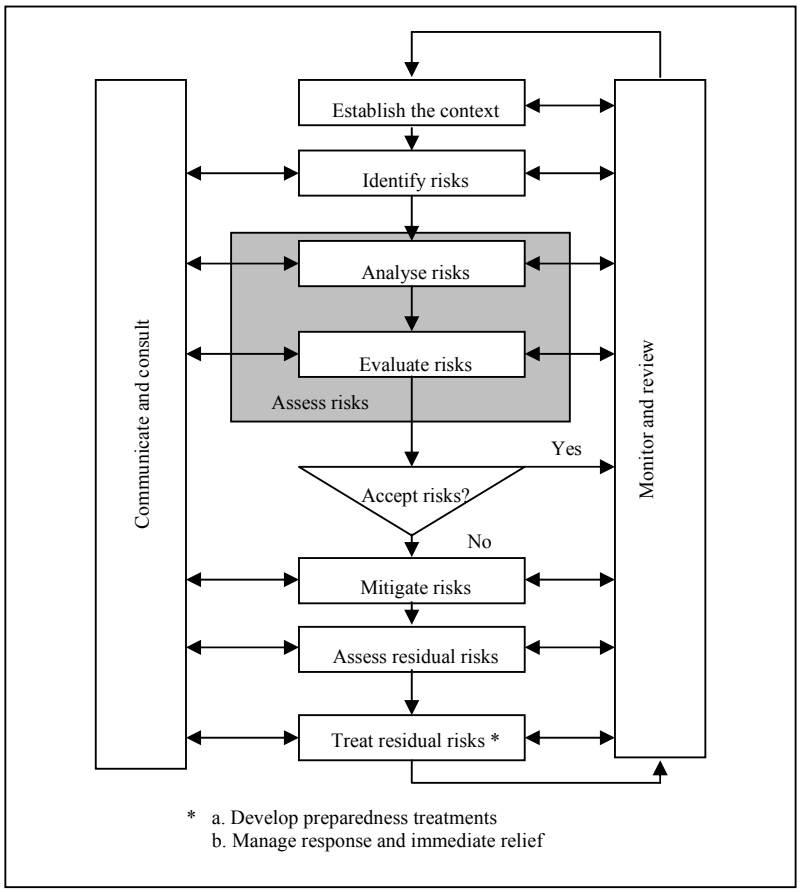
This workshop also led to the appointment of a three-person High Level Advocacy Team and outline programme for Team activities in the first half of 2002. Subsequent six-monthly meetings of the Working Group have reviewed Team activities and methodologies, and have determined the future activities of the Team. Drawing on the experiences of early Team visits to Fiji and Samoa and of visits by individual Team members to a number of other Pacific Island countries, a review in November 2002 formalised a Team visit process.

The process involves initial communications by the Team with SOPAC National Representatives and heads of departments responsible for disaster management in the country concerned to make appropriate date and programme arrangements, followed by a Team visit (of 4 – 5 days duration). During the visit, following the necessary in-country preparatory activities including a courtesy call on the minister responsible for disaster management, the Team conducts a high-level briefing of key ministers and heads of departments dealing with the need for the establishment of comprehensive and integrated risk management policies linking disaster management with sustainable development, poverty alleviation, sustainable living and environmental management, and the value of CHARM in facilitating the development of such policies and in ensuring their effective implementation.
This briefing is followed by a more general briefing and workshop session with senior representatives of relevant government and non-government agencies and stakeholders, and by

calls on appropriate donor agency and consular representatives to explain the process and gain support for the programme. These activities conclude with a final briefing and discussions with the relevant minister and head of department, and an exit call on the Prime Minister in which the outcomes of the visit are summarised and an offer made, contingent upon the establishment of national policies embracing a comprehensive and integrated approach to risk management, for further support which can include funding for specific activities and processes, further Team visits and activities and CHARM or 'Public Safety and Risk Management Workshops' funded and arranged by SOPAC.

In developing this new approach, it was found necessary to revisit the emergency risk management process model which had been drawn from the basic AS/NZS 4360 risk management process model illustrated in Figure 1, with its emphasis upon the PPRR paradigm as the primary treatment for 'emergency risk'. The need for comprehensive and integrated national risk management policies and programmes which would link disaster management with a broad range of other national development and public safety policies and programmes led to the development of a revised 'Community Safety Risk Management' process model:

Figure 2 The SOPAC Community Risk Management Process (adapted from AS/NZS 4360: 1999)



The process of developing a mitigation strategy and plans needs to be undertaken in terms of feasibility and cost benefit, and there will undoubtedly be ***residual risks*** for which mitigation actions may be either impracticable or insufficient. The treatments for those residual risks which fall within the responsibility of emergency and disaster management agencies include the development of preparedness plans, organising and training for response, exercising plans, organisations and response capabilities, and managing response and immediate relief activities in the event that such residual risks may be made manifest.

At whatever level the model is applied – regional, national, sub-national or individual community – it is clear that the whole community safety risk management process needs to have highest-level endorsement and support and to involve all relevant agencies. Disaster management agencies and managers, along with those responsible for national/community development programmes and other public safety activities, need to have input into the process of establishing the strategic and organisational contexts in which community safety risk management policies and programmes are to be developed and implemented, into the processes of identifying and assessing community safety risks, and into the development and implementation of mitigation strategies and plans. Each agency then bears responsibility for the development and implementation of appropriate treatments for residual risks which fall within its area of responsibility, within a framework of communication, consultation, monitoring and review which is oversighted at the highest level.

Such a model can significantly assist in reducing or eliminating the 'silo' phenomenon. More fundamentally, it addresses the recognised need for a 'whole of government', integrated and comprehensive approach to risk reduction across the whole complex range of sustainable development, sustainable living, poverty alleviation and environmental management issues which face governments and communities today, world-wide – and has been demonstrated to be particularly relevant and practical to the needs of small island developing states such as those in the Pacific.

SOPAC's Role and Programme in Community Risk Management

An extensive review of SOPAC's role, functions and organisation in 2000/2001 led to the development of a new Corporate Plan 2002-2004 (SOPAC, 2001b). Within its overall vision, that 'natural resources, principally non-living resources, be developed in a sustainable manner and vulnerability reduced for the people of the Pacific', SOPAC affirmed that its mandate was:

- to contribute to sustainable development, reduced poverty and enhanced resilience for the people of the Pacific
- by supporting the development of natural resources, in particular non-living resources, investigating natural systems and the reduction of vulnerability
- through applied environmental geosciences, appropriate technologies, knowledge management, technical and policy advice, human resource development and advocacy of Pacific issues.

The plan envisaged that by 2004 SOPAC would be supporting national and regional initiatives and actions towards sustainable development by providing services in three key programme areas:

- **Ocean and Islands**: An integrated programme focused on research, development and management of non-living resources in ocean and island systems addressing issues relating to seabed resources, energy, maritime boundary delineation and monitoring of ocean processes.
- **Community Risk**: A comprehensive programme aimed at reduction of community vulnerability through improved hazard assessment and risk management.
- **Community Lifelines**: A diversified programme that strengthens national capacities in energy, water and sanitation, information and communications.

Work continued throughout 2002 on the development of detailed operational programmes for each of these areas, determining strategy through establishing a goal and programme rationale and addressing critical issues, opportunities, links to regional and international development initiatives and arrangements, priority setting and partnerships. The sought outputs, linkages, key performance indicators, means of verification and means of delivery for each component in each programme area were established. The resultant 'Work Programme and Strategies' document (SOPAC, February 2003) was endorsed by the SOPAC Governing Council, and was to be implemented progressively from 1 January 2003.

The goal of the new Community Risk Programme was established as 'to improve hazard assessment and risk management practices to build safer communities'. Three component areas were identified within the programme:

- Strengthening resilience to disasters – seeking to strengthen the current levels of national disaster management capabilities.
- Mitigating the effects of hazards – building safer or less vulnerable communities through understanding the cause and effects of the risks to which they are exposed.
- Mainstreaming risk management – obtaining commitment by Pacific Island Countries to a more integrated, all hazards and whole-of-country comprehensive hazard and risk management process that will enhance the sustainability of national planning processes and encourage a more coordinated and integrated regional approach to risk reduction.

In the first half of 2003, following a final evaluation of the work of SOPAC's Disaster Management Unit (DMU) and with the approval of all stakeholders, the DMU was terminated, its work absorbed into the new Community Risk Programme and its Director appointed as Manager of that Programme.

Given the new structure, the programme clearly has much closer links with the other two programme areas within SOPAC, but it also has close linkages with and inputs to a number of other regional and international programme and initiatives.
The programme supports several regional initiatives towards addressing vulnerability such as the development of the Environmental Vulnerability Index (EVI), Initiative to Develop Capacities in Small Island Development States (SIDS) to Manage Vulnerability and Build Resilience particularly to Disasters.

From an international perspective the Geneva Mandate on Disaster Reduction, which was adopted at the IDNDR programme Forum (1999) reaffirms the necessity for disaster reduction and risk management to become essential elements of government policies. In this respect the IDNDR experience, the Yokohama Strategy (1994) and the Strategy " A Safer World in the 21st Century: Disaster and Risk Reduction" (1999) provide the basis for future endeavours with regard to building safer Pacific communities.

SOPAC has contributed to and been closely aligned to the UN International Strategy for Disaster Reduction (ISDR) global strategy for disaster reduction and risk management since its inception in 2000. The new concept of disaster reduction which is now embodied in the ISDR Strategy and articulated in the Community Risk Programme approach will allow SOPAC member countries to become more resilient to hazards and risks and reduce the overall environmental, human, economic and social losses.

The key elements of the ISDR Strategy, which are also consistent with the SOPAC approach, are:

- increasing public awareness;
- obtaining commitment from public authorities;

- stimulating interdisciplinary and inter-sectoral partnerships and expanding risk reduction networking at all levels, and
- Improving further the scientific knowledge of the causes of disasters and the effects of natural hazards and related technological and environmental disasters on societies.

During 2004, in addition to pursuing activities commenced under the DMU and developing new activities in accordance with its agreed work programme and strategies, the Community Risk Programme will be conducting a full review of progress in the Pacific since 1994 towards fulfilment of the goals of the Yokohama Strategy and Plan of Action. It is anticipated that a preliminary report on this review will be presented to the ISDR Taskforce and 1st Yokohama Preparatory Committee meeting in Geneva in May. Subsequently, a regional disaster risk management planning framework will be prepared and a draft Pacific Strategic Action Plan developed for presentation in Geneva at the September/October ISDR and 2nd Yokohama Preparatory Committee meetings. SOPAC proposes to make these the subject of a detailed presentation to the 2nd World Conference on Disaster Reduction in Kobe, Japan in January 2005.

Opportunities in Implementing the New Programme

Given the levels of risk to which Pacific Island Countries will remain subject, there is a continuing need to strengthen resilience to the impact of disasters by improving preparedness, response and coordination activities, including ensuring the most effective use of limited resources. This need will be addressed through activities under the Strengthening Resilience to Disasters component of the Community Risk Programme. But while we cannot hope to eliminate all hazards there is considerable scope through this programme for the reduction of the current levels of unacceptable risks as part of the broad approach to sustainable development planning.

Encouraging a greater commitment from national governments through high-level advocacy will assist the integration of disaster reduction practices into national planning processes and increase inter-sectoral coordination at all levels. Disaster reduction strategies can be effectively developed through the application of Comprehensive Hazard and Risk Management (CHARM) and the mitigation of hazards can be more effectively addressed through the development of scientific solutions and the application of hazard mitigation technologies.

Developing the ability to assess community vulnerability is the key to building safer communities. The further development of vulnerability tools such as the Environmental Vulnerability Index (EVI) (SOPAC, 2002c) will provide insight into the conditions, processes and environmental factors, which increase the susceptibility of a community to the impact of hazards. The outputs from the use of such tools can then assist with the development of appropriate community awareness programmes and strategies to increase resilience and reduce risks.

The expansion of disaster management networking and partnerships will lead to improved communication and coordination mechanisms throughout the region and ensure a more effective disaster preparedness and response decision making capability.
Promoting better understanding of the cause of disasters through the exchange of experiences, scientific research, indigenous knowledge and providing greater access to relevant data and information will support the successful transfer of knowledge and technologies.

Understanding the relationship between disasters, vulnerability and globalisation will assist in formulating future disaster reduction strategies to protect investment and secure trade opportunities. In a globalising world, disaster reduction is an essential element in building competitiveness and a basis for sustainable development.

Capacity building and strengthening of institutional arrangements needs to address disaster reduction as an ongoing function, including disaster reduction related legislation, covering such issues as land-use regulations and building codes. At the national level capacity building should include the development of an integrated disaster risk management plan that covers areas of hazard and risk assessment, early warning systems, training and public awareness programmes as well as emergency response and recovery management.

There is also a need to monitor the results of the continued research regarding the relationship between climate, hazards and related socio-cultural and environmental vulnerability in particular the impact of climate change variables, such as El Nino and La Nina.

The SOPAC approach to the management of community risks is based on the fact that risk itself involves two elements – 'sources of risk' (hazards) and 'elements at risk' (vulnerable communities, economies, infrastructure and environment). The three programme areas now established within SOPAC – Ocean and Islands, Community Risk and Community Lifelines – bring together key areas of scientific research and analysis of hazards (sources of risk) and of developing a better understanding of community and environmental vulnerability (elements at risk).

SOPAC's existing expertise in regional coordination, disaster management, advocacy and capacity building, with the continuing support of its donor governments and agencies, will allow for the effective application of the outputs of all three programme areas in the best interests of the small island developing states of the Pacific.

References

Asian Development Bank (1991). Disaster Management: A Disaster Manager's Handbook/W. Nick Carter, Asian Development Bank, Manila ISBN 971 561 006 4

AS/NZS 4360. Risk Management, Standards Association of Australia, Strathfield NSW (first published 1995; revised 1999) ISBN 0 7337 2647 X

Carter, W. Nick (1984). Procedures and Guidelines for Disaster Preparedness and Response, Pacific Islands Development Program, Disaster Preparedness Project, East West Center, Hawaii ISBN 0 86638 063 9

EMA (2000). Emergency Risk Management: Applications Guide, Emergency Management Australia, Dickson ACT 2602

SOPAC (2000). Disaster Management Unit: Project Design Document, South Pacific Applied Geoscience Commission, Suva, June 2000

SOPAC (2001a). Poverty Alleviation: SOPAC's Philosophy and Approach, South Pacific Applied Geoscience Commission, Suva, January 2001

- (2001b). Corporate Plan 2002-2004, South Pacific Applied Geoscience Commission, Suva, December 2001

SOPAC (2002a). Regional Comprehensive Hazard and Risk Management (CHARM): Guidelines for Pacific Islands Countries, South Pacific Applied Geoscience Commission, Suva, 2002

- (2002b). SOPAC Sustainable Development Strategy, South Pacific Applied Geoscience Commission (SOPAC Miscellaneous Report 471), Suva, August 2002

- (2002c). The Environmental Vulnerability Index and Profiles: Outcome-Focused Environmental Management at the Scale of Countries, South Pacific Applied Geoscience Commission, Suva, 2002

SOPAC (2003). Work Programme and Strategies, South Pacific Applied Geoscience Commission (SOPAC Miscellaneous Report 499), Suva, February 2003

SPDRP (2000). Natural Disaster Reduction in Pacific Island Countries, Final Report for IDNDR 1990-2000, South Pacific Office of the Emergency Response Division of UNDP, August 2000 ISBN 982 207 013 6

QDES (1999). Disaster Risk Management/Alice Zamecka and Graham Buchanan, Queensland Government Department of Emergency Services, Brisbane 1999 (reprinted 2000) ISBN 0 7242 9341 8

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

RISK MANAGEMENT PERSPECTIVES ONE YEAR AFTER A SARS OUTBREAK

Ross T. Newkirk, Ph.D., MCIP, RPP

Past Director, School of Planning, University of Waterloo

Keywords: Risk identification, risk management, risk communication, SARS

Abstract

A brief introduction to the Toronto SARS experience introduces a review of some possible risk management issues that could be used to explore the response to SARS. These are in the following areas: Managing the Risk to Contain an Existing Outbreak, Managing the Risks that Could Assist Transmission, and Managing Risks to General Health Care Services. Short summaries of selected key submissions to the SARS Review Commission by The Community and Hospital Infection Control Association, The Ontario Nurses Association, The Ontario Medical Association, The Ontario Association of Radiologists, and The University Health Network are provided. This is followed by a summary of the Commission's interim findings. Generally, it is observed that the Commission is yet to get to the specific matter of systematic risk assessment and management for a SARS related experience. This update was developed by the author at the request of the President of TIEMS 2004, the author provides these simply as personal observations.

Disclaimer

The author is not a public health professional nor is he involved with the public health system. He has experience in risk assessment, and as a planner is professionally interested in public administration and emergency response. The observations reported here are opinions based on the 222 page interim report submitted by The Honorable Mr. Justice Archie Campbell and selected submissions to the SARS Commission established by the Government of Ontario as well as prior observations of pubic briefings given by the SARS senior management team, media reports, and observations of public response and comments during the SARS crisis. Individuals interested in details regarding the Toronto SARS experience should consult the reports of appropriate public health professionals and government agencies and commissions.

Introduction

Newkirk (2003) reports that the first hospitalization of a SARS affected patient in Toronto occurred in mid March 2003 *before SARS was known to the world community.* As far as anyone knew, this was just an elderly Chinese woman suffering from acute pneumonia. However this indeed was the index case for what turned out to be a significant SARS cluster. The patient was ventilated and one was transferred to an acute care hospital leading to the infection of some other patients in the intensive care units and health care professionals. Within hours SARS was already established in two Toronto hospitals before the first World Health Organization (WHO) alert was received. Senior Public health staff within only a few hours of having received the WHO SARS alert identified a concern with the index cases and informed all effected areas. The two hospitals were secured to all

patients and visitors and public health staff were at work contacting individuals about quarantine. This was very effective and rapid initial emergency response but because the very infectious nature of SARS was not yet understood, it spread through a number of health care workers and some patients – but primarily in the intensive care and SARS units of four area hospitals. SARS turned out to be primarily a health care worker epidemic taking weeks to work its way through the expected series of infections of various directly contacted individuals. It was largely contained – although with significant service dislocations and inconvenience to the general public due to extensive use of public precaution quarantines. *At no time did SARS jump into the community at large.* The reader can obtain more complete overviews of the Toronto SARS experience by consulting the presentations to the SARS Commission by Dr. James Young, Commissioner of Public Safety and Security and Dr. Colin D'Cunha, Commissioner of Public Health, Chief Medical Officer of Health by accessing the web site of the Campbell Commission. The total Toronto SARS experience was spread over several months in two distinct waves and in the end it left exhausted hospital staff and public health workers and a concerned public. It was in this context that the Province of Ontario established an independent judicial review commission to review all aspects of the SARS crises and report its findings to inform public policy.

In an initial risk management review from a public perspective reported last year, Newkirk (2003) identified some areas where risk management lessons might be learned from the Toronto SARS experience. This paper summarizes his suggestions and then explores some of the SARS Commission discussion. Clearly there were many important categories that could be profitably considered for risk analysis and these may well be more important and accordingly attract more attention from health professionals and the Commission. Newkirk chose to identify three obvious areas of interest to a member of the public: containing the outbreak, minimizing risk of transmission, and risks to general public health care. Following is a brief summary of his related comments:

1. Managing the Risk to Contain an Existing Outbreak

    a) *Communication about the Quarantine must not introduce risk.*
    Public health officials used a legalistic term "voluntary" quarantine confusing citizens. A risk analysis of the terms used and information given to the media is required to ensure that there are not any unwanted interpretations.

    b) *Ensure that health care professionals do not introduce risk*
    Sensible risk management would suggest that public health authorities should make extra effort to provide very good and clearly informative briefings to all health care professionals so that they do not take personal decisions that increase risk of transmission.

    c) *Ensure that the media information does not introduce risk*
    The apparently virile transmission potential of SARS was not adequately discussed appropriately in the media. Risk must be communicated clearly to ensure general public and health care staff compliance with quarantines. *Net* morbidity values would better allow people to understand the seriousness of exposure.

2. Managing the Risks that Could Assist Transmission

    a) *Reduce risk in patient transfers between care facilities*
    In-depth risk assessment needs to be competed regarding the practices involved in patient transfer between health care facilities.

    b) *Reduce the interchange of staff*
    A risk analysis should be completed regarding the employment patterns of health care workers who work part time in several separate facilities and thereby provide

possible vectors for the transmission of infection. Improved staff tracking and new protocols could reduce these risks.

3. Managing Risks to General Health Care Services

   a) *Examine the risk of allowing doctor's offices and clinics to be located in hospitals*
   The risks of having doctors maintain offices in hospitals rather than outside in separate facilities should be examined. This also applies to clinics and labs.

   b) *What is the risk of continuing partial hospital services in a crisis?*
   A careful risk analysis is essential to allow reliable "fire walls" to be built that would allow out patient and other hospital services to be maintained even if there was an acute care area under quarantine.

We now consider some of the presentations to the Commission and its interim report.

The SARS Commission

The Honorable Mr. Justice Archie Campbell was appointed in summer 2003 by the Ontario government to conduct an independent SARS investigation. The Commission was provided with a suitable staff and hearings began in September 2003. There were a large number of submissions to the Commission both in writing and verbally. Only selected aspects from some verbal presentations to the Commission are noted here as it is anticipated these provided the essence of some key submissions. In most cases, the verbal presentation was supplemented by a lengthy written submission. The reader is encouraged to read the full submissions to obtain a more complete understanding.

Elements of some verbal submissions to the Commission:

The Community and Hospital Infection Control Association (2003) [hospital physicians, nurses, and technical staff with certification in hospital infection control] chose to make its primary emphasis the shortage of resources for infection control in hospitals (staff and facilities.) It made particular reference to the shortages and inadequate practices in smaller regional hospital. It indirectly addressed items in #2 above.

The Ontario Nurses Association emphasized the shortage of resources and the many particular sacrifices made by nurses in the SARS crisis. There was a significant emphasis on issues associated with exhaustion and lack of clear information and directions (#1(b) above.) The Association very effectively raised the issue of nurses having to work several part time jobs in different hospitals to make up full time employment. This was seen as a potential risk area (#2(b) above) and also a significant stressor for staff.

The Ontario Medical Association represents all medical doctors in the Province of Ontario. Its submission (OMA, 2003) was very pithy and raised a number of critical points. It particularly emphasized aspects of communications problems that included but went far beyond #1(b) above. The Association was particularly concerned about a number of failures in the medical directives area, of failure to understand the difference between what was academic and what was practically possible, of patient transfers (#2(a) above), the poor quality communications generally (#1(b) and #1(c) above, and in particular an inadequate and confusing communications structure. It raised the issue of inadequate translation capability for information and directives. (The OMA on its own undertook to translate important information into more than 8 languages.) Its key emphasis was to revise governance structure to allow practicing professionals to be engaged along with a more effective role for local and regional Medial Officers of Health.

The Ontario Association of Radiologists were very engaged in SARS treatment since SARS diagnosis and treatment involved regular monitoring by chest imaging systems. The

Association was particularly critical about poor, incomplete and contradictory information provided to the radiologists especially regarding risk management. This was compounded by a nearly complete failure to provide the facilities with the necessary infection control masks, gloves, gowns, etc. A particular emphasis was on the fact that 50% of all radiology services are delivered by independent clinics located in the community. In fact "one of the first SARS cases was actually imaged at an [outside the hospital] clinic and there were several others throughout both SARS I and SARS II that went through these independent Health Facilities. The Association raised the need to deal more clearly with the risks associated with #2(a), #3(a) and #3(b) above.

The University Health Network (UHN) is the consortium of major (teaching) hospitals in Toronto. 38 SARS patients (including 4 hospital staff) were treated in the UHN during SARS. 5 of the patients died. Organizational and communications issues as well as staffing issues were key points of the UHN submission. It observes that the hospital system is too "structurally fragmented and is overburdened with demands for service" and that the system suffered under "poor communications and jurisdictional confusion." It noted lack of sufficient infection control infrastructure, inadequate training and education in general staff regarding infection control (#1(b) above), and problems of isolation management in hospital facilities designed and operated on an "open" concept. As one would expect UHN complained about staff shortages (especially of nurses) and how this has led to too much use of part time staff. It particularly noted concern about part time staff movement between hospitals (#2(b) above) and sick time policies that lead to too many health care staff at work when they should be at home. It recommends that communications issues (including #1(b) and #1(c) above) be resolved.

These selected submissions show common themes indicating concerns about communications and resources, and most are concerned about organizational and structural issues. While some elements of Newkirk's (2003) proposed areas for risk assessment are touched on by some presentations, there are only a couple of direct mentions of one or two of them. None of the presentations specifically addressed the need for risk assessments of a SARS response system.

Commission interim recommendations

In its 222 page report, the commission was in many places very direct and to the point. The reader is advised to consult the PDF version available on the web for full details. The Commissioner's (Campbell, 2004) found "Ontario's central public health system to be unprepared, fragmented, poorly led, uncoordinated, inadequately resources, professionally impoverished, and generally incapable of discharging its mandate." He then made the 21 initial findings summarized as principles to be followed as he develops his final report. They are:

1. Public Health in Ontario requires a new mandate, new leadership, and new resources.
2. Ontario public health requires renewal according to the principles recommended in the Naylor Kirby, and interim Walker reports.
3. Protection against infectious disease requires central province-wide accountability, direction, and control.
4. Safe water, safe food, and protection against infectious disease should be the first priorities of Ontario's public health system.
5. Emergency planning and preparedness are required, along with public health infrastructure improvements, to protect against the next outbreak of infectious disease.
6. Local Medical Officers of Health and public health units, the backbone of Ontario public health, require in any reform process a strong focus of attention, support, consultation and resources.

7. Reviews are necessary to determine if municipalities should have a significant role in public health protection, or whether accountability, authority, and funding should be fully uploaded to the province.
8. If local Boards of Health are retained, the province should streamline the processes of provincial leadership and direction to ensure that local boards comply with the full programme requirements established by the province for infectious disease protection.
9. So long as the local Boards of Health remain in place: The local Medical Officer of Health should have full chief executive officer authority for local public health services and be accountable to the local board. Section 67 of the *Health Protection and Promotion Act* should be enforced, if necessary amended, to ensure that personnel and machinery required to deliver public health protection are not buried in the municipal bureaucracy.
10. Public health protection funding against infectious disease should be uploaded so that the province pays at least 75 per cent and local municipalities pay 25 per cent or less.
11. A transparent system authorized by law should be used to clarify and regularize the roles of Chief Medical Officer of Health and the local Medical Officer of Health in deciding whether a particular case should be designated a reportable disease.
12. The Chief Medical Officer of Health, while accountable to the Minister of Health, requires the independent duty and authority to communicate directly with the public and the Legislative Assembly whenever he or she deems necessary.
13. The operational powers of the Minister of Health under the Health Protection and Promotion Act should be removed and assigned to the Chief Medical Officer of Health.
14. The Chief Medical Officer of Health should have operational independence from government in respect of public health decisions during an infectious disease outbreak. Such independence should be supported by a transparent system requiring that any Ministerial recommendations be in writing and publicly available.
15. The local Medical Officer of Health requires independence, matching that of the Chief Medical Officer of Health, to speak out and to manage infectious outbreaks.
16. The operational powers of the local Medical Officer of Health should be reassigned to the Chief Medical Officer of Health, to be exercised locally by the Medical Officer of Health subject to the direction of the Chief Medical Officer of Health.
17. An Ontario Centre for Disease Control should be created as support for the Chief Medical Officer of Health and independent of the Ministry of Health. It should have a critical mass of public health expertise, strong academic links, and central laboratory capacity.
18. Public health requires strong links with hospitals and other health care facilities and the establishment, where necessary, of an authoritative hospital presence in relation to nosocomial infections. The respective accountability, roles and responsibilities of public health care and health care institutions in respect of infectious outbreaks should be clarified.
19. Ontario and Canada must avoid bickering and must create strong public health links based on cooperation rather than competition to avoid the pitfalls of federal overreaching and provincial distrust.
20. The Ontario government must commit itself to provide the necessary resources and leadership for effective public health protection against infectious disease.
21. Public health requires strong links with nurses, doctors and other health care workers and their unions and professional organizations.

An analysis of these principles 21 principles is revealing; see the summary in table 1 following.

Table 1: Main Issues Addressed in the SARS Commission's Interim Principles

Issue	Number of Principles Applying	Principles
Organization and Structural Arrangements	12	1, 2, 3, 5, 6, 7, 8, 9, 11, 12, 13, 18
Reporting and Accountability	6	8, 9, 12, 14, 15, 16
Role and Responsibility of Medical Officers of Health	5	6, 9, 11, 15, 16
Priority Setting	4	2, 4, 5, 8
Infection Control	3	3, 10, 17
Resources	2	10, 20
Cooperation Between Governments and Associations	2	19, 21
Centre for Disease Control	1	17

More than half deal with organizational and structural arrangements as a means to deal with the overall finding. It should be understood that this SARS crisis came after a decade of significant cuts to public health by a "reform" or "republican" style right wing Provincial Government.

Concluding Comments

As yet the Commission has not turned any significant attention specifically to the risk management that is required to ensure that future SARS-like events are to be properly contained. It is likely that the actual execution of the principles listed by the Commission will need to rely on effective risk analysis. Failure to deal with risk carefully and thoroughly can have consequences. Some of the aftermaths of the problems with the Toronto SARS response have been: the Commission of Public Health and Chief Medical Officer of Health replaced, and the government removed from office in a sweeping electoral defeat (fall 2003.)

It is better for risk assessment be a normal part of regular health care facility audits than when the facility is in the middle of a crisis. We look forward to the next steps in the SARS Commission investigation and the resulting improvements in the Public Health capability in Ontario.

References

Campbell, Hon. Justice Archie, 2004. *The SARS Commission Interim Report: SARS and Public Health in Ontario. Campbell Commission.* Pages 222.

Community and Hospital Infection Control Association, 2003. "Inadequate infection control resources in many Ontario hospitals and long term care facilities." Media Release, Dec. 17, 2003. (See extensive expert panel report: *For The Public's Health* Ministry of Health and Long Term Care for more details.)

Newkirk, R.T., 2003. "A perspective on some risk management lessons from a SARS outbreak." *Proceedings of The International Emergency Management Conference, Nice, 2003*. Oslo: TIEMS Vol. 10, pp. 390-393.

Ontario Medical Association, 2003 "Presentation to the SARS Commission." OMA: www.oma.org/phealth/sars/sep29present.htm

Author Biography

Ross Newkirk recently retired as Director of the School of Planning at the University of Waterloo, Waterloo, Ontario Canada. He was a founding member of the Board of The International Emergency Management Society, and has served as an officer and conference chairman of the organization. He holds a Ph.D. in Systems Design Engineering Science, a M.Sc. in Computer Science, a bachelor's degree in Economics and is a Registered Professional Planner. His interests are in regional analysis, risk analysis, modeling, simulation, decision support and policy development in which areas he has published extensively.

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

AN EXAMINATION OF JAPANESE ENTERPRISES RISK MANAGEMENT SYSTEM: IS TOP-DOWN RESPONSE ALMIGHTY?

Asako Takada, Ph.D[1]
Takachiho University

Eri Yokota Ph.D.[2]
Musashi University

Keyword: crisis management, organizational culture, top-down management

Abstract
It has been assumed that the way of thinking that "a crisis should be handled through strong top-down organization" has traditionally prevailed among Japanese enterprises. We conducted a questionnaire survey on enterprises listed on the Tokyo Stock Exchange, concerning their crisis management systems and organizations. This survey made it clear that, although according to the way of crisis management regarded as the standard by Japanese enterprises in the past, the most important element for a systematic crisis response is top-down leadership and concentration of all information focussed at the top. In fact, this standard is now being replaced through speeding up of information distribution and response by those at the scene.

1. Introduction
In the business world, enterprises continue to collapse without the underlying critical condition being remedied time. How can one get along in a crisis? For an enterprise to survive, the most important task in management has become to foresee the occurrence of an irregular event, respond to it, and bring about early restoration.

This paper has two purposes. The first is to make clear the present situation of how Japanese enterprises think about their own "crisis management." Since the terrorist attacks on September 11, 2001 in the United States, Japanese enterprises' interest in "crisis management" is said to have rapidly increased, but the actual state is not clear. For one thing, from the viewpoint of crisis management, it has been assumed that the way of thinking that "a crisis should be handled through strong top-down organization" has traditionally prevailed among Japanese enterprises (Sassa, 1987). Is this way of thinking still valid today? The primary purpose of this paper is to make clear how Japanese enterprises think concerning their crisis management.

The second purpose is to make clear the relationship between the crisis management now performed by Japanese enterprises on one hand, and their respective organizational culture on the other. As mentioned above, it seems to have been believed, more or less, that the best method for crisis management is "from the top down," but is this applicable to any enterprise? It is during a crisis that the values of the organization are important; in this sense, it will be possible to think

[1] Email: morning-star@nifty.com

[2] Email: yokota@cc.musashi.ac.jp

about crisis management from a new viewpoint in the future by taking a look at the relationship between the organizational culture and the crisis management system.

Based on these considerations, this paper will examine the organizational culture that should ultimately be formed to create an "organization resistant to a crisis."

2. Study in crisis management: the traditional way of thinking about crisis management

Broadly speaking, there are three types of traditional studies in crisis management (Takada, 2003). First, assuming the primary aim of response is to "return to the normal state," "stud[ies] concerning actions for returning to the status quo ante" have mainly been conducted (Mitroff and Pearson, 1993). It has been assumed that one important action toward this end is to draw up a response manual, providing against the occurrence of risk events, and it is essential to take action based on the manual when a risk event has occurred.

Second, it has been assumed that, in making a response, it is important to strengthen top-down, hierarchical organization-type actions. The understanding has been to regard high-ranking officials of the organization, starting with the top, as the "decision-making center," in which all information and decision-making authority was concentrated, and to treat the people at the scene as "executors," who faithfully carry out the instructions and commands from the top (Oizumi, 1997).

Third, it has been assumed that the key to response was for the top to display strong leadership (Mayer, N., & Norman, A. 1988, Takei,1998). In risk management studies, response at the time of the occurrence of a risk has been explained using a metaphor from armed forces and war. The hierarchical organization, which has dominated for a long time, is so designed that authority and information are concentrated at the top, and the scope of responsibility is clearly specified for each level. Considering that armed forces represent a typical hierarchical organization, it may be said to have seemed logical to concentrate authority in the top and emphasize the importance of the leadership of the top.

Based on the three points mentioned above, a clear conclusion, from past study, is that enterprises think the best method for risk management is to prepare a manual, and for strong leadership to be shown from the top down.

3. Realities of crisis management as seen by enterprises: results of a questionnaire survey

To ascertain if actual risk management by Japanese enterprises is based on rules regarded as appropriate traditional risk management studies, we conducted a questionnaire survey[3] on enterprises listed on the Tokyo Stock Exchange, concerning their crisis management systems and organizations. The survey period was from late August to late September in 2003, and questionnaires were mailed to personnel in charge of management planning. A total of 2,132 companies were surveyed, and the recovery rate was 7.17%, with 153 companies replying. As to the types of industry of the replying companies, construction accounted for 6.8%, clothing/texture manufacturing for 1.4%, petrochemical manufacturing for 8.8%, steel/nonferrous manufacturing

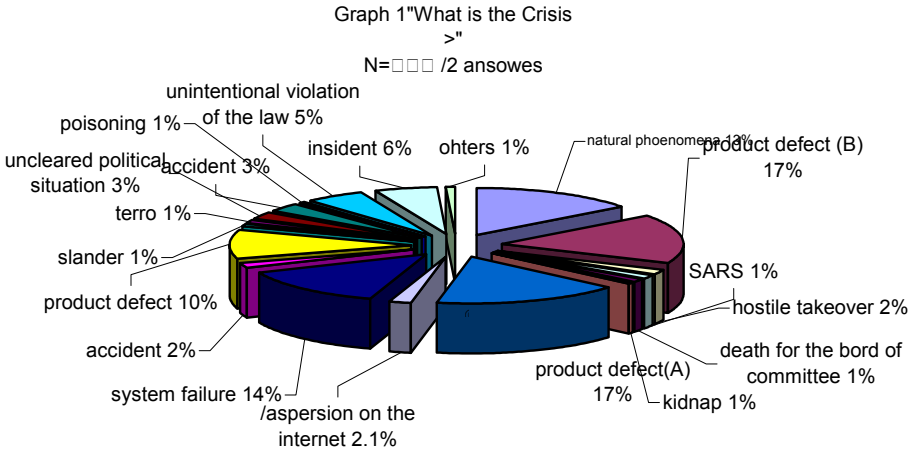
[3] The survey was conducted with a FY 2003 Musashi University Research Center research subsidy (Research subsidy representative: Eri Yokota, Musashi University).

for 5.4%, machinery manufacturing for 12.2%, other manufacturing for 24.3%, wholesaling/retailing for 16.9%, eating/drinking business for 2.0%, finance/insurance/real estate for 7.4%, transportation/communications for 2.0%, information service/advertisement/investigation business for 7.4%, other services for 4.7%, and others for 0.7%.

3.1 What is a crisis for Japanese enterprises?

It has become clear that there are broadly two types of events that are regarded as crises by Japanese enterprises. One is unexpected events beyond control, and the other is unforeseen crises that occur related to products, such as complaints about a company's products. We had them select three events that they regard as the crises to be most guarded against, and their replies were related to defects in their own product service, such as product defects and complaints about products (34.3%); next came the occurrence of an extraordinary natural phenomenon (13.4%), system failure (14.8%), unintentional violation of the law (5%), etc. It became clear there is a tendency for hostile takeover (2%), terrorism (1%) and slander/aspersions on the Internet (2.1%), (which have become common concerns in the international community recently) are not regarded as major crises by the surveyed forms. It became clear that they tend to think of their crisis management based on events with a high probability of occurrence caused by defects in their own products.

3.2 Thirty percent of Japanese enterprises have no crisis response manual



A total of 102 companies, or 66.7% of the replying companies, said they have a crisis response manual. Conversely, about 30% of enterprises do not yet have a crisis response manual. Eighty-two companies, or 53% of the total, replied that they have an organization for the possible occurrence of a crisis, such as a crisis response committee.

3.3 Information distribution within the organization is regarded as most important in crisis management

We asked respondents to select up to three matters that are most important in a crisis situation: Leadership from the top (54.1%) and the construction of a lucid instruction/command system (54.8%) were named, but information distribution (57.5%) was considered important in a time of crisis. Next were accomplishment of social missions of enterprises (37%), concentration of information in the top (22.6%), and transmission of information to society (18.5%). Further, they were asked to rate the appropriateness, and its extent, as a communication tool within the organization in a time of crisis response, using a 7-point scale; and, oral communication was considered the most appropriate (5.33), with electronic mail (5.27) coming next. On the other hand, an electronic bulletin board (4.30) was low in importance.

3.4 Response by "the top with strong leadership" in name only

Interestingly, as mentioned earlier, 79 companies, or 54.1% of the replying companies, selected "Leadership of the top is important" from among choices for the most important factor in a crisis situation. On the other hand, nine companies (6.2%) out of 146 that gave effective replies supported the top-down, hierarchical organization response based on "The top does all decision-making, and people at the scene execute the decision," as advocated in risk management study. The correlation between the two (Pearson's correlation coefficient) was -0.107, showing a negative relative tendency, although this cannot be clearly concluded, with a significance probability of 0.199. Also, "Commitment by those at the scene" ($r = 0.210$) and "Concentration of information in the top" ($r = 0.201$) both had negative correlative relationships, with 5% significance. This shows that, although leadership of the top is necessary, concentration of information in the top or decision-making by the top is not preferred.

3.5 Crisis response for Japanese enterprises

The questionnaire survey showed that, with leadership at the top, information distribution within the organization, and the construction of a lucid instruction/command system are considered important by Japanese enterprises, they do not attach great importance to all of the factors, as the three had mutually negative correlations, at the 5% level. What was considered important, by the enterprises that said decision-making by the top and execution by those at the scene are important, was concentration of information in the top (correlation of 0.202, 5% level) and lifesaving (correlation of 0.178, 5% level). It is conjectured that these enterprises do not expect the top to directly lead personnel in making a response inside the company; rather, they expect the top to take response actions directed outside the company, such as giving society information on the state of the company, the direction of response, etc. In other words, it may be conjectured that "strong leadership by the top" and "response based on a top-down, hierarchical organization," which have been advocated in past crisis management study, are not accepted at face value in actual business scenes.

In terms of the trend of management, what is required of today's organization of enterprises is not "concentration of decision-making authority in the top" but "delegation of decision-making authority to those at the scene." There will be no objection to the trend of not concentrating all decision-making in the top but rather enabling more autonomous actions by individuals at the scene. It may be said that, although the top-down style has been the past standard in crisis response, a tendency to review this standard is forming within enterprises.

4. Three types of organizational culture and crisis management response

Since we have grasped that, as a characteristic of Japanese enterprises overall, the trend in crisis response is not limited to strong leadership by the top officials, we next examined the relationship between this trend and the organizational culture, as it can be readily supposed that crisis response actions are closely related to the values accepted in an organization. As such, we prepared 50 question items about organizational culture to be addressed, for each enterprise, and conducted factor analysis on their replies. In preparing the survey items on organizational culture, we referred to items in the organizational culture scale questionnaire prepared by Masahide Sekimoto et al. It became clear that there are three relationship types between the three factors of organizational culture extracted and the crisis management system of enterprises.

4.1 Three factors of organizational culture

As a result of our attempt to extract factors from 50 question items, by principal factor analysis and varimax rotation, there were three factors whose sum of squares of the load after rotation was 5% or more (cumulative load of 29%), although no very great strong factor was extracted. The items for which the factors had a correlation of 0.6 or more were as follows: For the first factor, "Warm human relationship between the upper and lower ranks," "Individuality can be displayed freely," and "One can speak freely"; for the second factor, "Not raise objection against what the strongman says," "Not change the old way," "Even when a problem arises, it is not clear where responsibility lies," and "One's own department or work takes precedence over the company"; for the third factor, "Examination is important in planning" and "Act with the utmost caution"; and, there was a strong negative correlation for "Quick decision-making." Thus the first factor was named the "cheerful family-type organizational factor," the second factor the "shark sucker-type organizational factor," and the third factor the "cautious-type organizational factor."

4.2 Relationship between organizational culture and crisis response

Next, we examined the correlation between the way of thinking for the three factors and question items. First, for the cheerful family-type factor, there is a culture in the company for the individuality of each employee to be respected; a warm human relationship exists, and one can speak freely. For this factor, there is a tendency to consider that the most important matter in crisis response is "lifesaving" (correlation of 0.173, 5% significance level). The negative correlation of r = 0.262 (5% significance level) with the item "Not spend much cost," as an important matter in crisis, shows that the human element is valued regardless of cost. Moreover, though not significant, there was a positive correlation with commitment by those at the scene to crisis response (0.142), and with the accomplishment of social missions by the company (0.112). For this factor, there is a strong tendency to consider that, in the event of a crisis, members of the board of directors, or managerial officers of sales-related departments, should actively transmit information to outside society on behalf of the company (0.240, 0.199; both at the 5% significance level). For the “shark sucker-type” organizational factor, importance is attached to precedents, and new ways are not introduced actively. Moreover, since importance is attached to what is said by the strongman, there is vagueness as to where individual responsibilities lie. This is based on the “shark sucker-type” nature for decisions to be made after ascertaining the intention of the strongman. For this factor, as to the question of what constitutes a crisis, there was a strong negative correlation with complaints about products (r = 0.302 a 1% effective level), and as to information-sharing within the company, there was a strong negative correlation with the electronic bulletin board (r = 0.223, 5% effective level). That is to say, when asked what constitutes a crisis, a complaint about a product is not thought of, and in a time of crisis, a method based on using an electronic bulletin board is not thought of. However, no correlations were seen with any of the other survey items, showing a weak tendency to attach special importance to any particular element

in crisis management. It is conjectured that, in an organizational culture having a strong tendency to cater to the strongman, a fixed way of thinking is not favored in matters of crisis; in other words, response according to circumstances is favored. The third factor, i.e. the cautious-type organizational factor, represents an organizational culture that is timid about failure, where one is required to choose a safe and sound way in whatever situation. In crisis response in this group, although there is no very strong correlation, it has a crisis response organization (0.157, 10% significance level) and concentrates decision-making there. As to communication with society in a time of crisis, a tendency was observed for those who often come in contact with customers, such as officials in managerial positions in operating departments, to be negative about transmitting information to society ($r = 0.230$, 5% significance level).

4-3 Organizational culture and crisis response

In crisis response by the three types of Japanese enterprises, there is a tendency, in the warm family-type organizational culture, compared with the two other organizational cultures, to attach importance to human life rather than cost, and to accomplish social missions through commitment by those at the scene. This can be said to be a noteworthy element as to what new crisis response should be, which was not noticed in the past crisis management study. On the other hand, for a case in which the shark sucker factor is strong, it may be said that there is no clear way of thinking as to a crisis.

5. What is necessary for crisis management by Japanese enterprises in the future?

Takada (2003) mentioned generation of a sense of team effect as an important element for making crisis response succeed, and pointed out that, to this end, it is essential to build a mechanism for information circulation within the organization. With information rapidly circulated, members of the organization are enabled to respond to a crisis more systematically. Based on Takada's framework, it can be supposed that enterprises with a warm family-type culture would respond to a crisis more systematically.

This survey made it clear that, although according to the way of crisis management regarded as the standard by Japanese enterprises in the past, the most important element for a systematic crisis response is top-down leadership and concentration of all information in the top, in actual fact, this standard is now being replaced through speeding up of information distribution and response by those at the scene.

In crisis response, leadership of the top plays an important role, but this was not the "you-follow-me"-type role indicated by the past crisis management study; rather, it serves as an advertising tower that announces the company's activities and way of thinking to the outside world, and that fulfills the company's social responsibility. According to our questionnaire survey on enterprises listed on the Tokyo Stock Market, most of them think "fulfillment of social responsibility by the enterprise" and "transmission of information to society" are important. Therefore, it is necessary, in the future, to attach importance to the top actively assuming the role of fulfilling the responsibility to explain things to the outside world.

Moreover, it is essential to quickly create, early in response, a communication system that can enable the smooth information circulation that is regarded by enterprises as most important in crisis management; to maintain it, and to have it used actively by members. It is considered important, in a time of crisis, for members of the organization to be fully aware of the importance of "quick feedback."

What should not be forgotten is that a crisis is not at all "a special situation separated from the normal state" but rather "simply an extension of the normal state." It is difficult to think that, once you are in a crisis, your crisis response ability would suddenly become enhanced. Needless to say, it is important to keep information circulation active within the organization even in a normal situation; that is, to create a warm family-type organizational culture.

*** Detailed statistical data will be presented at presentation.**

References

Mayer,N.,& Norman,A. (1988). *The Handbook for effective emergency and crisis management.* Lexington: Lexington Books.

Mitroff,I.I.,& Pearson,C. (1993). *Crisis Management: A diagnostic guide for improving your organization's crisis-preparedness.* San Francisco: Jossey-Bass Publishers.

Ohizumi,K.,(1997)"*Crisis Management: NIHON KIGYO NO KIKIKANRI" (Crisis Management: Japanese case, translated by auther)*"Dobukan.

Sekimoto,I,. Kamagata,M,. and Yamaguchi,Y,. "An Attempt to Prepare an Organizational Culture Scale (I)," *Toyohashi Sozo College Bulletin No. 5, pp. 51-65.*

Takada, A(2003), " The Role of Team Efficacy at Crisis Management" *TIEMS2003 Proceedings.*

Takada, A(2003) *"KIKITAIO NO EFFICACY MANAGEMENT("Efficacy Management at Crisis moment" translated by author)* Keio University Press/

Takei,I,.(1998) *"RISK MANAGEMENT TO KIKIKANRI"(Risk management and Crisis management, translated by author),* Chuokeizaisya

Author Biographies

Dr. Asako Takada is an associate professor of Takachiho University. Her research is focused on Organizational Behavior, especially leadership.

Dr.Eri Yokota is a Professor of Musashi University. Her research interest is on the management control and Organizational behavior.

Academic and Professional Practice

Peer reviewed articles

TRANSPORTATION ACCIDENTS AND SAFETY

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

SAFETY INVESTIGATION OF ACCIDENTS – NEW CHALLENGES?

Sverre Roed-Larsen[1]
Project Manager, Work Research Institute – Norway

John A. Stoop[2]
Associated Professor, Delft University of Technology,
Managing Director Kindunos Safety Consultancy,
The Netherlands

Keywords: Disaster, accident, safety, incident, investigation, risk

Abstract

Accidents and disasters are categorized in several classes, varying from minor, major up to the level of catastrophes. Accidents may vary also with respect to their nature; they may stem from natural or man-made origin, may be of a technical or social nature, are frequently registered events or are supposed to be rare phenomenon. A recent OECD study issued in 2003 is used to focus on new information about emerging risks and disaster data as well as adequate responses to such treats. The conventional accident concept is challenged by new emerging risks. The numbers of both natural disasters and technological disasters are growing on a global scale, the fatalities of technological disasters are very high in the last decade, and the financial costs of natural disasters are also high in the same period. The risks of disasters are a constant threat to both developed and developing countries.

Based on a survey of the ESReDA Working Group on Accident Investigation, an overview is presented to clarify the state of the art of accident investigation practices among selected authorities and agencies in several European countries involved in formal investigations. The scope of the survey has been on high-tech industrial sectors to find information on best practices and methods applied during these investigations.

Research into the nature of such investigations in addition revealed a wide diversity of notions and fundamentals underneath these approaches, emphasizing the need for a harmonization towards a more general accident investigation theory and methodology.

However, new and external demands are formulated, based on the involvement of new actors in the process. There is an increased interest of the public opinion in safety and transparency with respect to the findings and recommendations drawn from these investigations. Simultaneously, rescue and emergency aspects are becoming relevant for the benefit of enhancing emergency management and trauma care.

[1] Project Manager Sverre Roed-Larsen, Work Research Institute, P.O. Box 6954 St. Olavs plass, NO- 0130 OSLO, Norway. Phone: +47.23369218/00. Fax: +47.22568918. Mobile phone: +47.91101305. Private phone: +47.22448835. Email address: sverre.roeed-larsen@afi-wri.no
[2] Associated Professor John A. Stoop, Delft University of Technology, Managing Director Kindunos Safety Consultancy, the Netherlands. Phone +31 15 278 3424. Email: johns@tbm.tudelft.nl

The contribution finalizes with identifying some conclusions and proposals for further research and organisational developments.

1. New Approaches to Accident and Disaster Investigation

'Unwanted event' is a modern umbrella concept that covers a huge range of different events: from near accidents within different sectors (such as health, occupational safety, environmental safety, security, operational safety etc.) in private or public arenas to real accidents of different magnitude, often categorised as accidents, disasters and catastrophes. Each of these categories has some different properties. One common feature is, however, that they have severe and damaging consequences to human life, materials, the environment, production, reputation or public confidence.

Traditionally, major accidents and disasters have been investigated with the aim of identifying guilt and allocating blame. In recent times, the focus has shifted to identify multiple causes to accidents or deviations and to propose preventive measures or severity-reducing actions. Increasingly, the necessity of accident investigations has been considered a public task. The developments have included trends in increased independence, higher analytical risk and safety competence, extended use of research and scientific results, more elaborated methodology, and internationally harmonised requirements to investigative procedures. A growth in permanent investigation bodies has occurred, especially in the transport modes, while the use of ad hoc commissions has diminished.

Today, major trends concerning accident investigation can be summarized as follows:

- the scope of accidents and disasters is questioned
- a cross-scientific approach is more common
- a multi-methodological application is preferred
- multi-modal investigation commissions are more predominant, especially within the transport sector in several countries
- investigation commissions have expanded their independence and legal competence
- public safety boards with a distinct preventive objective have been more frequently involved in investigations
- international contacts and cooperation is gradually increasing

but:

- there are large differences between countries, both between countries within same or in different continents and between developed and developing countries
- scientific theories, thesis, terminology and methodology are still developing
- institutional frameworks, resources, powers and influences are still in their initial phase in a global perspective

New threats facing nations, inhabitants and the environment all over the world represent major challenges to the emergency management society. A crucial question will be if preventive strategies developed as results of investigation efforts and based upon lessons learned from earlier accidents, crisis or disasters can be instrumental in reducing the risks from such new threats.

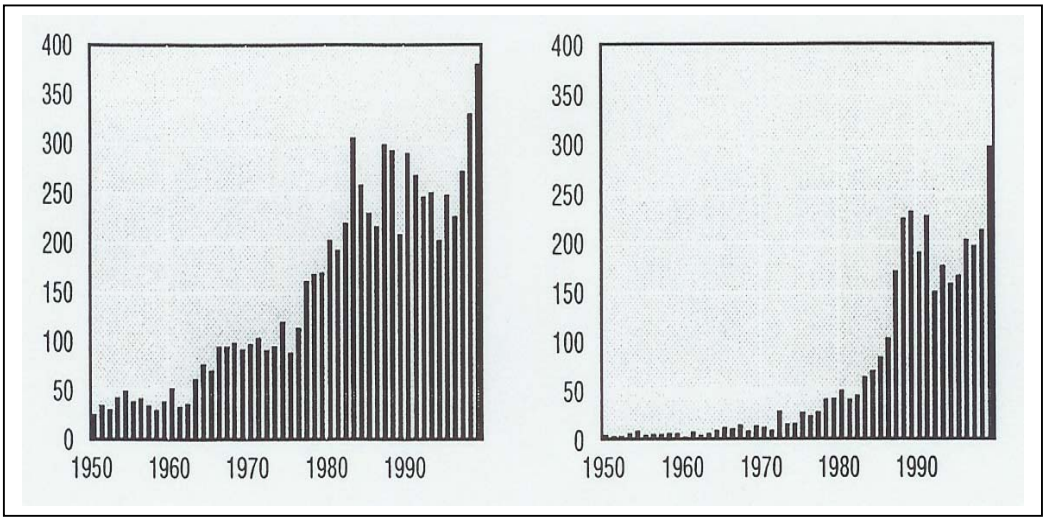
2. World disasters in the period 1950 - 2000

Several disasters from natural events and technical breakdowns have shocked the world during recent years. The consequences have been many lost lives, health injuries and severe material damage. Many – including politicians, safety authorities, victims, mass media and the public– have asked questions about their causes; some have focused on the possibilities to prevent similar

accidents. They all unite in the common belief that some disasters could have been prevented, and that the severe consequences arising from other disasters could have been reduced.

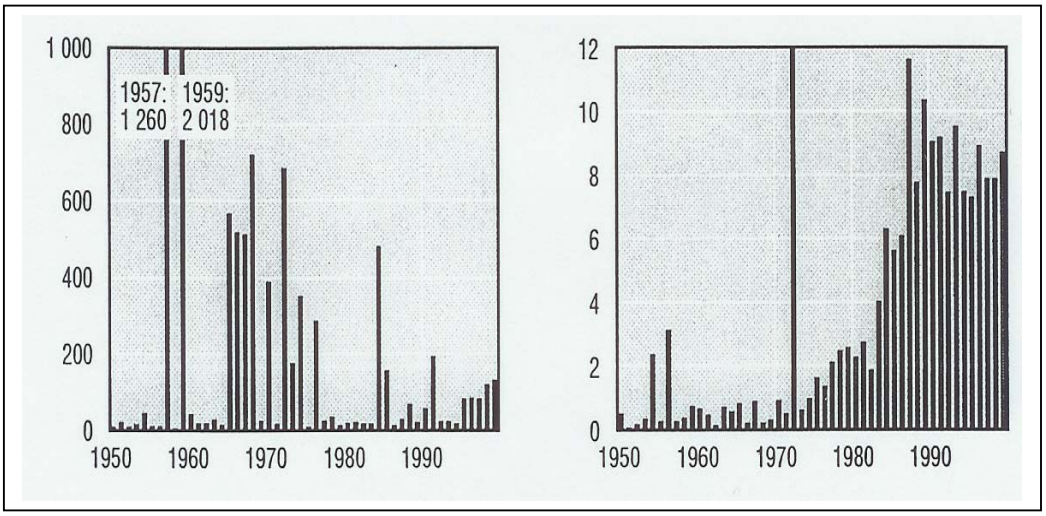
These disasters have a very wide scope – they range from natural events, via technological accidents to comprehensive public health treats. Examples from the period 1950 – 2000 based on the long-term trend in natural disasters and technological disasters illustrate the growing risks of such events (disasters are classified according to one out of four
criteria: 10 people are reported killed, 100 people are reported affected, international assistance is officially requested, or a state of emergency is declared)[3]:

Fig. 1: Number of events: Natural disasters and technological disasters



The same database also contains information about the trend in severity regarding disasters for the same period (1950-2000). The number of fatalities (in thousands) from natural and technological disasters using the same criteria's are:

Fig. 2: Fatalities (in thousands): Natural disasters and technological disasters



3 Emerging Systemic Risks in the 21st Century – An Agenda for Action (2003). Report from OECD. Paris. Page 35. Data source is the OFDA-CRED International Disaster Database.

Although the data should be treated with caution, the long-term trends are nevertheless clear: there is an increasing tendency to higher risk with regard to both natural and technological disasters since 1950 to 2000, and the severity measured by fatalities is increasing with regard to technological disasters and is rather unclear concerning natural disasters. In addition, the financial costs from disasters have increased during the same period, especially with regard to natural disasters and to some years around 1990'ies concerning technological disasters. In total, the burden of disasters measured by frequency, severity and costs have increased during the second part of the 20th century.

3. Accident Investigation in Europe: Results from a recent ESReDA Survey

Little or no comprehensive research studies have been done to establish the extension of accident investigation and to measure the effectiveness of such investigation systems or procedures on a global or even a European level.

The European safety organisation ESReDA (European Safety, Reliability and Data Association) created a new and separate expert group in 2000 with studies and recommendations concerning accident investigation as the main objective. First of all, there was a need to clarify the use of accident investigation practices among public safety authorities and organisations involved in high risk activities.

As a first step, the ESReDA AI group decided in 2001 to use a questionnaire in order to gather as much systematic information of the state of the art as possible and to find out if there was a need for information about "good practices" in the field. 136 organisations were selected. The majority were authority or government bodies (92) and the rest mainly industrial firms or organisations, research centres, universities and consultancy firms. A few international organisations, such as OECD and Joint Aviation Authorities, were also included. Altogether, 59 authorities, firms or organisations responded with a few from outside Europe responded. 49 answers are treated in the ESReDA report[4], covering 15 countries in Europe

The questionnaire was structured with 16 questions, partly with given response alternatives. The questionnaire covered several aspects, such as the definition of accident/incident used, the formal investigation structure, the internal decision-makers, the selection criteria used, the objectives, the scope, the procedures/instructions, and information about the standard method (see Appendix 1 to the report).

The respondents were divided in three main categories:

- Authority (27)
- Company (15)
- Research (7) (Consultant/Research centre/University)

Some findings from the survey can be summarized in the following way:

The respondents were asked about the **primary objectives** of the **different levels** in the investigation organisation. Generally, the main objective of **the investigation team** (both in the public and private sector) was to collect facts and to find primary and underlying causes of an accident. Another objective was to prevent a similar accident to happen. Authority or government bodies also mentioned other objectives:

- making recommendations (also mentioned by a research body)

[4] ESReDA (2003): Accident Investigation Practices – Results from a European Study. Oslo: Det Norske Veritas.

- finding a need for development of legislation
- finding any breaches of law
- learning from the accident
- deciding on information dissemination

When the question of primary objective where directly connected to the accident investigations, the concentration on prevention of accidents or recommendation to reduce or eliminate the identified threats were even more overwhelming (60 replies). But 23 replies mentioned "just fact-finding" as a primary objective.

The respondents were also asked if a formal investigation is carried out depending on the **probability** and/or the **consequences** of an accident. For about 33% of the responding organisations only the consequences or the consequences weighted by their probability (i.e. the accidental risks), determined whether or not an accident investigation is carried out. While authorities or government bodies concentrate more on consequences only, companies tend to also include considerations on risk. About 26% of the responses (especially authorities, but partly also companies) responded that "all accidents" are investigated.

The organisations were also asked if a **formal permanently established organisation** is active in carrying out accident investigations within their field in their country. About 75% of the organisations replied that a formal permanent established organisation was active in carrying out accident investigations within their field in their country.

Next, the organisations were asked if it is **mandatory or voluntary to provide information to an accident investigation team.** For about 66% of organisations the provision of information for an accident investigation team is mandatory (the case of many organisations, and especially the case of most authorities (in some cases mandatory directly by law). Sometimes, in cases where the statement is considered very important and critical, questioning is carried out by bodies representing the law (the police, the court).

Respondents were asked to "*describe the procedures/instructions that are available for carrying out accident / incident investigations*". Several organisations (45%) mentioned that they use internal procedures, instructions or rules. Some of the organisations are referring to international procedures, such as:

- Annex 13 (Aircraft Accident & Incident Investigation) to International Civil Aviation Convention
- International Maritime Organisation (IMO): Resolution A.849 (20), Code for the Investigation of Marine Casualties and Incidents (27th of November 1997) and Resolution A.884 (21), Amendments to A.849 (20) (25th of November 1999).

The respondents were also asked to "*describe the standard **method** that is recommended for carrying out accident / incident investigations*". Examples are:

- TRIPOD method
- Human error analysis
- Cause-consequence analysis

11 organisations stated that they have a recommended method. However, the largest group explicitly answered that they had no standard method. It can be noted that 12 answers were difficult to interpret, and they were classified as "unclear". Among the 11 organisations with a recommended method, five selected Cause-consequence analysis. The rest of these organisations had all chosen different methods. These were Fault Tree Analysis, Human Error Analysis, Probability Risk Analysis, and Root Cause Analysis. In all, there were 14 names of different

methods mentioned. Out of these methods, eight of the methods were mentioned by only one respondent each.

A clear majority (69%) of the organisations referred to a standard procedure of some kind for making the investigations. The procedure issue had a much higher priority than the choice of methods. It was a large variation on the view on methods, both considering the use and the preferred type of method. There was no clear dominance for any specific method.
An even more important finding however by Sklet (2002) indicated an almost complete lack of a systems approach. Without exception, all methods and procedures focused on the event itself, defining the accident sequence (if identified at all) as an unwanted deviation from some normative standard operating procedure. No method applied the experiences of transportation safety boards over the past decades, which defines accidents as the result of system deficiencies, facilitating systems change over isolated causational factors. Such a change in focus from deviation towards deficiency may be considered a paradigm shift in accident investigation, establishing a new relation between safety board investigations and a systems approach towards safety.

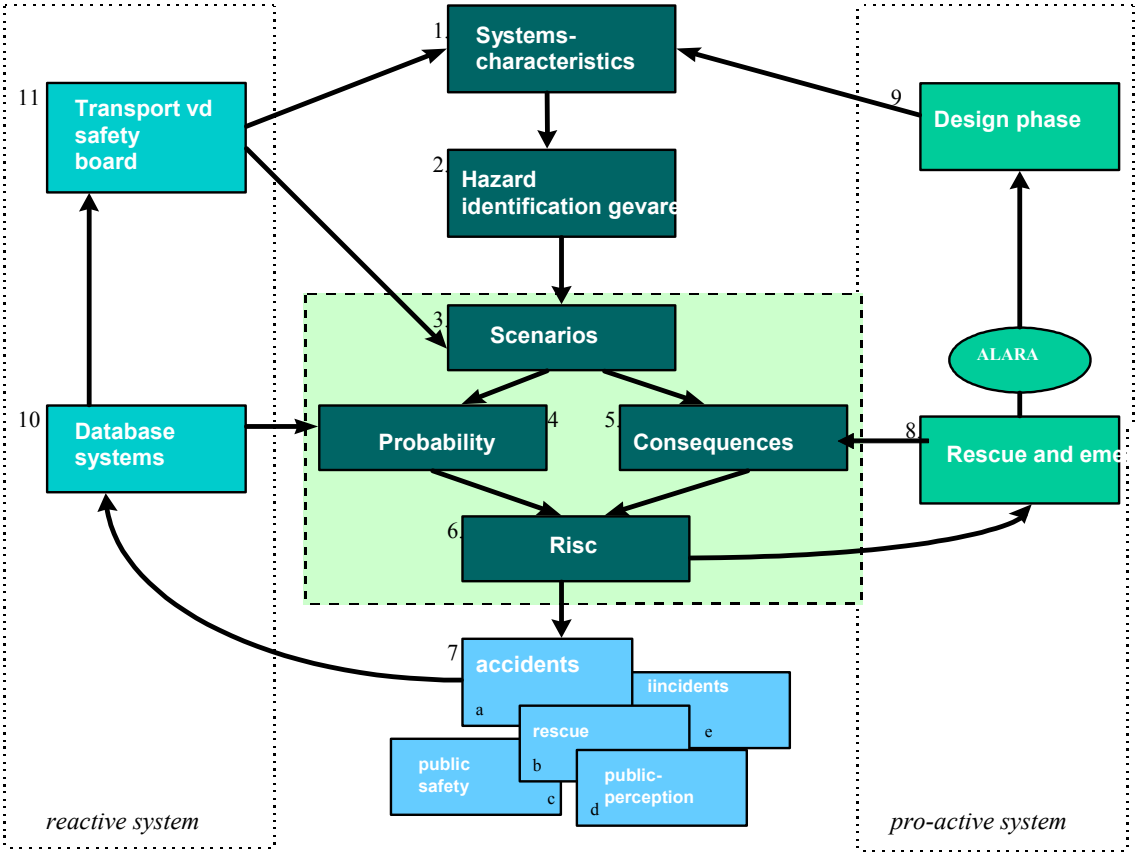
4. Towards a System Safety Framework in Accident Investigation

The evolution from technical-investigative and sector-specific committees into independent and interdisciplinary based diagnostic instruments for socio-technical systems yields a superior capability to advocate for safety, provide a public voice advocating safety, provide transparency in the complexity of systems and contribute to a proper functioning of a civil society[5]. The products of a fully evolved board may serve as input for risk decision-making by private and public stakeholders in the management of complex systems during their design and operations. Safety boards may serve as 'problem providers' to other stakeholders in the system. Consequently, fully evolved boards may add to the learning potential of organisations. Moreover, they may serve the integration of safety in a systems safety approach at a socio-technical level.

Such an integration of an integral safety approach can be demonstrated in a systems safety model (Stoop 2001).

5 See also Stoop, J. A. (2003), Divergence and convergence: Trends in accident investigation. IRIA Conference 2003, Williamsburg, USA

Fig. 3: Systems safety approach



Consequently, the conventional risk model will be expanded from its reactive risk equals probability times consequence focus with additional pro-active and systems oriented components. Traditionally available components such as data systems and quantitative risk assessment components are amplified with higher order components. Accident scenarios are no longer solely based on data systems or generic failure modes, but can be derived from a of the overall systems structure, including specific characteristics and operational conditions. Such a systems analysis facilitates an object-, process-, and system-specific decomposition. Safety interventions deal with redesign and update of the system, modification of conditions and constraints in the operating envelope and organisational or institutional conditions. The main focus is on 'system deficiencies', replacing the conventional focus on deviation, liability or even blame. Focusing on a multi-aspect approach, a variety of safety performance indicators becomes available, covering additional aspects beyond working conditions, internal and external safety such as rescue and emergency, public risk perception, incident handling or public order and security.

Two principal new safety aspects and their actor groups are represented by the Transportation Safety Board component and the Disaster and Emergency component. They both will have a major impact on a new approach in engineering design of transportation systems from a point of view of innovation. This requires a more specific focus on the Design Phase component in the systems safety approach scheme.

A possible next step in the evolution of safety boards will be towards the role of public safety assessor (Kahan, Frinking and De Vries 2001). Present safety boards already function as gatherers of information across stakeholders and actors. It is a small step into an information dissemination role as well. During the TWA 800 and Swissair 111 disasters, the NTSB and the Canadian TSB took a role of clearinghouse for informing the public and victim's relatives after the disasters. In the near future, safety boards may be seen as safety ombudsmen, the principal advocate for safety and appropriate care of accident victims (Hovden 2001, Bosterud 2001). They also may expand to the area of rescue and emergency issues, since modern safety boards have a mission in investigating relevant aspects before, during and after the event. A convergence with other system functions is emerging.

5. Trend in enhancing Emergency Management: Family Assistance

In October 1996, Congress of the United States of America passed the Aviation Disaster Family Assistance Act[6]. This act followed the president's executive memorandum asking the National Transportation Safety Board (NTSB) to be the lead federal agency for coordinating federal assets at an accident scene. The legislation gave the Board the authority to bring together various federal, states and local government agencies to better serve the victims of transportation accidents and their families. The need for such legislation emerged from a number of major accidents in aviation in which relatives and families were left unprotected by the authorities. In meetings with NTSB numerous experiences were exchanged regarding lack of information, untimely notification, misidentified remains, personal effects being mishandled, unidentified remains not being handled with dignity and the use of confidential information obtained during the grieving process in the litigation that inevitably followed. At a time when they most needed guidance, assistance and compassion, relatives and families felt abandoned and sometimes abused.

The approach of assigning such a family assistance task to a special force proved its value in several serious accidents, dealing with aviation crashes, bus accidents and cruise ship fires. As a result, for the first time, there is an effective coordinator on the accident scene that can integrate the major resources of the federal government and other organizations to support the efforts of local and state government agencies and the airlines to better meet the needs of victims and their families. At the same time there now is an entity available to help these stakeholders to be more proactive, so that they are better prepared in advance of an accident. Especially in these cases where recovery of victims and wreckage from an en-route crash is extremely difficult, a co-operation between all parties involved should be coordinated (NTSB 1999).

The same need for victim support and family assistance have been recognized in several major accidents, including process industry accidents, fire disasters, flooding, transport accidents etc. outside USA during the latest years. A similar approach to the victims' and their families' needs as now provided by NTSB in disasters have served as a model for several public safety boards in other countries. Recently, the European Commission has recognised the rights of transportation accident victims in addition to the Passenger Rights and Consumer Rights. The European Commission has acknowledged the Van Vollenhoven doctrine on accident investigation and victim care, reading: Independent Accident Investigation, a Citizens' Right and Society's Duty (Van Vollenhoven 2001).

6. Some considerations and conclusions

The state-of-the-art of accident investigation and major developments and trends raise a series of crucial questions regarding the future situation of investigation: one cluster of questions are related to the institutional framework, including resources, staff and competence, of such bodies, a second to the scientific platform used and the further development of theories, thesis, terminology and

6 For a broader discussion of this topic, see Stoop, J.A. (2002), "Accident investigation: trends, paradoxes and opportunities", Int. J. Emergency Management, Vol. 1, No. 2, pp. 170-182.

methodology, a third to relationships to national and international players, and a fourth to the position towards new emerging risks in the 21st century. A fundamental debate at different levels and between national and international decision makers should be initiated and stimulated.

The ESReDA survey about accident investigation reveals a positive attitude among several public authorities and companies in using such a tool to find causes and propose measures to prevent similar accidents in the future. However, definitions, structure, procedures and methods vary considerable among the players. A more systematic and structured approach with well-defined procedures and methods should be developed.

The OECD study analyses and identifies new and important risks to modern societies. The over-arching conclusion in the report is that "emerging systematic risks demand a systemic response"[7]. The study also proposes 41 recommendations grouped under five major headings:

- adopting a new policy approach to risk management
- developing synergies between the public and private sectors
- informing and involving stakeholders and the general public
- strengthening international co-operation in all elements of the risk management cycle, and
- making better use of technological potential and enhancement research efforts

The challenge to the international emergency management society - although organised in different organisations - is to develop its comparative strength in order to be a necessary and valuable contributor in the future dialogue. To obtain such a position implies development of organisational strength, scientific competence, formal and real independence, efficient use of rapid communication and good networking possibilities.

An explicit obligation to meet the needs of victims and their families are necessary in all type of disasters and should be formalized in the mandate of accident commissions or safety boards.

Observations, trends and paradoxes show some first indications of major changes and inherent threats in accident investigation. Three areas of concern are emerging: public confidence due to a change in disaster perception and suspicions of conspiracy, a need for improved transparency and resource allocation due to increased size and complexity of the accidents and finally improved skills and proficiency of investigators due to methodological issues. However, a number of challenging possibilities and opportunities seem to be present as well and are recognized by other sectors. Public support, self-organizing victim organizations, re-engineering of governmental agencies, ICT applications and integral safety concepts may provide a critical mass for change. In addition to the interest of prevention and pro-action, repression and aftercare require equal interest since they may also define the credibility of an accident investigation. Additionally, the analysis of major accidents may reveal system deficiencies, leading towards prevention of disaster. Due to a number of internal and external conditions, the role of safety boards is changing. Although threats appear to be present, major opportunities exist to adapt accident investigation methodology to demands of the new century.

References

Bösterud, Helen (2001), Emergency Management in a Changing World, *International Conference on Emergency management.* TIEMS 2001, June 19th-22nd, Oslo.

ESReDA Safety Series (2003), *Accident Investigation Practices – Results from a European Enquiry.* Oslo: Det Norske Veritas. ISBN 82 515 0301 9.

7 The OECD Study (2003), Emerging Systemic Risks in the 21st Century, chapter 6, page 257. Paris.

Kahan, Frinking and De Vries (2001), *Structure of a Board to Independent Investigate Real and Possible Threats to Safety*. RAND Europe, May 2001

Hovden, Jan (2001), Regulations and risk control in a vulnerable society: points at issue. *International Conference on Emergency management.* TIEMS 2001, June 19th-22nd, Oslo
NTSB (1999) *International Symposium on Transportation Recorders, Transportation Recording: 2000 and Beyond.* National Transportation Safety Board, 3- 5 May, Arlington, Virginia.

OECD (2003), *Emerging Systemic Risks in the 21st Century – An Agenda for Action.* Paris.
Roed-Larsen, Sverre (2003), Accident Investigation Practices in Europe – Main Responses from a recent Study of Accidents in Industry and Transport. Pre-Proceedings of the JRC/ESReDA: *Safety Investigation of Accidents*. Petten, The Netherlands, 12 – 13 May, 2003.

Sklet S (2002), *Methods for accident investigation.* Norwegian University of Science and Technology, Dept. of Production and Quality Engineering. Trondheim, Norway

Stoop, J. A. (2001), Veiligheid. Van operationele kostenpost naar strategisch beleidsissue. In: *Zeven jaar transportbeleid en logistieke organisatie*. Lessen voor de Toekomst. Technische Universiteit Delft.

Stoop, J. A. (2002), Accident investigations: trends, paradoxes and opportunities. *International Journal of Emergency Management* . Vol 1, No 2, 2002, pp 170-182

Van Vollenhoven P. (2001), *Independent accident investigation, a citizens' right and society's duty.* Third European Transport Safety Council Lecture, Brussels, 2001

Author Biography

Sverre Roed-Larsen, sociologist (mag. art. from the University of Oslo), has more than twenty years of experience from consumer and product safety work in Norwegian public authorities; most of the time in leadership positions in different ministries and directorates. He was Director of Safety, Health and Environment in the Executive SHE Staff at the Norwegian State Railways 1993-1998 and chairman of the Occupational Safety Group at The International Union of Railways (UIC) in Paris 1998-2000. He is currently a researcher at the Norwegian Work Research Institute, where he is working on a Ph D dissertation on the use of accident investigation commissions following transport disasters, inclusive railway, air, and maritime accidents. He was elected international secretary 2002/2003 for The International Emergency Management Society (TIEMS). He has broad experience from international work at among others UIC, OECD, EFTA, ECOSA, PROSAFE, and ESReDA, where he currently is a member of the Accident Investigation Expert Group.

John A. Stoop is associated professor in Safety Science since 1993 at the Faculty of Technology, Policy and Management of the Delft University of Technology. He is a senior research participant in the TRAIL Research School. After graduating as an aerospace engineer at Delft University, he did his Ph.D. on the role of safety in the design process. He specialized in safety of transportation, focusing on incorporating safety in major infrastructural projects. He was involved in the foundation of the Dutch Transportation Safety Board, developing a conceptual framework for its legislative basis in cooperation with RAND Europe. He is also the managing director of the safety consultancy KINDUNOS, established in 1990. He is chairman of TIEMS' International Program Committee.

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

RESEARCH IMPLICATIONS: EVALUATION OF RESIDENTIAL EVACUATION PRACTICES FROM A TRAIN DERAILMENT/OLEUM SPILL INCIDENT

Susan M. Smith, MSPH, EdD, Tyler Kress Ph.D., CIE, Sean Lennon, Alan Lawson, Holt Clark, and Jerry Harnish
UT Safety Center, The University of Tennessee[1]

Keywords: Residential Evacuation, Train Derailment, Post Incident Assessment

Abstract
This research paper outlines the specific elements involved in the evacuation of approximately 3,000 residents following a train derailment in the spring of 2002 in a suburban community in the southeastern United States (U.S.). The derailment caused the release of an Oleum (sulfuric acid) spill/plume. A major focus is the post-accident assessment of the procedures used for the evacuation, including recommended improvements/modifications. These recommendations were designed to improve future compliance with evacuation procedures in residential neighbourhoods.

Introduction
Massive amounts of hazardous materials are transported through the United States everyday. In one study to determine the public health consequences that occurred from actual releases of material in transit 9,392 transportation events (83.6% ground transportation and 11,1% rail transportation) were analyzed from 16 states in the United States between 1993 and 2000. Looking at this information, it was determined that 855 of the accidents resulted in 2,008 victims, in this were included 115 deaths. Evacuations were ordered for only 5.5% of the events occurring in the U.S. leading to 63,686 people being affected. Hazardous materials transported in the U.S. exceed 800,000 shipments per day and result in more than 3.1 billion tons annually via air, ground, rail, and maritime[2]. Given the number of transports a day and the few accidents that occur, releases are rare. These releases however do impact residential communities in both urban and rural regions. The evacuation of residents can aggravate existing medical conditions. There is potential for stress or anxiety during an evacuation if there is separation of family members from each other or from their pets. This paper addresses the issues surrounding the evacuation of part of the community of Farragut, Tennessee (a small suburb of the city of Knoxville), following an Oleum spill and plume caused by a train derailment.

The Accident
The community (Farragut) where the train derailment occurred has a population of 22,000 and covers an area of approximately 25 square miles. On Sunday, September 15, 2002, at approximately 11:20 a.m., a westbound Norfolk Southern Railway train derailed in Farragut, TN,

[1] 1914 Andy Holt Avenue, Knoxville, TN, 37996-2710. Contact Dr. Susan Smith at UTK-Knoxville at 865-974-1108; email: smsmith@utk.edu.
[2] Horton, D. Kevin, Zahava Berowitz, Gilbert S. Haugh, Maureen F. Orr, & Wendy E. Kaye. "Acute Public Health Consequences Associated with Hazardous Substances Released During Transit, 1993-2000". Journal of Hazardous Materials. Vol. 98, Issues 1-3, 17 March 2003, pp. 161-175.

while it was moving at approximately 35 miles per hour. The train consisted of 3 locomotives, 56 loaded cars, 86 empty cars, with a total 142 cars weighing close to 9,900 tons. Two of the locomotive engines and the first 25 cars derailed at 11:20 a.m. on September 15. There were no fatalities as a result of the derailment, but a railcar containing sulfuric acid was punctured. This car released a cloud of toxic sulfuric fumes into the air that rose to a height of 3,000 feet at one point. 9600 gallons of the fuming sulfuric acid were released from the container car.

Response

The people in the area originally reported the derailment as a traffic accident. The Knoxville Rural Metro fire department was the first to respond to the incident. There were already employees of the rail company on the scene. Railroad employees were on site because they needed to inspect the rail line due to a report from an earlier train that had gone through and reported problems with a section of the track in the area. Chief Harnish of the Knox County, Tennessee (U.S.), Rural Metro Fire Department was called to the scene when it was determined that there was a HAZMAT situation present. When the Chief arrived on the scene he was able to determine that the substance was fuming sulfuric acid based on what the rail employees stated and the markings on the car. An incident command system was initiated. The incident command system is a model tool used for the command, control, and coordination of resources at the scene of an emergency. In hazardous materials incidents in Knox County, Rural Metro is the lead agency and Chief Harnish was designated as the incident commander. The Incident Command Emergency Response Guide Book was utilized to determine that the minimum evacuation radius around the point of the spill should be 1.3 miles.

The Evacuation

Having people shelter in place was not an option due to the potential toxic hazards that the sulfuric acid represented to the public. Chief Harnish called for the evacuation about ten minutes after his arrival on the scene. The Sheriff's Department was given the responsibility of implantation of the evacuation. The evacuation area made it necessary to contact approximately 9,000 residences in the area. However, because it was Sunday, most of the residents of the area were at church or away from their homes. There were over 3,000 evacuees that the police had to contact and get out of the evacuation zone. The Sheriff's department utilized the REVERSE 911 telephone system. This system uses a combination of database and GIS technologies. It allows the 911 Center to quickly target and contact a precise geographic area and saturate it with thousands of calls per hour. It is a system that is fast and can be used in other ways too, such as for facsimiles, TTY/TDDs for the hearing impaired, and Bulletin Board Services. The local radio and television stations were also used to notify the people of the evacuation. However there were some residents with special mobility needs who were not able to evacuate on their own, and other unique situations. These were:

- At the time of the evacuation there was a fishing tournament that had begun on the river. The Emergency Operations Center (EOC) worked with authorities in charge of the area dams, the state wildlife/resources agency, and the Coast Guard to clear the river. Some of these fishermen refused to leave initially and law enforcement had to take steps to get them off the river and to safety.
- There was also a bike tour in progress that was sponsored by the Multiple Sclerosis Society that had cyclists traveling near the effected area. Short-wave radio operators that were assisting with the bike tour were alerted to the chemical spill and were able to communicate with the few remaining cyclists so that they could evacuate.
- There were calls coming through the 911 Center identifying elderly residents who were unable to evacuate on their own and required the assistance of the police department. A recent heart/lung transplant recipient also required assistance.

There were a total of nineteen subdivisions that were within the designated evacuation area and two neighborhoods were part of a voluntary evacuation. Through the evacuation there were no injuries reported.

The Sheriff's department kept patrols going on the edge of the evacuation zone and maintained control of all points of entry into the area to ensure that people did not make runs back into the contaminated areas and to ensure that control of the scene was established.

At the time the evacuation was ordered, the prime concern was to get the residents rapidly out of the hazardous area so they were not exposed to the toxic Oleum gas. The residents were not told that they might be away from their homes as long as forty-eight hours or more. Many of the residents did not bring their pets with them when they evacuated. Some of them left so quickly that they forgot their necessary prescription medicines. The Knoxville/Knox County Emergency Management Agency (KEMA) was able to coordinate with the Red Cross to assist those residents in need of prescription medications. However, the issue of pet owners was more complicated to resolve. After it became clear that the residents were going to be away longer than they had known, they began to try to become anxious and concerned for their pets. When the police and sheriff's department did not allow this, residents began to call the 911 emergency phone center to get information about the evacuation. Residents wanted to know if their pets were safe from exposure, and when they may be allowed to go and retrieve their animals. The volume of calls became a crippling issue for the 911 Center because the number of pet-related calls jammed their lines. People with human health or accident-related emergencies had difficulty getting an open line.

During the incident, air monitoring of the site was accomplished through the services, staff and equipment provided by The Center for Toxicology and Environmental Health (CTEH). CTEH was contacted by Norfolk Southern Railroad to assist in monitoring the Oleum plume. They were able to arrive the day of the accident and set up all required equipment. They were able to monitor concentration of the toxic fumes within the evacuation period and the movement of the cloud through wind direction and speed. The EOC and Command Post received constant updates on this air quality information.

On Monday, the day following the accident, the air monitors were able to determine that there would be a four-hour window available for residents to go back into the evacuation zone and retrieve their pets without a very low risk of exposure to Oleum fumes. The air monitors were reporting safe readings. However, residents were not allowed to return to their homes or places of business because the wrecked railcar was scheduled to be removed from the rail at 4 p.m. It was determined that the removal process itself might cause the toxic emissions plume to increase and add to the danger of the previously evacuated area. The media was asked to notify the public of this possible exposure and explosion risk during removal of the railcar, and of the window of opportunity available to remove stranded pets from the evacuated area. It was publicized that those interested in returning to retrieve pets should meet at a nearby shopping center at noon to be escorted into the zone. By 10 A.M., there were over 200 people in the parking lot waiting to retrieve pets and more were arriving. It became clear very rapidly that there would not be enough law enforcement officers to escort the residents in individually to retrieve pets and return prior to the 4 pm deadline. While the residents began to organize themselves by streets and subdivisions under the direction of KEMA and the Sheriff's department, KEMA's Holt Clark contacted other agencies and was able to secure 15 additional officers and vehicles to help with the pet evacuation. Each group of residents had 10 minutes to go in and get their animals with one officer assigned to escort each group. When the residents returned to the shopping center, a volunteer veterinarian was present to attend to any medical problems exhibited by the rescued animals. Residents participating in the pet evacuation were also provided with a list of veterinary care locations in case

they felt their animals exhibited related medical issues coming from the exposure to the gas and wanted to take them in to an animal clinic.

OLEUM (Fuming Sulfuric Acid)

Oleum is a highly reactive and aggressive material that is used in process industries. The main feature is a rapid and highly exothermic reaction of SO_3 and water that occurs in both the liquid and vapor phase[3]. Symptoms of exposure include headache, fatigue, dizziness, and muscular twitching in the eyelids. Oleum is a clear/colorless-to-dark brown, odorless, dense, oily liquid. It will not burn but it can decompose at high temperatures forming toxic gases. Contact between sulfuric acid and combustible materials may cause a fire and it is considered to be highly reactive. Contact between many organic and inorganic chemicals may cause fire or explosion and contact with metals liberates flammable hydrogen gas. It will also react violently with water.

- Eye exposure can result in irreversible eye injury, and burns.
- It can cause severe burns to the skin and if ingested can cause gastrointestinal tract burns.
- If inhaled it can result in chemical burns to the respiratory tract.
- Prolonged exposure to the skin can result in dermatitis. Exposure to sulfuric acid can burn the eyes and skin, causing third degree burns and blindness on contact. Prolonged or repeated inhalation can result in nosebleeds, nasal congestion, erosion of the teeth, chest pain and bronchitis.

The sources of information used to describe the accident are the National Transportation Safety Board's[4] report on the incident, the After Action Review (AAR)[5] critique of the incident led by KEMA, the Center for Toxicology and Environmental Health[6], WBIR- the local NBC affiliate[7], and the National Association of Amateur Radio.[8]

Findings

According to the After Action Review (AAR) critique conducted by KEMA that included input from all of the involved agencies, the following were some issues that should be addressed to be better prepared for future large-scale emergencies involving evacuation. The hope is to mitigate exposure to toxic, flammable or explosive chemicals.

- There was some confusion among the residents as to who was to evacuate and who was not. When the 1.3-mile zone was established, it was set up as a radius from the crash site. This use of a circular boundary to determine the hazard area made it hard for some people to understand if they were in the evacuation zone or not.

- There were some problems with the REVERSE 911 system. Many of those who had unlisted phone numbers did not get phone calls to be alerted.

- Better communication with the public regarding pet evacuation remained an problem issue throughout the evacuation. The public was notified through the media that there would be

[3] Kapias, T., R. Griffiths. "Dispersion and thermodynamics of clouds generated from spills of SO_3 and Oleum". Journal of Hazardous Materials. 1999. A67. pp. 9-40.
[4] National Transportation Safety Board Railroad Accident Brief, Accident Number DCA-02-FR-013, adopted July 21, 2003.
[5] Knoxville/Knox County Emergency Management Agency **Critique of Train Derailment,** October 24, 2003
[6] Center for Toxicology and Environmental Health, L.L.C., www.cteh.com
[7] WBIR, Local NBC Affiliate, Reported by Sarah Jernigan , 9-16-02. www.wbir.com
[8] National Association for Amateur Radio, www.arrl.org, author's email awextra@arrl.org, September, 20, 2002.

an opportunity to go back in and get their pets, however the public was not effectively notified of the 4p.m. deadline and why it was in place. This continued to cause concern for those few who were not able to go back in. It escalated to the point that the Sheriffs' Department had to aid the Knoxville Rescue Squad in managing an unruly crowd that developed at the shopping center location designated as the staging area for the pet evacuation project.

- It would be wise in future evacuations for the public to initially be told to prepare to be gone for 48 hours. Therefore, the individuals could bring clothes, medications, and pets with them as they were asked to evacuate their homes.

Discussion

If the protest actions of the unruly crowd had been considered as a part of previous training or drills by emergency response staff, the initial evacuation plan might have taken in consideration the potential for frustration to arise as a normal concern of pet owners and created more efficient methods of evacuation. It is important to remember that the people effected by a chemical emergency will be dealing with medical uncertainties and will be relying heavily on "expert information" through the news media over the course of the evacuation and afterwards. Also, the residents of a chemical or man-made disaster face a threat that may not be visible to them. They may feel a continuing sense of vulnerability and powerlessness, especially if there are those that were left behind. It has been shown that the grief experience associated with the death of an animal is similar to the feelings that are experienced with the loss of a significant human relationship.[9] It can be inferred that the separation from a pet that is trapped in a hazardous zone could produce similar negative emotions and anxiety as experienced while separated from a "human loved one". Typically, sleeping and eating patterns become erratic to pet owners or their family members and 70% of the respondents became less involved in social activities.[10] The separation or threat of separation from an attachment figure can create feelings of alarm and anxiety in people.[11] With this in mind it is important to make sure the general population understands what to expect during an evacuation. It would not be reasonable to expect them to be calm and happy to leave their pets behind in a hazardous area.

Given the nature of the evacuation and some of the issues that the responding services faced, it is important to take into consideration the effect an evacuation can have on the residents of the community and to recognize the importance of the media in maintaining communication, especially when residents are away from their homes. Some of the most immediate impacts of toxic transportation emergencies are created when a derailment forces an evacuation of a residential or business area. People in the area of potential exposure will often want to know about the possible medical conditions that they may face when exposed to a situation that is beyond their control and may feel vulnerable. An example of documented psychological effects resulting from a hazardous materials transport accident is the Exxon Valdez oil spill in 1989. A study focused on the health effects that the spill had on the local population indicates that there were increased rates of anxiety disorder, post traumatic stress disorder, and depression.[12]

---

[9] Gerwolls, Marilyn K., Susan M. Labott. "Adjustment to the death of a companion animal". Anthrozoos. 1994. Vol. 7(3). pp. 172-187.
[6] Quackenbush, James T., Lawrence Glickman. "Helping people adjust to the death of a pet". Health and Social Work. 1984. Vol.9 (1). Pp. 42-48.
[11] Hock, Ellen, Wilma J. Lutz. "Psychological meaning of separation anxiety in mothers and fathers". Journal of Family Psychology. March 1998. Vol. 12, No.1, pp. 41-55.
[12] Palinkas, L., M. Downs, J. Petterson, J. Russell. "Social, cultural, and psychological impacts of the Exxon Valdez oil spill". Human Organization. Vol. 52, 1-13. 1993.

Recognizing and addressing the psychological and physical effects that a disaster can have on a population is as equally important for the health of the community as keeping them from physical harm. In the cases of natural disasters, the health related damage in many cases may be easily recognized and assessed by emergency responders and local health agencies. However, with a chemical disaster there are potential health hazards that the general public may either underestimate or over-exaggerate without clear and accurate information. Chemical accidents, perceived exposures, and the uncertainty associated with those exposures can cause chronic stress, which in itself can cause physical and psychological consequences to the individual whether or not an individual experiences actually clinically diagnosed harm.[13] For this reason it is important to be sure that the public is made aware of any health consequences they may suffer if they do not evacuate when required by the local authorities.

Previous research has reported that there are long-lasting and measurable health consequences for those exposed to a potential chemical hazard including such things as increased blood pressure, higher epinephrine and nor-epinephrine levels, and lower task performance. The more facts that the public can be given about the psychological and physical effects of a chemical spill through the appropriate media outlets, the more receptive to the evacuation and following recommended evacuation procedures.

It is also important to keep in mind that communication with the public may be as important before and after a crisis as it is during a crisis event. There are several different types of communication with the public that a government or other response agencies have at their disposal and could use to help educate a community. These include surveys, modeling, exhibits, focus groups, websites, television and radio, workshops, facilitated meetings, and site tours[14]. It was discussed in the AAR of the derailment that there were problems getting information out to the public in a timely and efficient manner. It was recommended in this meeting that information be placed on the city's website to get information out to the public more quickly. This would take some of the pressure off of the 911 Center and assist in providing everyone with the same information. Something else that may be useful to a response agency before a crisis occurs would be surveys. If distributed through the city or region in question in a manner as to represent the whole of the population, it may be possible to understand what concerns they have as to possible hazards they feel exist in their area. Using this approach first, it would be easier for the government to identify the concerns that are held by the public and address them as needed to educate the people. It would be possible for misconceptions to be identified and appropriately dealt with before a disaster took place and allow the residents to know that the governing agencies have a vested interest in their safety and well-being. If the public has that impression, then they may be more likely to respond as directed during an evacuation and take appropriate steps to ensure that they have everything that they need before they leave their homes[15].

The evacuation of the Farragut community was required to take less than 30 minutes according to the Emergency Response Guide recommendations. However, there were problems getting people out in a timely manner because people who were out walking or driving through the area had attempted to get a better view of the wreckage rather than leave the scene.

---

[13] Baum, Andrew, Ian Fleming. "Implications of psychological research on stress and technological accidents". American Psychologist. Vol. 48. No. 6. pp. 665-672. 1993.
[14] "New Risk Communication Guidance Available". Hazardous Waste Consultant. 2003. Vol. 21. Iss. 4. pp. 1.5-1.7.
[15] Heath, Robert L., Julie Bradshaw, & Jaesub Lee. "Community Relationship Building: Local Leadership in the Risk Communication Infrastructure. Journal of Public Relations Research. 2002. Volume 14, Issue 4. pp. 319.

Risk management uses two components - risk assessment and risk communication. They are used in conjunction to see how an environmental problem can be addressed with available materials, staff and funding[16]. A risk assessment should be used to examine the hazards a community will face, and a risk communication should address the ability of the local government to inform the residents of the hazards. Both should be used as the basis for planning an evacuation and any related emergency plans.

In relation to the evacuation zone, it was recommended by the AAR that in the future it would be more effective to set up the zone and then use streets as the boundaries for the public. This would allow the people to have a clear understanding of whether or not their safety was in question. These boundaries would then need to be conveyed to the public via news media and press conferences. The 911 Center was receiving calls constantly after the evacuation was called because people did not know if they were in danger of being exposed to the toxic fumes. They had trouble understanding the boundaries of the evacuation zone.

Because of the problems with the REVERSE 911 system, ways of looking onto having the Caller ID read Knoxville/Knox County Emergency Services are being explored. It also would be useful to work with the cell phone companies to develop a similar system or open up their records so that those subscribers, who reside in an evacuated area, even if they are away from home or out of town, can be alerted so arrangements can be made.

Following this derailment, the site was cleaned up and people returned home in a few days. In the future, agencies in charge should be sure that residents, visitors, and business owners know that they may be away from their homes for an extended amount of time when an evacuation of this nature is required (i.e., to prepare for at least 48 hours just in case). Although this evacuation was achieved with no apparent major injuries and few minor ones, future evacuations could be improved through the adoption of the aforementioned recommendations.

References

Baum, Andrew, Ian Fleming. (1993). Implications of psychological research on stress and technological accidents. *American Psychologist*. Vol. 48. No. 6. pp. 665-672.

Baumeister, Roy F., Laura Smart, Joseph Boden. (1996). Relation of threatened egotism to violence and aggression: the dark side of high self esteem. *Psychological Review*. Vol. 103, No. 1, pp. 5-33.

Gerwolls, Marilyn K., Susan M. Labott. (1994). Adjustment to the death of a companion animal. *Anthrozoos*. Vol. 7(3). pp. 172-187.

Heath, Robert L., Julie Bradshaw, & Jaesub Lee. (2002). Community Relationship Building: Local Leadership in the Risk Communication Infrastructure. *Journal of Public Relations Research*. Vol. 14, Issue 4. pp. 317-353.

Hock, Ellen, Wilma J. Lutz. (1998). Psychological meaning of separation anxiety in mothers and fathers. *Journal of Family Psychology*. Vol. 12, No.1, pp. 41-55.

Horton, D. Kevin, Zahava Berowitz, Gilbert S. Haugh, Maureen F. Orr, & Wendy E. Kaye. (2003). Acute Public Health Consequences Associated with Hazardous Substances Released During Transit, 1993-2000. *Journal of Hazardous Materials*. Vol. 98, Issues 1-3, pp. 161-175.

[16] White, Angele. "Risk Assessment: Environmental Health Depends Upon It". Public Management. July 2000. Vol. 82. Issue 7. p. 17.

Kapias, T., R. Griffiths. (1999). Dispersion and thermodynamics of clouds generated from spills of SO3 and Oleum. *Journal of Hazardous Materials*. A67. pp. 9-40.

Sharkin, Bruce S., Donna Knox. (2003). Pet Loss, issues and Implications for the psychologist. *Professional Psychology: Research and Practice*, Vol. 34, No. 4, pp. 414-421.

New Risk Communication Guidance Available. (2003). *Hazardous Waste Consultant*. Vol. 21. Issue 4. pp. 1.5-1.7.

Palinkas, L., M. Downs, J. Petterson, J. Russell. (1993). Social, cultural, and psychological impacts of the Exxon Valdez oil spill. *Human Organization*. Vol. 52, pp. 1-13.

Quackenbush, James T., Lawrence Glickman. (1984). Helping people adjust to the death of a pet. *Health and Social Work*. Vol. 9 (1). pp. 42-48.

White, Angele. (2000). Risk Assessment: Environmental Health Depends Upon It. *Public Management*. Vol. 82. Issue 7. p. 17.

Knoxville/Knox County Emergency Management Agency Critique of Train Derailment, October 24, 2003.

Center for Toxicology and Environmental Health, L.L.C., www.cteh.com

WBIR, Local NBC Affiliate, Reported by Sarah Jernigan , 9-16-02. www.wbir.com

National Association for Amateur Radio, www.arrl.org, author's email awextra@arrl.org, September, 20, 2002.

National Transportation Safety Board Railroad Accident Brief, Accident Number DCA-02-FR-013, adopted July 21, 2003.

National Transportation Safety Board Railroad Accident Brief, Accident Number DCA-02-FR-013, adopted July 21, 2003.

Author Biographies

Dr. Susan M. Smith serves as the Director of the UT Safety Center, Coordinator of the UT Graduate Safety Program and is a tenured Associate Professor at The University of Tennessee.

Dr. Smith serves as one of the Board of Directors for TIEMS and the Vice-Chair of the Educational Resources Division of the National Safety Council. Dr. Tyler Kress is an Adjunct Associate Professor for the UT Safety program at the University of Tennessee and presently serves as the Secretary of the Educational Resources Division of the National Safety Council**.**

Mr. Sean Lennon is a safety graduate student at the University of Tennessee. Mr. Jerry Harnish,

Mr. Holt Clark, and Mr. Alan Lawson are all emergency response professionals serving the Knoxville, Tennessee, area with direct management responsibility for the train derailment incident.

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

INDEPENDENT INVESTIGATION; TRANSPARENCY BEFORE, DURING AND AFTER THE EVENT

John Stoop
Delft University of Technology
Kindunos Safety Consultancy

Introduction

Aviation accident investigation is as old as aviation itself. From the start of aviation on, accident investigation has been an integral part of aviation policy making. Establishing the International Civil Aviation Organization ICAO in 1944 and its Annex 13 on accident investigation has been part of an evolutionary process in achieving a safe, international aviation industry. Aviation has been the only industry, which has institutionalized accident investigation at a sectoral level.

From the beginning with 'lighter than air' aircraft, aviation has been international. There has been a need for international agreements because hot air balloons could drift across national state borders and zeppelins proved to be unsafe due to their vulnerability and limited maneuverability. National sovereignty of the airspace and safety of aviation were at stake. Establishing rules for uncontrolled flights in airspace or above territorial waters led to the first international aerial congress between 21 states in 1910 in Paris. With the introduction of the 'heavier than air' aircraft, international civil aviation could begin after the development of such aircraft during the First World War. In 1919 the International Air Convention achieved an agreement on technical, judicial, and military aspects of aviation with the establishment of the International Commission for Air Navigation, the predecessor of ICAO. Since then, an evolutionary development has taken place.

Based on experiences in aviation, this contribution elaborates on the potential of independent investigations as a learning tool for safety enhancements by providing timely and clear information regarding the sequence of major events and their systemic deficiencies. Such an instrument may serve also as an assessor of public faith in the professional conduct of rescue and emergency services and workers. Finally, the instrument may be considered a Citizens' Right and Society's Duty (Van Vollenhoven 2002).

Aviation

As early as in the Interbellum, accident investigation in aviation was a crucial tool in safety enhancement. This type of dealing with failure emerged from the military aviation and rapidly spread to the civil sector. The British Air Accidents Investigation Branch had its origin in the Royal Flying Corps in 1915. The Air Navigation Act 1920 gave the secretary of State for Air power to make regulations for investigating air accidents. By that time, air crashes were investigated in almost every country in Europe as a prerequisite for developing an international civil aviation network. Also in the Netherlands, due to a series of serious civil air crashes, a permanent body for aviation investigation was established in 1937.

During the end of the Second World War, the USA, Canada and the UK took the initiative to establish an international organization for harmonizing international civil aviation and setting standards and procedures for developing the sector on a global scale.

At the foundation of ICAO, the International Civil Aviation Organization, a series of Annexes was drafted, including accident and incident investigation, the ICAO Annex 13.
To avoid a conflict between states, this Annex should facilitate participation of a stakeholder state - such as manufacturer, operator or registration- in an accident investigation by the state of occurrence (ICAO 2001).

With the closing of the Second World War, the preparation of a globalization of civil aviation occurs. The Chicago conference deals with routes, rates, fares and frequencies, elaborating on the commission which gathered in Paris in 1910 on the technical aspects of air navigation.

Three models for a global aviation are discussed: the UK favors a supranational organization, according to the model of the British Commonwealth, the USA favors an open competitive community at the operator level and the Soviet Union favors a closed system, based on influence hemispheres, separated along state borders. No agreements are achieved and finally settlements are negotiated at the levels of technical matters. Twelve preliminary Annexes are drafted which eventually result in 13 official Annexes, of which accident investigation is allocated number 13.

International air traffic is settled along lines of bilateral agreements between states.
As the flywheel for progress the level of technical harmonization is selected focusing on navigation, communication and reliability. The precaution principle and a timely feedback of findings are pivotal. From the beginning on there is a clear distinction between blame and causation for the benefit of taking rapid and necessary measures. A strict separation is maintained between technical Investigations and Judicial Inquiries. Annex 13 settles the agreements and cooperation between states which are involved in an aviation accident, being the State of Occurrence, Operations, Registry and Manufacturing and the provides harmonization of investigation procedures. This harmonization receives ample consent and gains the status of pseudo-legislation for the ICAO member states.

This concept should be understood in its era; in 1944 the US and UK national administrations fulfilled the role of problem owner. Operators were still in their infancy and focused on their own world region. A fierce, wartime related competition was going on between the many American and British aircraft designers and manufacturers. Due to the war, many former European competitors had not even started with their revival, if allowed at all by the allies in contrast with the UK and US aviation industries, which were on their peak production due to the war. The UK and US took their natural role as the advocates for internationalization of civil aviation. However, they had to cope with a careful coordination and cooperation with other sovereign national state interests.

Among the major issues to be taken care of were routing issues, landing rights, airfares, navigation and communication systems and airport traffic control facilities.
After the war, the implementation of accident investigation primarily focused on technological development of the aircraft. Many resources had to be invested in improving the technical reliability of the aircraft, because new technologies were in their infancy, causing teething troubles in various areas. New technologies involved the introduction of pressurized cabins, jet engine technology, radar and all-metal airframes.

The large-scale introduction of civil aviation required a change in aircraft design. Before the war, civil aircraft were derivatives of military aircraft with respect to their design concepts as well to their construction and materials. After the war, large civil aircraft had to transport great numbers of passengers over long distances, based on regular timetables, putting high demands on endurance, range and comfort. In contrast to these requirements, military aircraft were designed for relatively short-range combat performance, serving as airborne battle stations. National administrations were

tasked with certification of these civil aircraft, in contrast with military aircraft, which remained submitted to a manufacturer based certification process.

Separation from blame

Already before the Second World War, the aviation industry concluded that learning from deficiencies had to take place on an international, sectoral level rather than on a basis of a single operator, manufacturer or state. In order to keep public faith in the aviation industry, a common process of learning without allocating blame was deemed necessary. In order to provide a timely feedback to all stakeholders in the sector, accident investigations had to be separated from judicial procedures, which by nature, are very time consuming and focus on individual responsibilities and liability.

This approach is until today based on the principle of precaution:
in order to protect the aviators from threats of serious or irreversible damage, a timely response is required, while a lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent further degradation.

In addition, a very practical reason forced national states to cooperate in accident investigation; to conduct a proper investigation, each stakeholder had to have access to the accident site, which was in most cases on the territory of another state.

Consequently, two types of investigations emerged, which could be conducted parallel to each other: an independent technical investigation into the causes of an accident and a judicial inquiry into responsibilities and liability.

Technical investigations into the failure of designing and operating aircraft have seen an impressive development. Based on a limited number of 'showcases' design principles were developed in order to improve the safety of aviation. In such a development, four consecutive phases can be distinguished in developing safety concepts:

1. Crash-worthiness. This concept was developed already before the Second World War from civil aviation crashes, focusing on technical survivability of crashes for crew and passengers. Technical requirements were drawn up for equipment and material properties within aircraft in order to reduce the extend of injuries due to fire and smoke propagation, deceleration forces, debris and other hazards which occurred during a crash. A wide range of technical devices was implemented such as seat belts, life jackets, slide bars, floor lighting and oxygen masks. At airports, specific facilities became mandatory such as airside fire brigades and search and rescue facilities.
2. Victim identification. Two major showcases have land marked the development of medical attention in victim identification: Tenerife in 1977 and Mount Erebus in 1979. They have become typical for the interest in identifying human remains after a major air-crash with relatively little survivors. In both cases the accessibility of the crash site was troublesome for the fire brigade and rescue services, either due to the extend and density of the site or the size of the search area for SAR activities. While from the Tenerife disaster lessons were drawn with respect to salvage and identification of victims, the Mount Erebus disaster benchmarked the need for survivability in SAR restricted areas and implementation of these requirements in ICAO regulations.
3. Family assistance. In the aftermath of a series of major air-crashes in the USA and Canada, victims and their relatives have started to organize themselves in order to represent their interest in the aftermath of air-crashes. This development bears similarities with the emerging of labor unions in the middle of the 19th century and the environmental movement in the sixties of the previous century. In Europe similar developments can be noticed in the aftermath of the capsizing of the passenger ferry Estonia and in road victim organizations, which have

organized themselves in a European federation. In the USA, this interest in victim care and family assistance has materialized in an additional legal obligation for the National Transportation Safety Board to facilitate family assistance after a major accident.

4. Professional performance. Over the past decade, several major accidents have occurred in Europe, questioning the professional conduct and judgement of the emergency and rescue services. After the WTC collapse, a more fundamental debate has emerged, questioning the strategy and principles of present disaster response and repression strategies. In order to be prepared for such events, a more pro-active approach is favored, focusing on safety and risk management in addition to disaster response. There are many issues at stake, such as on-scene coordination, situation awareness, aggravating conditions with respect to occupational hazards for rescue workers, the use of a safe haven concept, accessibility of the site and public confidence in administrative response. After the WTC attack, a legal basis for a safety investigation agency in structural collapse was established in the USA, -the National Construction Safety Team Act- according to the role model of the NTSB.

Independence from state interference

During the sixties of the 20th century the issue of independence is raised in order to relief the investigations from a dominant influence of the state. During investigations, the influence of the state interests, secondary causal factors and circumstantial influences should also be addressed. In several countries, such as the Netherlands, this debate starts before the Second World War. Already in 1937 after a series of major air crashes independence of investigations from a state interest is debated. A formal assurance of independence however proves to be a time consuming process in many countries. National states serve as the owner of national airlines and are knowledge providers for investigative committees by supplying experts, expertise and resources. Simultaneously, there are the prime recipients of the accident reports and recommendations from the committees. In 1961, the Cairns Report in the UK identifies these primary issues in independent accident investigation, which are debated nowadays, but does not get much public or political support. In 1988 the Wilkinson and Rapp reports lay the basis for the European Directive on harmonization of European aviation investigation. Two major issues are identified in these reports:

- the separation between blame and accident causation
- the fundamental differences between inquisitory and accusatory legal systems in the various European countries.

The European Union seems to head for a single-mode, international accident investigation board, exclusively focusing on aviation. Major players are the UK, France and Federal Republic of Germany, counterbalancing the influence of a strong US/Canadian industrial position. The introduction of the EU Directives on mandatory, independent maritime and railway investigation agencies strengthens a wider application of accident investigation along lines of modality specific developments.

In responding to specific European needs in harmonizing practices current in the States of the Community, an additional procedural arrangement on ICAO Annex 13 has been developed. This development led to the EU Directive 94/56/EC on Accident Investigation, despite fundamental differences between legal systems in the various countries of the Community. Conflicts of interest linked to the issue of double inquiries by technical permanent bodies and by judicial authorities were recognized, but nevertheless lead to a Community strategy to adaptation of the existing legal and institutional framework, harmonizing national legislation and strengthening cooperation between Member States. Although strong relations have remained between military and civil accident investigations, military accident investigations have had their counterpart of ICAO Annex 13 in the NATO Standardization Agreement (Stanag) on the Investigation of Aircraft/Missile Accidents/Incidents.

Expanding concepts

Multi-modal

A second strategic line in developing independent accident investigation agencies emerges at the beginning of the nineties, focusing on establishing multi-modal safety boards on a national basis. The initiative for this development is taken in the USA, where in 1967 the National Transportation Safety Board becomes the first multi-modal investigation agency in the world. Multi-modal boards are primarily a case in the USA, Canada, Australia, New Zealand, Scandinavian countries and the Netherlands. In addition to a visionary approach, based on the concept of multi-modal and systemic learning, arguments of economy of scale, critical mass in investigative resources and organizational efficiency play an important role in particular in smaller countries.

Establishing such multi-modal boards is frequently initiated by parliamentary interference after one or more major events, which disrupt a public confidence in the transport systems. A breakthrough of independent investigations in the public eye occurs after a series of major events outside the transportation sector, such as with disco fires in Sweden and the Netherlands, the firework explosion at Enschede, the chemical plant explosion in Toulouse, or the WTC attack in the USA. The European Union takes initiatives to advocate independent accident investigations as a consequence of the introduction of the Seveso Directive on major chemical hazards in the process industry and related sectors (Stoop 2003).

New missions

Recently, a new development in accident investigation has emerged. Transportation Safety Boards are faced with new missions, dealing with public faith, serving as a public safety assessor, support to victims and relatives in taking care of family assistance and focusing on rescue and emergency services in their performance in dealing with the aftermath of major accidents. In the USA, this broadening of the concept of independent investigations has lead to the establishment of the Chemical Safety Board and National Construction Safety Team Act following the role model of the National Transportation Safety Board.

In a wider context, due to the occurrence of disasters in other sectors, various Transportation Safety Boards in Europe are developing into multi-sectoral agencies, covering other sectors such as health, defense, industrial sectors, natural disaster, and events such as explosions, major fires and collapse of buildings (IDAIP 2002). In this respect, independent accident investigation is considered every citizens' right, society's' duty (Van Vollenhoven 2002). The International Transportation Safety Association ITSA has adopted this doctrine as a basic policy, while the European Commission has shown interest in addition to their Passenger Rights and Consumer Rights declaration.

Conclusions

Transportation Safety Boards across the world have served as role models for independent investigation into major events, irrespective whether the causation of the accident and its consequences origins from before, during or after the events. Such independent investigations may be conducted in any sector, expanding from aviation to other modes of transport, defense, industrial sectors, natural disaster, occurrences detrimental to the environment and to health, disasters, accidents and incidents in other sectors such as explosions, major fires and the collapse of buildings or structures.

They may serve as quality assurance in the professional conduct of fire fighters, rescue workers and emergency services in order to guarantee public faith in the performance of the emergency management sector during their operational tasks.

But, in analogy with aviation, they most of all may lead to new concepts by integrating emergency management principles in the design of complex structures and systems, covering safety before, during and after the event.

References

ICAO, 2001. Aircraft Accident and Incident Investigation. Annex 13 to the Convention on International Civil Aviation. International Standards and Recommended Practices.

Van Vollenhoven, 2002. Independent accident investigation; a citizens' right and society's duty. Updated version. www.itsasafety.org October 2002

IDAIP, 2002. Independent Disaster and Accident Investigation Project. Main Points Memorandum. Ministry of the Interior and Kingdom Relations. The Netherlands, Jan 2002

Stoop, 2003. Divergence and Convergence, trends in accident investigations. Second Workshop on the Investigation and reporting of Incidents and Accidents. IRIA 2003, NASA/CP-2003-212642. Williamsburg, USA

Academic and Professional Practice

Peer reviewed articles

HAZARDS OF CONTAMINANT TRANSPORT

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

ADVANCED REAL-TIME MODELLING OF ATMOSPHERIC TRANSPORT OF CHEMICAL ACCIDENTAL RELEASES FOR EMERGENCY RESPONSE SYSTEMS

M. Borysiewicz
Institute of Atomic Energy, Otwock-Swierk, Poland[1]

A. Galkowski
Institute of Plasma Physics and Laser Microfusion, Poland[2]

S. Potempski
Institute of Atomic Energy, Otwock-Swierk, Poland[3]

Keywords: decision support system, chemical emergency, atmospheric dispersion.

Abstract
A computerised system for emergency planning, handling safety oriented data in case of chemical accident (SWAR) has been developed by the Centre of Excellence MANHAZ ("Management of Health and Environmental Hazards") for implementation in one of the biggest chemical plant in the north-western part of Poland Chemical Works "POLICE". The system can be used for emergency plans development and for diagnosis and prognosis of emergency situation by estimating endangered areas for a broad scope of scenarios, taking into account potential consequences for people and environment. The technology used in the system is based on distributed network computer capabilities allowing for fast exchange of information and presentation of results on digital maps available on a Web server.

The pilot version of the SWAR system was presented during TIEMS 2001. A new version of the system includes more advanced set of sophisticated models (UMPDA – Unified Model of Pollutant Dispersion in Atmosphere) for real-time calculation of accidental releases and atmospheric transport of pollutants. The UMPDA models the dispersion following a ground-level or elevated two-phase un-pressurised or pressurised release. It allows for continuous and instantaneous releases. The model includes a unified model for jet, heavy and passive two-phase dispersion including possible droplet rainout, pool spreading and re-evaporation. The UMPDA calculates the phase distribution and cloud temperature using either a non-equilibrium thermodynamics model or a non-reactive equilibrium model. For the models of UMPDA, the fundamental underlying physics has been considered in conjunction with a literature review and verification of the numerical solution against analytical solutions. This paper includes an overview of the new model of the SWAR system and its realisation.

[1] Institute of Atomic Energy, 05-400 Otwock-Swierk, Poland, +48-22-7180132, e-mail:mietek@cyf.gov.pl
[2] Institute of Plasma Physics and Laser MicroFusion, 00-908 Warsaw 23Hery Str, Poland, +48-22-6381460, e-mail: andrzejg@ifpilm.waw.pl
[3] Institute of Atomic Energy, 05-400 Otwock-Swierk, Poland, +48-22-7180010, e-mail:slawek@cyf.gov.pl

Introduction

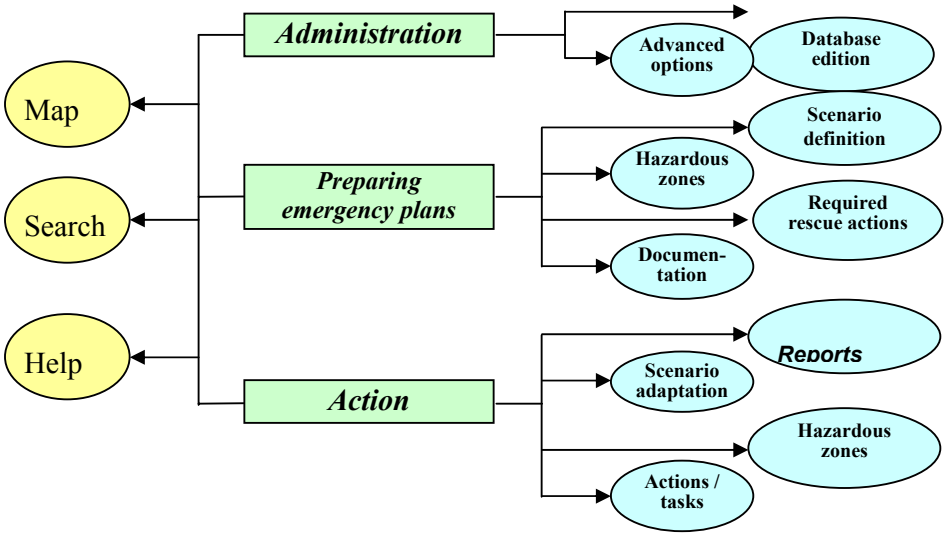
This paper describes the new version of the Unified Model of Pollutant Dispersion in the Atmosphere (UMPDA) implemented into the MANHAZ Centre of Excellence software package SWAR [2]. The SWAR system has been developed as a decision support system in case of chemical accidents both for emergency planning and support of emergency response: automatic alarming of personnel, assessing quickly required forces and means and assisting in action to be taken, by the co-ordination staff, responders and endangered personnel. In particular the SWAR system has been designed for:

- providing capabilities for computer aided emergency planning,
- providing sufficient means to co-ordinate emergency actions via a computer network,
- easily handling diversity of hazardous sources and scenarios by: assessing releases, predicting dispersion in the environment and assessing consequences,
- assessing quickly required emergency response (forces, vehicles, equipment),
- presenting results in a form of text, diagrams, drawings and maps,
- providing an easy access to the relevant information via a WWW site,
- providing means for training and simulation of any situation.

The system can operate in three main modes (see Fig. 1):

- administration,
- preparation of emergency plans,
- action.

Fig. 1 Modes of operation of the system SWAR.



The functions of the SWAR system relevant for a crisis management can be described as follows:

- diagnosis and prognosis of emergency (real time estimates of endangered areas, transport in the environment, potential consequences to people and environment),
- support of emergency response with use of a distributed computer network,
- automating alarming of personnel to be involved in emergency actions,
- assisting in action to be taken, by the co-ordination staff, responders and endangered personnel with use of computer network,
- collecting real time data from chemical meteorological, hydrological, fire detection and visual monitoring systems, and from measurements of parameters determining the state of buildings and waste dumps,

- GIS based graphical presentation of data,
- collecting and updating plant specific data (safety related design, operational and organisational information),
- generating subject oriented layers of digital maps.

Theory and methods

The UMPDA model

As the SWAR system has been designed as a modular one, any part of the system can be easily upgraded. Therefore, the UMPDA can be considered as one module of the SWAR system although it can be run as a standalone program.

The UMPDA represents unified approach to modelling of pollutant dispersion in atmosphere, for a ground-level or elevated two-phase pressurised or un-pressurised releases both continuous and instantaneous. The model is modification of approach used in the PHAST program, in the model calculating the pollutant dispersion [13].

As the unified model, the UMPDA consists of the following linked modules:

- jet dispersion,
- droplet evaporation and rainout, touchdown,
- pool spread and vaporisation,
- heavy gas dispersion,
- passive dispersion.

A single form of concentration profile is used to cover all stages of a release. This allows for anything from a sharp-edged profile in the initial stages of a jet release through to the diffuse Gaussian profile that would be expected in the final passive stage of spreading.
The UMPDA includes the effects of droplet vaporisation using a non-equilibrium model. Rainout produces a pool which spreads and vaporises. Vapour is added back into the plume and allowance is made for this additional vapour flow to vary with time. In addition to the non-equilibrium model, UMPDA also allows for an equilibrium model.
The UMPDA allows for vertical variation in ambient wind speed, temperature and pressure. Another feature of the UMPDA is possible plume lift-off, where a grounded cloud becomes buoyant and rises into the air. Rising clouds may be constrained to the mixing layer if it is reached.
The model coefficients have been obtained directly from established data in the literature (based on wind-tunnel experiments), rather than doing UMPDA simulations and fitting the UMPDA results to the experimental data.

In order to integrate all phases of atmospheric dispersion the UMPDA needs to use some physical-chemical properties of released substances corresponding to DIPPR standards. This includes also data bank for the prediction of the thermophysical properties of materials.

The material before release is assumed to be stored in a vessel under either pressurised or refrigerated (un-pressurised) conditions. The initial conditions are specified by the temperature pressure, phase, and liquid fraction (if stored as a saturated mixture of liquid and vapour). Discharge modelling consists of the following steps:

- Establishing the initial storage conditions and type of release (flashing/nonflashing, liquid/vapour/two-phase);
- Establishing the mass flow rate and choke conditions;
- Expansion from choke conditions to atmospheric pressure;
- Calculation of droplet size (for flashing or nonflashing liquid);
- Discharge calculation.

One must choose one of the scenarios. The choice of scenarios available depends on which vessel type has been used [1].

- Catastrophic rupture scenario — an instantaneous release of the entire inventory, either in a spontaneous failure, an internal explosion, or a BLEVE;
- Leak scenario — from a hole in the body of a vessel, or a small hole in a large pipe.
- Line rupture scenario — outflow from a full-bore rupture of a pipework attached to a vessel (or any kind of pressure reservoir);
- Relief valve scenario — a release in the event of a relief-valve opening. The program can model two causes of valve-opening: overpressuring, in which case the material released will be vapour; and overfilling or liquid swelling, in which case the material released will be two-phase;
- Rupture disk scenario — a release in the event of a disk rupture;
- *n* minutes release scenario — a leak with the size that will drain the inventory in *n* minutes;
- Vent from vapour space — venting of material from the vapour space of an un-pressurised or refrigerated vessel, typically during a filling operation.

The most important quantities calculated to describe the condition of the material and release are as follows:

- Mass flow rate;
- Phase (vapour, two-phase, liquid);
- Liquid fraction (for two-phase conditions);
- Temperature (for gas or liquid conditions);
- Final velocity;
- Droplet diameter (for liquid or two-phase conditions). If the final state of the released material at ambient pressure contains liquid then the program calculates the size of the liquid droplets. The method used depends on whether or not the liquid flashes.
- Duration.

These are the quantities that are passed to the dispersion modelling. Some additional quantities are calculated in the course of the modelling and are used to obtain the quantities above, but are not required for the dispersion modelling. These are: discharge velocity, choke pressure, choke temperature, discharge coefficient.

Meteorological data are assumed in the form of the profiles in order to model the lower layer of the atmosphere in which the dispersion is assumed to take place.
The wind speed varies with height in the atmosphere, as does the atmospheric temperature, pressure, density, humidity, etc. Simple relations are described here, which are appropriate to the first few hundred metres of the atmosphere. Three options are provided for the variation of atmospheric temperature and pressure with height:

(i) Constant temperature and pressure profiles;
(ii) Linear temperature and pressure profiles;
(iii) Logarithmic temperature profile and linear pressure profile;

Two options for the variation of wind speed with height are possible:

(i) Constant wind speed profile;
(ii) Power-law wind profile.

It is recommended that logarithmic temperature, linear pressure, and power-law wind profiles be used since this will give the most realistic modelling.

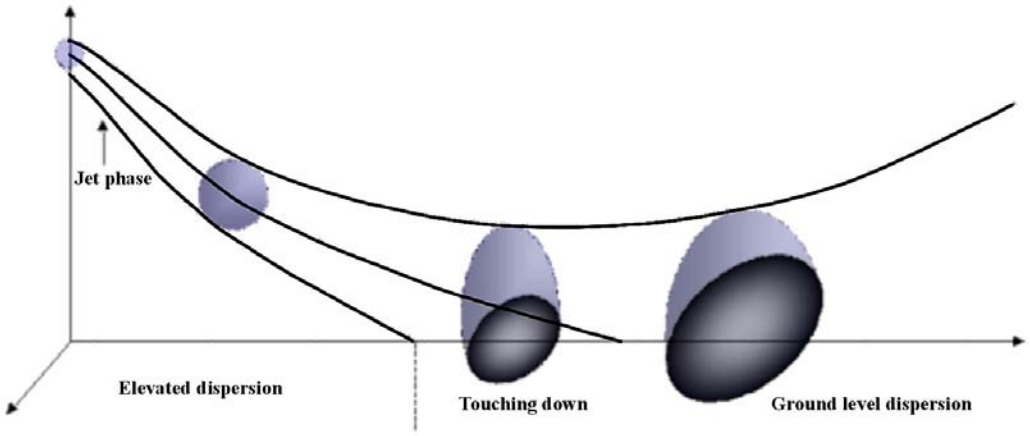
Dispersion is calculated using Gaussian-like profiles i.e. exponential decay of concentration is assumed in terms of the cross-wind (continuous release) or horizontal (instantaneous release) and vertical

dispersion coefficients (see Fig. 2). Empirical correlations are adopted for the exponents such that the near-field sharp-edged profile develops into a classic Gaussian profile in the far field [4,5,7,8,13].

The UMPDA invokes the thermodynamics module while solving the dispersion equations in the downwind direction [10,12]. The module describes the mixing of the released component with moist air, and may take into account water-vapour and heat transfer from the substrate to the cloud. The module calculates the phase distribution (component: vapour, liquid; water: vapour, liquid, ice), vapour and liquid cloud temperature, and cloud density. Thus separate water (liquid or ice) and component (liquid) aerosols may form.

The liquid component in the aerosol is considered to consist of spherical droplets and additional droplet equations may be solved to determine the droplet trajectories, droplet mass and droplet temperature. Rainout of the liquid component occurs if the droplet size is sufficiently large.
The UMPDA includes the following types of thermodynamic models:
Equilibrium model (no reactions). Thermal equilibrium is assumed, which implies that the same temperature is adopted for all compounds in the cloud (vapour and liquid). The equilibrium model determines the phase distribution and the mixture temperature.
Non-equilibrium model (no reactions). This model allows the temperature of the droplet (liquid component) to be different of the temperature of the other compounds in the cloud. The non-equilibrium model determines the phase distribution of the water and the vapour temperature.

Fig. 2 Dispersion phases [13]



A brief assessment of the UMPDA droplet model has been carried out. In conjunction with the equilibrium thermodynamics model the droplet model is used to set the droplet trajectories and the point of rainout only. In conjunction with the non-equilibrium thermodynamics model, it additionally calculates the droplet mass and the liquid droplet temperature. The initial drop size is taken as the minimum of the droplet size calculated by mechanical break-up and flashing break-up.

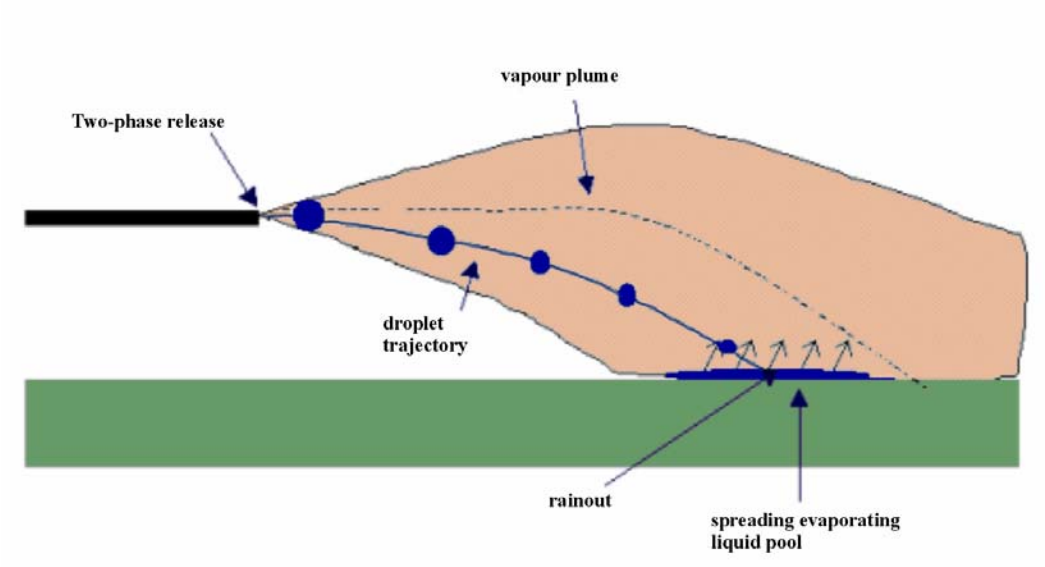
If the droplet reaches the ground, rainout occurs, i.e. removal of the liquid component from the cloud. This produces a liquid pool which spreads and vaporises [9]. Vapour is added back into the cloud and allowance is made for this additional vapour flow to vary with time (see Fig. 3).

The UMPDA source term model calculates the spreading and vapour flow rate from the pool [11]. The pool spreads until it reaches a bund or a minimum pool thickness. The pool may either boil or evaporate while simultaneously spreading [6].

For a continuous release, the rate of generation of vapour from the spilt liquid is added to the vapour already in the cloud to give a total flow rate for the combined source. When the release stops there may then be a period of vapour generated from the liquid pool alone.

In the case of an instantaneous release the vapour produced by the spilt liquid is added back into the cloud, so long as part of the cloud still covers the point at which the pool was formed by the rained-out liquid. If the spilt liquid all evaporates while covered by the cloud then all that is produced is an instantaneous cloud. If the liquid has not all evaporated then once the upwind edge of the cloud has moved past the pool any remaining liquid is assumed to form a continuous source of vapour.

Fig. 3 Two-phase release with droplets and evaporating liquid pool [13]



Design of the SWAR system

The SWAR system has been designed in order to work out an optimised decision, for which the following key factors play important role:

(a) accurate information on accident,
(b) proper assessment of current status and prognosis of development of situation,
(c) proper information on availability of means needed for emergency action like rescue teams, technical and medical equipment, means of transport etc.,
(d) reliable and fast communication system between decision makers, persons responsible for management of crisis situation, rescue teams and people in affected areas.

The first two elements (a) and (b) are related to appropriate monitoring network and models for assessment of emergency situation. The element (c) is supported by GIS-like systems available at crisis centres. The last factor (d), however is, to much extent, a question of proper organisation of decision making process and management during emergency action. It seems also that often there are some kind of gaps between items (a)-(b) and (c)/(d) or may be particularly between (d) and other factors mentioned above. Therefore more integrated approach has been proposed in the SWAR system. It should be also mentioned that the last element (d) is usually the weakest point in the whole system. This is often caused by not clear organisation and division of responsibilities between persons engaged in the decision making process and management. The problem of communication has also some technical aspects. This can be solved by using more advanced techniques like satellite technologies and centralised computer communication systems of new generation, which allows for fast and reliable sending and receiving messages not only in form of

text but also images or films. It is however interesting, that the same communication system can stand as a basis for integrating all elements (a)-(d) of the system. Such an approach has been investigated in the SWAR system [2,3]. The main idea has been based on design of central message server, which allows for:

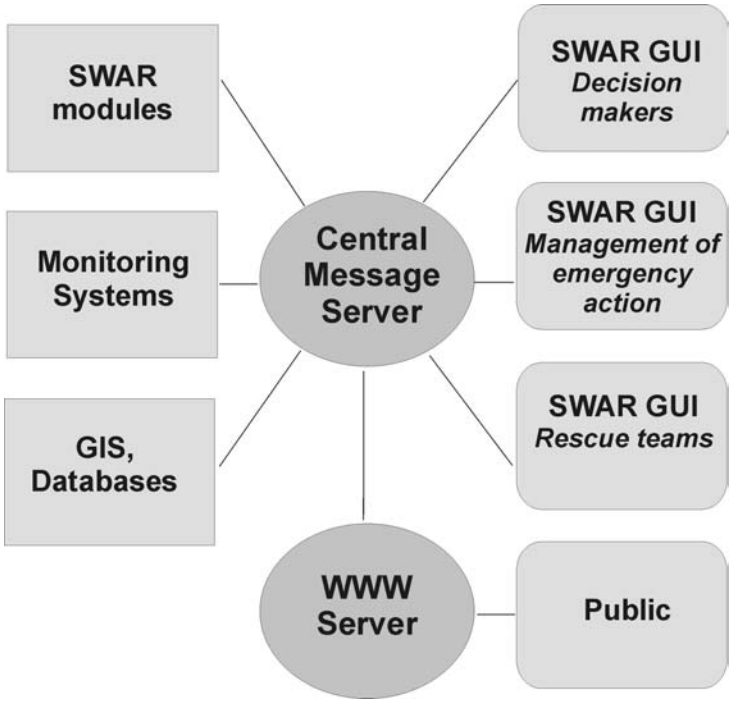
- bringing up to date information about current situation on numerical maps coming from decision support and monitoring systems,
- bringing up to date information about current status of emergency action,
- communication by sending and receiving messages, images, maps etc.,
- rapid access to all elements of contingency plans, defining responsibilities and possible actions of the key actors of the emergency scene.

Thus the central message server plays the key role for integration of all modules in the system. Therefore the whole system is composed of (Fig. 4):

- set of tools and functional modules located on the server,
- graphical user interface,
- central message server with connection to monitoring systems, GIS maps and databases, and WWW server.

It should be stressed that such design makes possible to apply distributed and/or parallel computing, as the SWAR modules can communicate via central message server as well. Software tools useful for development of the system are based on client-server and object-oriented methodologies.

Fig. 4 Structure of the SWAR system



Results

At the current stage of development the SWAR system consists of:

- Databases on: sources of hazards (materials, objects), employees in particular objects and forces and means for rescue actions - data integrated with digital maps under a GIS system.
- Database on basic chemical and physical properties of chemical substances.

- Digital maps of the plant and its vicinity.
- Module for collecting information from meteorological services, monitoring of concentration of dangerous substances etc.
- Modules for diagnosis and prognosis of accident scenarios, with use of information from real-time monitoring systems and/or simulation programs.
- Module for visualisation of pollution transport in the environment, indicating endangered areas, and for preparation of reports.
- Module for alarming personnel and warning people in the vicinity of the plant, and inform appropriate authorities.
- Module for support of co-ordination of the action and exchange of information between groups of rescue teams based on dedicated protocol.

The UMPDA model is included into SWAR system as a part of analysis module both for scenario calculation for emergency planning and for supporting emergency response in real-time. Usage of the central message server allows for fast and reliable exchange of data between all modules of the system. It means, that on-line meteorological data are transferred to the UMPDA module via central message server and can be used as input data. Similarly emergency zones calculated in the UMPDA model can be automatically sent to Web server and become visible for all user connected to the network. Basing on UMPDA calculations proper decisions important for emergency action can be undertaken and realised. Then the whole action can be co-ordinated and managed using SWAR system like. One of the attractive issue is a possibility of making analysis of crisis situation as well as preparing proper decisions by group of experts by persons not directly present in emergency centres.
The SWAR system uses digital maps, which can be stored in most popular GIS, like ArcInfo, MapInfo or Microstation. However it's possible to add information strictly relevant for supporting emergency response. This includes data on:

- technical equipment for rescue teams,
- organisation structure,
- external forces and means,
- all documents related to emergency preparedness,
- typical scenarios and their possible consequences,
- more detailed description of tasks of rescue teams stored in the form of control lists, which allows for better planning and controlling the situation.

Some of data can be linked to spatial objects. This is realised by defining attributes of the relevant object. The system is flexible as system administrator can add not only attributes or objects but also classes of objects via their attributes. All these operation can be made using Web browser. All documents are stored as html files, so they can be accessed independently of the system as well.

Discussions

The key advantages of the new UMPDA model with respect to other typical dispersion models can be summarised as follows:

- a single model for the entire dispersion regime from the point of release to the far-field dispersion including possible rainout and pool re-evaporation; this eliminates discontinuities and matching problems;
- a very extensive verification and validation to ensure that the model shows the correct behaviour and produces accurate predictions.

The UMPDA is integrated within the user-friendly and well-established SWAR computer network based decision support system for emergency response in case of chemical accidents. This enables plotting, linking with discharge/fire/explosion models, toxic/flammable impact and risk

calculations. The results of UMPDA calculations can be used in other modules of the SWAR system both for emergency planning and for supporting emergency response in real-time.

The SWAR system has been designed to integrate all key elements in the decision making process via central message server, which enables automatic transfer of all data between modules of the system as well as provides tool for information exchange and co-ordination of the emergency action.

References

Borysiewicz, M., Furtek, A., Potempski, S. (2000). A handbook for hazardous process installations risk assessment methods, Publ. Institute of Atomic Energy, Otwock -Swierk, ISBN 83-914809-0-9.

Borysiewicz, M., Galkowski, A., Potempski, S. (2001). Computer network based decision support system for emergency response in case of chemical accidents. In *Proceedings of the International Conference on Emergency Management (TIEMS 2001)*, Oslo, Norway.

Borysiewicz, M. & Potempski, S. (2002). Advanced real-time decision support system for chemical accidents. *Transactions of American Nuclear Society*, Vol. 87, pp.581-582.
Briggs, G. A. (1984). Plume rise and buoyancy effects. In D. Anderson (Eds.). *Atmospheric science and power production*, pp. 327-366. US Dept. of Energy Report DOE/TIC-27601.

Disselhorst, J.H. M. (1984). The incorporation of atmospheric turbulence in the KSLA Plumepath program, Shell Internationale Research Maatschappij B. V., The Hague AMGR.84.059.

Fleischer, F. T. (1980). SPILLS: An evaporation/air dispersion model for chemical spills on land. *Shell Westhollow Research Center*, *Huston, Texas,USA*.

McFarlane, K. (1991). Development of plume and jet release models. In *Materials of the Conference and Workshop on Modelling and Mitigating the Accidental Releases of Hazardous*, AIChE, CCPS, New Orleans, LA, pp. 657-688.

Morton, B. R., Taylor, G. I. & Turner, J. S. (1956). Turbulent gravitational convection from maintained and instantaneous sources. *Proc. R.. Soc London*, Sect. A, 1, 234, 1956.
Opschoor, G. (1979). Methods for the calculation of the physical effects of the escape of dangerous materials, *TNO Yellow Book*.

Reid, R. C., Prausnitz, J. M. & Sherwood, T. K. (1977). The Properties of Gases and Liquids McGraw-Hill.

Shaw, P. and Brisco, F. (1978). Evaporation from spills of hazardous liquids on land and water, SRD R 100 UKAEA, Culcheth, UK.

Whitaker, S. (1968). Introduction to Fluid Mechanics, Prentice-Hall. New York.
Witlox, H. W. M. (2000). Unified dispersion model (UDM). *Theory manual, DNV Software Products and Development Report* .

Authors biographies

Borysiewicz, M. J., Ph D in Physics, Director of the Centre of Excellence MANHAZ (Managament of Health and Environmental Hazards), Institute of Atomic Energy, Otwock-Swierk, Poland. Experience in assessment and management of major accident risk from industrial installations including development of methods, guidelines, real time computer aided emergency decision

support system for nuclear and chemical process installations and stand alone computer codes for pollutant transport in the environment.

Gałkowski, A., PhD in Engineering Science, DSc in Physics, Deputy Director the Institute of Plasma Physics and Laser Microfusion, Warsaw, Poland. Special fields of interest: plasma physics, transport and dispersion numerical modelling.

Potempski S., Ph D in Mathematics, Deputy Director of the Centre of Excellence MANHAZ (Managament of Health and Environmental Hazards), Institute of Atomic Energy Otwock-Swierk, Poland. Responsible for implementation of the national decision support system in case of nuclear emergency. Special fields of interest: numerical analysis, information technology and computer aided decision support systems for nuclear and chemical emergencies.

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

RADIOCHEMICAL CONTAMINATION ANALYSIS BASED ON DENDROCHRONOINDICATION DATA

Yuri Polichtchouk, Tatiana Peremitina, Valery Neswetajlo[1], Victor Migounov[2]

Institute of Petroleum Chemistry, SB RAS
Tomsk State University[1]
Yugorsky State University[2]

Keywords: Radiochemical contamination, nuclides, dendrochronoindication, endrochronology, geoinformation systems, principal component analysis, spatial analysis.

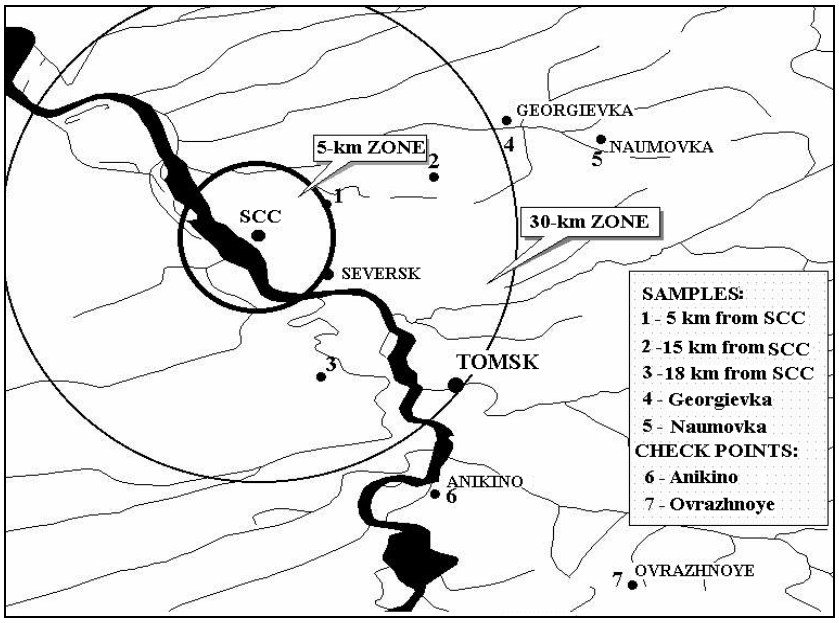
Abstract
Dendrochronoindication analysis based on combination of dendrochronology method and modern methods of the physical-chemical analysis of matter of tree annual rings is considered. In this paper, the dendrochronoindication method is applied for analysis of radiochemical contamination of soil and air in territory of Tomsk region which is under influence of Siberian Chemical Combine. Samples of the tree annual rings were collected both within 30-km zone of the Siberian Chemical Combine (SCC) and outside the one. Statistical analysis of the dendrochronoindication data on radioactive nuclide concentration in timber of annual rings was carried out using geoinformation approach based on combination of principal component analysis and spatial analysis with geoinformation systems. Dendrochronoindication and geoinformation methods application have allowed revealing the retrospective data approximately for 40-years period to the present. It is shown that some past emergency situations of large nuclear plant are revealed in past using the dendrochronoindication data.

Introduction
One of the important problems of urban emergency planning is nuclear safety. This paper is devoted to the environmental impact of radiation contamination [1] caused by activity of a radiochemical plant. It is known the most radiation pollution in the world was produced by multiyear nuclear weapon tests in the atmosphere. The former USSR and the USA finished these tests at 1962 and 1963 years correspondingly. Nowadays the main sources of radiation contamination of territories are from nuclear plants. As a result of their activity the territories of many regions are contaminated by the nuclides. That is why a very important problem is to develop effective methods and tools for monitoring nuclear plant impact on environmental state suitable for emergency management. The main aim of our work is to show the possibility of carrying-out spatial-temporal analysis of nuclear plant impact on the environmental state using dendrochronoindication data on nuclides concentration in annual rings of trees growing at different distances from the sources of radiochemical contamination.

In this paper, the objects of dendrochronoindication analysis are selected trees growing in impact zone of Siberian Chemical Combine (SCC) near Tomsk city in West Siberia. The location scheme of model trees in impact zone of nuclear plant is given in Fig. 1. The SCC is one of the largest radiochemical plants and has been in use about forty years. The 30-km zone of SCC involves many settlements with total number of inhabitants above 650 thousand people. The largest of them are Tomsk and Seversk.

There were some emergency situations in multiyear activity of SCC. The most known of them was the emergency of 1993 when nuclides were distributed by the wind direction to Georgievka and Naumovka villages (points 3 and 4 in Fig. 1) and points 1 and 2. The last two points are within 30-km zone of SCC. Two other points 6 and 7 placed near Anikino and Ovrazhnoye villages correspondingly were chosen in relatively poor territories as check points.

Figure 1: The places of research samples selection



The dendrochronoindication method application has allowed revealing the retrospective data on concentrations of tritium, radiocarbon and cesium in timber of annual rings approximately for 40-years period to the present. The DCA method is used for indication of environmental impact on radiochemical contamination of soil and air. The annual rings samples were collected both within 30-km zone of the SCC near Tomsk city and out of one.

Theory and Method

The method of dendrochronoindication analysis (DCA) is based on combination of the well known dendrochronology method and modern methods of the physical-chemical analysis of annual tree rings. Computer analysis of dendrochronoindication data was performed using geoinformation approach [2,3] based on combination of principal component analysis and spatial analysis with geoinformation systems. DCA method permits one to obtain retrospective information about natural processes and phenomena, as well as their dynamics, based on establishing the correlation between certain characteristics of annual tree rings and environmental impact. So the DCA method is prospective one for researches of environmental state changes in past which were conditioned by man-caused factors.

The approach of DCA is determined by a wide range of characteristics of annual tree rings and how they are informative about different natural and anthropogenic processes and phenomena. It is possible to outline a physical and chemical DCA based on the analysis of physical and chemical characteristics of annual tree rings (their density, reflection ability, element, biochemical and isotopic structure of wood in annual tree rings).

According to the types of tasks set, DCA can provide: 1–dating of events (dendrochronology); 2–indication of climate changes (dendroclimatology); 3–indication of natural processes and phenomena, for instance, solar activity dynamics, dynamics of forests and forest vegetation zone, forest fires; 4–indication of anthropogenic impact on environmental state.

Statistical processing and analysis of dendrochronoindication data were carried out in the frame of geoinformation approach using the well known statistical method of principal component analysis (PCA) which was applied in combination with spatial analysis. The method of spatial analysis allows dividing the large data array in several spatial homogeneous data groups using digital maps of model territories. Such a procedure permits to simplify analysis of dendrochronoindication data. The results of the principal component analysis of data groups are represented in graph form in space of the first two principal components using confidence ellipses for each data groups.

Such representation of the PCA results establishes if there is statistically significant difference between objects analyzed. But the realization of this procedure is impossible without applying geoinformation systems (GIS) and GIS-technologies. The application of geoinformation tools allows fulfilling a multidimensional data analysis by using digital maps and simplifies the procedures of environmental forecast and assessment of the technogenic impact on environmental state of territory.

The general structure of GIS for analysis of environmental impact given in [2] includes databases, digital map subsystem, general and special software. The digital map subsystem is intended collect cartographical information about the territory under study. A basis of the subsystem is digital map of scale 1: 1000000. There are some topographical maps of other scales and different thematic digital maps. The general software used consists of GIS ArcView 3.x and ERDAS Imagine. Special software is intended to carry out statistical procession and analysis of dendrochronoindication data. One of the main components of special software are PCA program tools.

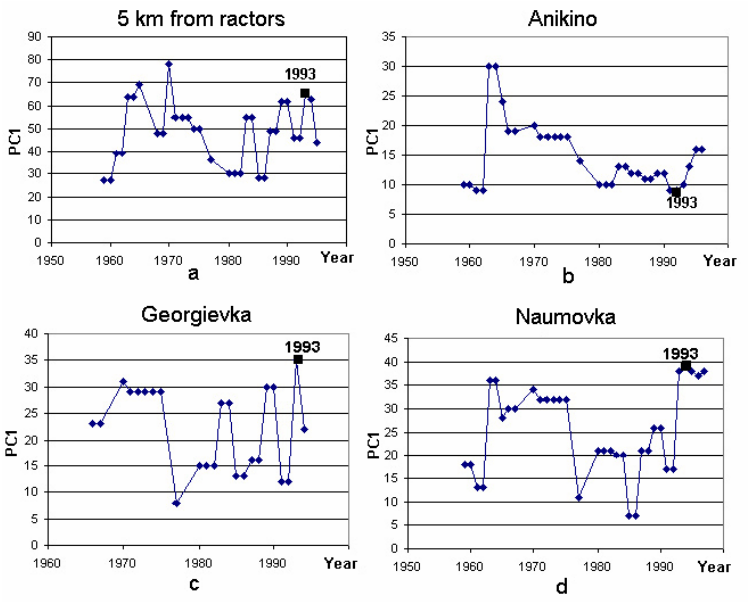
Results

Dendrochronoindication data processing is performed using principal component analysis, which is an appropriate way to reduce data sets containing a high number of variables. This approach highlights fundamental differences between groups of variables by reducing the number of original variables to a smaller number of independent variables (principal components).

The results of data analysis by a principal component method have shown that maximum activity of tritium is into a pine placed in 5 km from reactors. Smaller quantity of tritium is accumulated in trees near Georgievka and Naumovka villages (above 30 km from SCC), but the pine in Anikino village (above 30 km from SCC) has the smallest activity of tritium. Comparisons of results obtained in three different zones (5, 30 and above 30 km from nuclear reactors) have shown that data is divided in three classes. The first class involves samples from 5-km zone, the second class involves samples from 30-km zone and the third class involves samples from above 30-km zone. The first class has greatest values comparing with second and third classes.

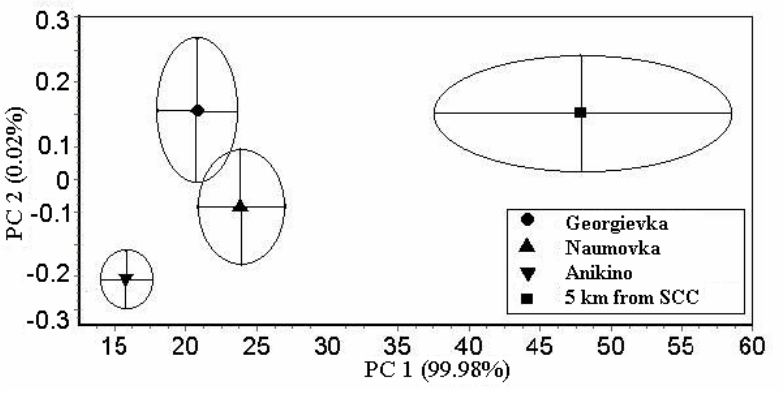
The values of first principal components PC1 and PC2 were determined for all trees in points shown in Fig. 1. Temporal dependences of PC1 calculated from dendrochronoindication data on tritium concentration in forth model trees located at different distances from SCC in points 1-4 is given in Fig. 2. As it is shown from Fig.2-a, Fig. 2-c and Fig. 2-d PC1 value is increased for 1993 year. The PC1 calculated for model tree from check

Figure 2: Temporal dependences of the PC1 value for some model trees



point Anikino (Fig. 2-b) did not increase at that year compare with neighbor years. As three trees corresponding Fig. 2-a, Fig. 2-c and Fig. 2-d are in direction of nuclide atmospheric emission caused by emergency of 1993 year at SCC, it may be concluded that PC1 calculated on base of dendrochronoindication data is sufficiently informative characteristic about past emergency situations in nuclear plant activity.

Figure 3: Representation of the results of samples analysis in space of the first two principal components



Representation of the PCA results in space of the first two principal components for the same points 1 – 4 is given in Fig.3. This graph illustrates clearly that there is statistically significant difference between objects analyzed in dependence of distance from nuclear emergency source.

Besides, it is revealed that maximum values of radiochemical contamination were found for the middle of the sixty years; may be considered as a consequent of nuclear-weapon tests in

atmosphere. A decrease of tritium activity is observed since 1965. However it increases in the 1970, 1983-84 and 1987-90 years, especially in a pine of 5-km zone. Increase of tritium activity in above-mentioned periods has not been revealed in the pine of Anikino, which is check point outside of 30-km zone.

Conclusion

Principles and methods of dendrochronology [4,5] in combination with modern methods of the physical-chemical analysis of annual rings are the base of the new approach to complex analysis of natural processes and phenomena. It is called dendrochronlogical analysis (DCA) and provides retrospective information about environmental state changes based on correlation between certain characteristics of annual trees rings and environmental impact. The DCA method is used for indication of environmental impact on radiochemical contamination of soil and air. The annual rings samples were collected both within 30-km zone of the SCC near the Tomsk city and out of one.

The dendrochronoindication method application has allowed revealing the retrospective data on concentrations of tritium, radiocarbon and cesium in timber of annual rings approximately for multiyear period. It is shown that principal component analysis allows revealing the tendency of changing the contamination level in respect with distances from radiochemical plants.

The results obtained may be applied to reveal past emergency situations in past at nuclear plants.

Acknowledgements

This work is a result of researches carried out in framework of Integrated Project of Russian Academy of Sciences, Siberian Branch “Siberian Geosphere-Biosphere Program” and supported by Program INTAS (project ATMOS, contract INTAS-00-189) and Federal Program of RF “Integratsia” (project F0009/1248).

References

Starkov V.D., Migounov V.I., Radiation ecology (in Russian), 304 pp., FGU IPP «Tyumen», Tyumen, 2003.

Polichtchouk Yu., Kozin E., Ryukhko V., Tokareva O., Geoinformation Systems for Regional Environmental Studies, Proceedings of SPIE, 3983, 572–577, 1999.

Polichtchouk Yu., Tokareva O., Geoinformation analysis of atmosphere pollution impact on the landscape of Siberian oil-producing territories, Proceedings of SPIE, 4341, 571–577, 2000.

Buzinny M., Kovalyukh N., Likhtarjov I., Los I., Nesvetajlo V., Pazdur M., Scripkin V., Shkvorets O., Ecological chronology of nuclear fuel cycle sites, Radiocarbon, 2, 469-473, 1995.

Professional Practice

The articles and presentations in this section are not peer reviewed.

CONFERENCE PRESENTATIONS

Presentations about TIEMS

Keynote Speaker Summaries

Other Presentations of Interest

TIEMS GLOBALISATION: FROM VISION TO REALITY

K. Harald Drager[1]
President, The International Emergency Management Society (TIEMS)

Introduction

Catastrophes are not limited by any borders. The Chernobyl catastrophe is a good example of an accident that had enormous consequences in neighbouring countries.

When natural hazards like earthquakes happen, like the one recently in 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 threatening spreading 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.

Background

The International Emergency Management Society (TIEMS) was founded in Washington in 1993, and arranged its 10th annual international conference in Provence, France, in June 2003, and the 2004 annual conference is beeing arranged in Melbourne/Shire of Yarra Ranges in Australia in May this year.

Over these 10 years, the society has been known to be a true international society with participants at its conferences from more than 50 countries, and close to 1000 papers of exceptional good quality have been presented.

At the international conference in Waterloo, Canada in 2002, the Board of Directors approved a very challenging program for the future, comprising the following issues:

- New organisational structure
- Globalisation of the society

[1] khdrager@online.no

- TIEMS conferences to be an annual meeting place for the international emergency management community
- Define TIEMS' professional role in a TIEMS strategy document

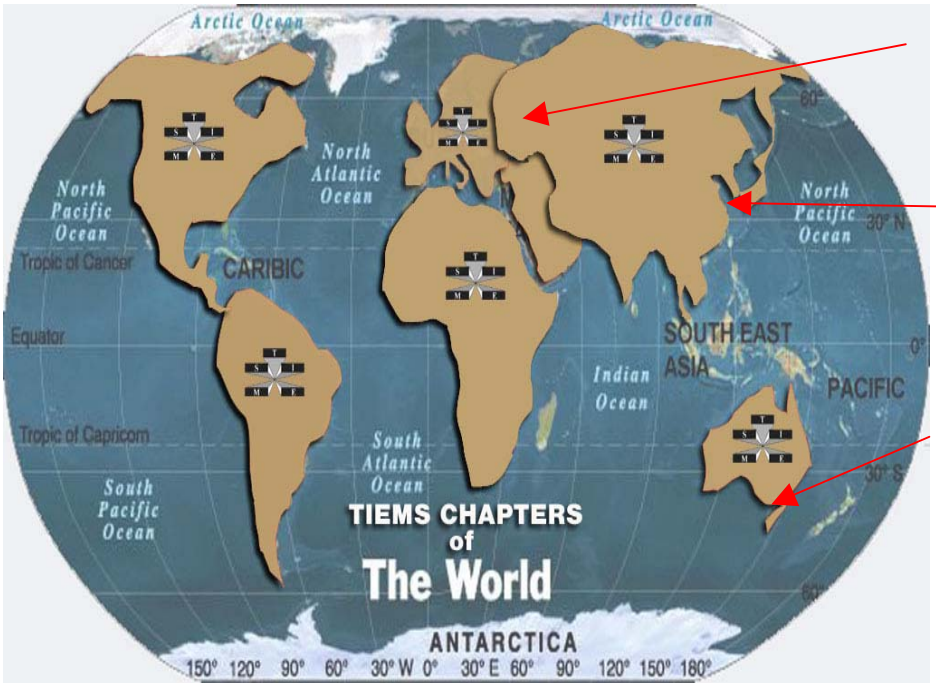
Since Waterloo, an international TIEMS Board of 17 directors and officers from 12 different countries is in place, with defined working tasks. The TIEMS' Web Site; www.tiems.org has been redesigned and updated in order to meet the challenge of today's interactive communication over the Internet. An electronic newsletter, "Carpe Diem", is available through the Web Site. All visitors are invited to participate with comments, questions, ideas and views on any matter related to Emergency Management. This will contribute to TIEMS WEB-site becoming an international forum for the Emergency Management Community. More than 50 000 visitors has visited TIEMS WEB-site since its redesign in September 2003.

Membership in TIEMS has been offered since January 1, 2003, with a secretariat to handle both membership and conference registrations in Oslo, Norway. An International Program Committee has been established to be responsible for the professional program at TIEMS conferences, symposiums and workshops. The recruitment of members to the International Program Committee is an ongoing activity.

The professional program has been extended to also include symposiums and workshops, and the first workshop in the history of TIEMS took place in Washington, D.C. in USA 28th - 29th January 2003, the second one in Seoul, Korea 12th – 13th February this year, and the third one in Moscow, Russia April 20th – 22nd. Further workshops are planned this year in Magdeburg in Germany 23rd – 25th June, in September in Split, Croatia, in October in England and in November in The Czech Republic.

TIEMS Board also approved establishment of a global organisational infrastructure for TIEMS, consisting of Regional and National TIEMS Chapters as the fundamental elements of the organisation to strengthen and add value to the central core organisation. In order to achieve this, directors and officers on the TIEMS Board have been appointed to serve as representatives for the six world continents, with the duty of initiating the establishment of regional or/and national TIEMS Chapters.

TIEMS' Board vision of establishing world wide TIEMS Chapters is visualized in the following:



Measures to Achieve TIEMS Global Goal

One of the aims when arranging Regional/National workshops and annual Conferences is to establish a Regional/National TIEMS Chapter with its own TIEMS Chapter Board, and with the aim of building up strong Regional/National TIEMS Chapters with members that will support the international TIEMS organisation.

To achieve TIEMS Global Goal, the following ingredients are necessary:

- An active TIEMS member, who takes the local responsibility and acts as the host
- The TIEMS International Task Force, which contribute with international presentations at the workshops and conferences
- Local Authorities and Organisations that cooperate with TIEMS in arranging the events
- Local and International sponsors which use the opportunity to support TIEMS mission
- Willing and interested professionals which take the responsibility to form the Regional/National TIEMS Board
- A Regional/National interest from emergency management professionals that like to join TIEMS as members

During this year's TIEMS annual conference, a TIEMS Australian Chapter is planned to be established.

TIEMS Mission Statement

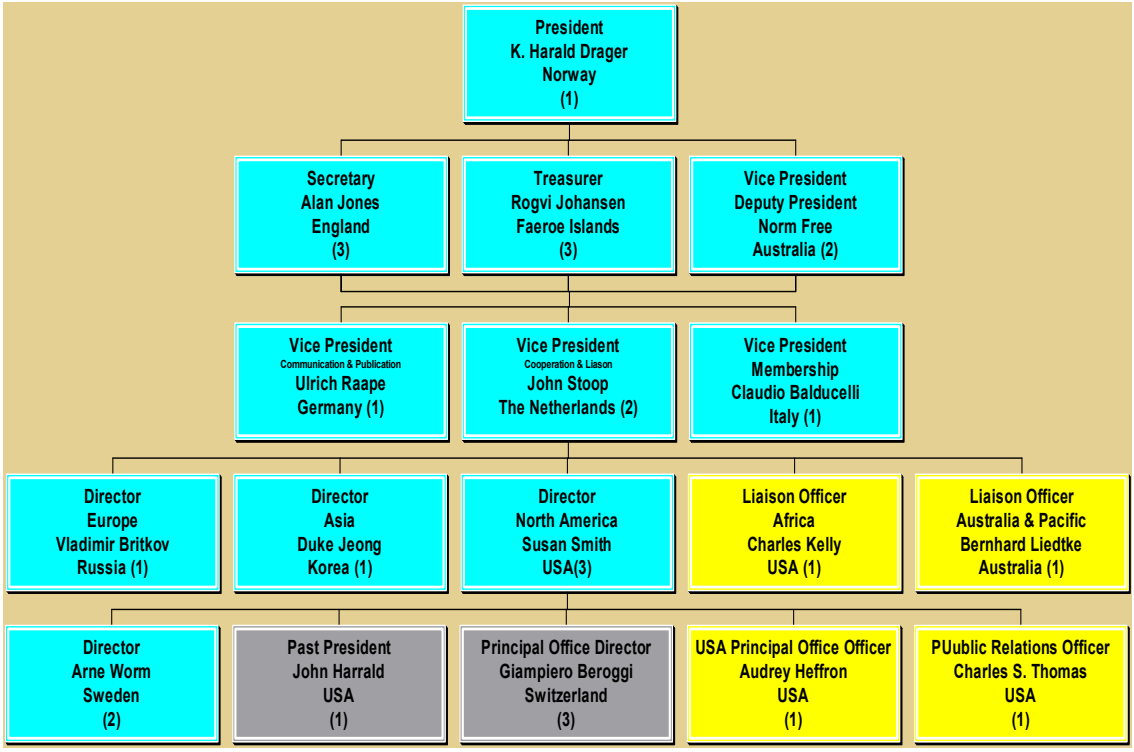
TIEMS is dedicated to developing and bringing the benefits of modern Emergency Management (EM) tools and techniques to society for a safer world.

TIEMS will achive its mission by:

- *Focusing on the transfer of technology from computers, communication, information technology and social sciences in providing emergency managers with helpful decision support;*
- *Providing a forum for policy guidance to governnmental bodies concerning the management of emergencies;*
- *Bring the modern tools of Emergency Management into market place to help provide high quality EM practices around the world;*
- *Addressing Emergency Management in the context of its implications to the environment and the society;*
- *Monitoring the evolution of the best practices in Emergency Management throughout the world;*
- *Making a multi-disciplinary "all-hazards approach" to tackling emergencies;*
- *Bringing together stake-holders such as governmental, industrial, academic, and volunteer organizations;*
- *Using technologies from various diverse fields such as simulation, operations research, knowledge based systems, decision support systems, information systems, psychology and other behavioral sciences.*

TIEMS Organisational Structure

TIEMS present Board of Directors and Officers is shown below:



TIEMS Board consists of ***TIEMS Executive Committee***; President, Deputy President, Treasurer and Secretary, ***TIEMS Vice Presidents***; Communication & Publication, Cooperation & Liaison and Membership, ***Regional Directors and Officers***; Europe, Asia, North America, Africa and Australia & Pacific, and ***TIEMS Duty Directors and Officers***; Past President, Principal Office Director; USA Principal Office Officer, Public Relations Officer and one Director without special duties.

The Regional/National TIEMS Chapters will have a TIEMS Chapter Board of at least 5 members; President, Vice-president, Treasurer, Secretary and one board member without special duties. An interim TIEMS /Regional/National Board of the /Regional/National Chapter will be proposed by the local host and local organisers and approved by TIEMS International Board, with the duty to have an election of a permanent TIEMS Chapter Board within one year, by the TIEMS members belonging to the actual TIEMS Chapter.

The President of the TIEMS Chapter will be proposed to become a member of the TIEMS International Board, as a representative of the Region the National Chapter belong to. When more National Chapters are established within a TIEMS Region, an election process or appointing process will be established within the TIEMS region.

Those who want to become TIEMS members, will be members of TIEMS International, with the choice of belonging to a TIEMS Regional/National Chapter, where they participate in Regional/National events and elections.

TIEMS By-laws will also be valid for the TIEMS Chapters with local adoptions. All adoptions shall be approved by TIEMS International Board. A new set of By-laws will be approved at TIEMS Annual Meeting in Australia, dealing with the relationship, both organisational, operational and economical, between TIEMS International and the Regional/National TIEMS Chapters.

Regional/National TIEMS Chapters shall be responsible for arranging Regional/National events, and should at least have one event annually, where a Regional/National annual meeting shall take place with a specific agenda, and election of the Regional/National TIEMS Chapter Board.

The Regional/National TIEMS Chapter should also be prepared to arrange TIEMS Annual Conferences in cooperation with TIEMS International Board. The Regional/National TIEMS Chapters should also actively promote TIEMS Annual Conferences Regionally/Nationally as well as TIEMS International Board will support the Regional/National events with international participation.

The Regional/National TIEMS Chapter shall also establish a Regional/National WEB-site in both English and the national language, which shall be linked to TIEMS International WEB-site; www.tiems.org

TIEMS Activities

In the following is listed some items of importance for TIEMS activities, which are shortly described below:

- TIEMS Events
- Contact/Information Network
- TIEMS WEB Forum
- Standardization
- Training

- Emergency Management Databases
- Library of TIEMS Papers
- TIEMS Journal

TIEMS Events

The upcoming international annual conference in Melbourne/Shire of Yarra Ranges, is TIEMS 11th international conference. In Waterloo the TIEMS Board decided to extend its events also to comprise:

  - Symposiums
  - Workshops
  - Exhibitions at TIEMS events

Along with the globalisation of TIEMS, it is important to build up the Regional/National activity and use this as recruitment for members and participants for the international conferences. The future program for TIEMS looks like:

- 2005 International Annual Conference in The Farao Islands

The upcoming annual conferences should from 2006 concentrate on those regions of the world where TIEMS has not arranged conferences before, like for example:

- 2006 The Korean Chapter has expressed interest to arrange this annual conference
- 2007 Russia?
- 2008 South America?
- 2009 Africa?

The Regional/National TIEMS Chapters are encouraged to be the host for TIEMS annual conferences.

Contact/Information Network

A global contact and information network could also be provided by TIEMS through its WEB-site network, giving vital information on different aspects of international emergency management. This could comprise, for example:

  - Universities/Students Exchange Program
  - Emergency Management Projects
  - Funding Availability
  - Emergency Management Industrial Companies
  - Public Authorities and National Emergency Management Organisations
  - Humanitarian Organisations
  - Emergency Management Societies
  - Emergency Management Consultancy Experts
  - Emergency Management Practitioners

This can then serve as a good recruitment base for TIEMS.

TIEMS WEB Forum

TIEMS WEB Forum is established at TIEMS WEB-site; www.tiems.org

The WEB-site is visited by more than 50 000 visitors since September 2003, and is TIEMS most important communication tool with the international emergency managemnt community.

The Regional/National TIEMS Chapters should establish WEB-site in English and its national language, which should be linked to TIEMS International WEB-site.

Standardization

Catastrophes are not limited by any borders. The Chernobyl catastrophe is a good example of an accident that had enormous consequences in neighbouring countries. Standards for warnings and emergency management systems and operations may reduce consequences and make the world safer.

The international base of TIEMS makes the society an excellent organisation for establishing a working group on emergency management standardisation.

Training

TIEMS conferences, symposiums and workshops represent a source of knowledge in emergency mangement. Some of the papers presented cover subjects of highly interest well beyond the TIEMS audience, and could form the basis for training courses on different aspects of emergency management.

TIEMS could form a working group with the objective of developing the most actual papers into training courses, which can be run around the world in TIEMS chapters.

TIEMS Korean Chapter has expressed interest to have emergency management education and training as their main activity.

Emergency Management Databases

A huge amount of databases with different emergency management data is available over internet from different sources. The data is of various type and quality. However, to develop a TIEMS database link and quality advicers for all these databases would be a tremendous help for those looking for emergency data and using these data in their different operations and research.

Library of TIEMS Papers

All papers from TIEMS Conferences and workshops will be available on TIEMS WEB-site shortly, and thus available for the international emergency management community.

TIEMS Journal

Selected TIEMS papers from TIEMS conferences are today published in International Journal of Emergency Management. The Executive Editor is Jean Luc Wybo, past President of TIEMS and host for last years conference in Provence, and several of the Associate Editors are active members and directors of TIEMS.

TIEMS may consider to issue its own international journal, to have a hard copy journal for distribution of papers and news, even if the WEB-site network will be the primary source of information distribution from the society.

Virtual conferences

In TIEMS effort to become a true international organisation, it is important to recognize the different social and economic situation in the world, and deal with these in a practicle way so that we also can involve those countries not having the economic ability to travel and participate in TIEMS global events. This year TIEMS has a special attention on Africa, and TIEMS Liaison Officer for Africa has taken the inititaive to do a virtual conference prior to TIEMS annual conference, aimed at involving the African countries, where emergency management professional may not have the financial resources to travel to Australia.

The idea is to have a virtual conference as part of TIEMS 2004, to organize an exchange of e-mails around four topics dealing with disaster management in Africa, with one topic covered in each of the four weeks preceding the conference.

The results of the exchange would be summarized each week and shared with participants as well as included in the conference proceedings in the form of a report posted to the TIEMS WEB-site. A poster-type summary of the exchange would also be provided at the conference itself. This poster would be a way to inform TIEMS members about Africa-related issues.

The experience from this effort will be used to repeat this at later conferences for other developing areas or in transition economic areas in the world.

Technology transfer and research exchange

Another important aspect of TIEMS international work and operation, is technology transfer and research exchange. A number of very qualified emergency management experts participate every year at TIEMS conferences and workshops. It should be possible to establish a working group within TIEMS, with the objective of putting together a Technology Transfer and Research Exchange Program, which could benefit those countries that would like to use this opportunity to "learn from others".

TIEMS main international emergency management focus

During TIEMS annual conference AGM(Annual General Meeting), TIEMS main international focus within emergency management will be discussed and concluded.

Risk can be expressed as:

(1) Risk = (Probability of occurrence of an incident) X (Cost of consequences)

To reduce the Risk, either

(2) Probability of occurrence of an incident

or/and

(3) Cost of consequences

can be addressed and reduced.

It is believed that having a proactive approach to risk by performing risk assessments in order to know the risk we are facing, and having focus on measures to reduce the probability of occurrence