INDIGO
Crisis Management Solutions

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Abstract

A State-of-the-Art report on services and tools available to emergency and civil security organizations for training and crisis management and the related interoperability issues.

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Content

1 Executive Summary

This report reviews core technologies that are available to crisis and emergency managers. By studying the academic literature as well as software reports found on line, the report provides an overview of decision-support systems, simulation software, and other technologies specifically designed to serve crisis managers. The report finds that despite the many promises found in the literature, there is still paucity in available technologies that enhance the effectiveness of crisis managers.

2 Introduction

2.1 Description of aims

This report reviews core technologies that are available to crisis and emergency managers. It studies the academic literature as well as software reports found on line. The aim is to map what type of software systems already exist and how they function. In addition to providing brief descriptions, we formulate potential implications for the INDIGO project. This report should help answer the question: what should we build (and what should we NOT build)?

2.2 Working method

To accomplish these aims, we have done the following:

- Desk top study: we studied selected journal articles using keywords. With few notable exceptions (because they were frequently cited in the literature), we did not study articles published before the year 2000.
- Journals accessed: *Communications of the ACM; Journal of Contingencies and Crisis Management; Simulation and Gaming; Journal of Management Information Systems; International Journal of Information Technology and Decision making; International Community on Information Systems for Crisis Response and Management; Decision Support Systems; Cognition, Technology and Work; Human Computer Interaction 2009; Journal of Crisis and Contingencies.*
- In addition, we searched the Internet for relevant product descriptions (using the same keywords and following up on names/products mentioned in the literature.

We organized our findings and observations into five product categories that are separate in both function and design:

- Crisis simulation software
- Decision Support Systems (DSS)
- Humanitarian logistics software
- Crisis communication technologies
- Tactile tables

2.3 General findings

Our main findings covering all product categories are:

1. The literature reports primarily on design specifications, ideas and “prototypes”– very little can be found on assessments/evaluations of software-in-use. As one pair of experts noted: “Even the most advanced information technologies did not seem to notably contribute to the faster relief of affected populations” (Van de Walle and Turoff, 2007:29; cf. Mendonca et al, 2007).

2. The research makes painfully clear that IT/software engineers and crisis scholars do not communicate (they are clearly unfamiliar with each other’s work and key findings of that work). This leads to IT products that crisis managers do not need; it also means that crisis managers are not familiar with the technological possibilities available to them).

2.4 Report Outline

This report begins by briefly outlining the main findings on the four product categories. We will first present the findings about simulation software (chapter 3); DSS (chapter 4); logistics software (chapter 5); crisis communication technology (chapter 6); and tactile tables (chapter 7). The report presents more detailed case studies in chapter 8. We end this report with a conclusion (chapter 9) and recommendations for the INDIGO project (chapter 10).

3 Simulation tools

In general, we can state that the crisis literature pays little attention to the use of IT-based simulation tools (for a general overview, see Dugdale et al, 2010).

In ideal-typical sense, we can distinguish between three types of audiences:

A. **Individual responders**: there is a large number of simulation games that individual responders can use to enhance their skills (see Te Brake et al, 2006). While the developments in this product category are spectacular, the findings do not bear much relevance for the Indigo project (that does not focus on individual responders). Quite a few software packages are also in 3D.

B. **Network of responders**: most crisis response operations are delivered through a network of response organizations. Indigo aims to provide simulation tools that can be used by multiple network participants. We did not find articles or software that is made specifically to train response networks.

C. **Leaders/executive teams**: We found no simulation software specifically designed to train executive leadership teams.

We end this section with one, overall observation: the need for 3D in executive/network training is not discussed in the literature. It is not clear, however, whether this reflects a genuine disinterest on the part of practitioners or a degree of ignorance on the part of crisis academics with regard to the possibilities of 3D software.

4 Decision Support Systems for Crisis Management

The literature describes a long history of trying to design decision support systems (DSS) for crisis and disaster managers. The assessment that emerges from reading the literature is pretty bleak, however. We found many ideas, design premises, and even prototypes – but very few descriptions of working systems (we will describe several of these systems in Chapter 8).

The most accurate premises and near-perfect design can be found in Turoff et al (2004; cf. French and Turoff, 2007; see also Hale (1997), Carver and Turoff (2007) and Kim et al (2007)). Even though this is a much-cited piece, it has not been translated into working software (personal correspondence with Prof. Turoff).

As this piece captures the state of the art in thinking about crisis management DSS, we hereby summarize the premises that should give rise to a Dynamic Emergency Response Management Information System (DERMIS):

1. System training and simulation: An emergency system that is not used on a regular basis before an emergency will never be of use in an actual emergency.
2. Information focus: people responding to an emergency are working 14-18 hour days and have no tolerance or time for things unrelated to dealing with the crisis.
3. Crisis memory: learning and understanding what actually happened before, during, and after the crisis is extremely important for the improvement of the response process.
4. Exceptions as norms: almost everything in a crisis is an exception to the norm.
5. Scope and nature of crisis: the critical problem of the moment is the nature of the crisis, a primary factor requiring people, authority, and resources to be brought together at a specific period of time for a specific purpose.
6. Role transferability: it is impossible to predict who will undertake what specific role in a crisis situation. The actions and privileges of the role need to be well defined in the software of the system and people must be trained for the possibility of assuming multiple or changing roles.
7. Information validity and timeliness: establishing and supporting confidence in a decision by supplying the best possible up-to-date information is critical to those whose actions may risk lives and resources.
8. Free exchange of information: crises involve the necessity for many hundreds of individuals from different organizations to be able to freely exchange information, delegate authority, and conduct oversight, without the side effect of information overload.
9. Coordination: the crux of the coordination problem for large crisis response groups is that the exact actions and responsibilities of the individuals cannot be pre-determined.

Five criteria for the conceptual design of a group communication system that appear especially appropriate to the emergency response environment:

1. Metaphors: metaphors are the mental models of a system that a user can easily learn in order to create a cognitive map that will make it easier to understand the system. The metaphor allows the user to translate the task objectives into interface actions to carry out those objectives.
2. Human roles: built into the software of group communication systems and supported by specific privileges and tools for carrying out the actions for these roles.
3. Notifications: relevant alerts to a user of changes in status, data, and/or information of concern to the given user.

4. Context visibility: the idea that the components of the meaningful data objects are presented in a context that relates to the understandings of the user.
5. Hypertext: possibility of multiple two-way linkages with semantic meanings that allow a person to utilize any item in the content of the application as a set of menu alternatives to move to other content or functionalities in the interface.

These concepts lead to the following requirements for the design of an effective Emergency Response Management Information System:

1. System directory: the system directory should provide a hierarchical structure for all the data and information currently in the system and provide a complete text search to all or selected subsets of the material.
2. Information source and timeliness: in an emergency it is critical that every bit of quantitative or qualitative data brought into the system dealing with the ongoing emergency be identified by its human or database source, by its time of occurrence, and by its status. Also, where appropriate, by its location and by links to whatever it is referring to that already exists within the system.
3. Open multi-directional communication: a system such as this must be viewed as an open and flat communication process among all those involved in reacting to the disaster.
4. Content as address: the content of a piece of information is what determines the address.
5. Up-to-date information and data: data that reaches a user and/or his/her interface device must be updated whenever it is viewed on the screen or presented verbally to the user.
6. Link relevant information and data: an item of data and its semantic links to other data are treated as one unit of information that is simultaneously created or updated.
7. Authority, responsibility, and accountability: authority in an emergency flows down to where the actions are taking place.
8. Psychological and sociological factors: encourage and support the psychological and social needs of the crisis response team.

There are a number of general requirements and supporting functionality and systems that are necessary for creating a comprehensive Emergency Response Management Information System:

1. Resource databases and community collaboration
2. Collective memory: event logs.
3. Online communities of experts.

The latest development mentioned in the literature is the use of user-generated content (Palen et al, 2007; Lafranchi and Ireson, 2009). People on location, from first responders to citizens, report in *real time* on the situation through such means as twitter, wikis etc. This leads to an additional design principle: DSS should be able to “mine” these data sources to help create an accurate picture of the situation.

In conclusion, we can note that the development of an effective DSS for crisis management is something of a Holy Grail – everybody seems to agree that an effective DSS could have revolutionary impact on the practice of crisis management. While no effective DSS seems to be in place, everything appears ready to build such applications.

5 Logistical software

In the specialized area of humanitarian disaster logistics (which bloomed after the 2004 Asian tsunami and 2005 Hurricane Katrina), a small industry of software developers has been building tools for two aims (for an overview see the special issue of the *Journal of International Production Economics* edited by Boin, Kelle and Whybark, 2010):

- to help address logistical/allocation puzzles
- to help training
- to help develop scenarios

While this software is built to understand, map, and manage logistical flows and thus falls outside the scope of the Indigo project, it has become clear that we can learn a lot from developments in this niche (especially in terms of end-user satisfaction, marketing).

6 Crisis communication technologies

Communications have traditionally been the Achilles' Heel of response operations. During disasters, communications networks often break down. The effect on information exchanges and, consequently, crisis coordination and effectiveness, has been widely described. A precondition for any working software system is a reliable communication network.

In recent years, the literature has described two promising developments:

1. The possibility of creating distributed crisis response systems based on cell phones (Meissner et al, 2006; Tatomir et al, 2006; Manoj and Baker, 2007; Bradler et al, 2009).
2. The quick delivery of GIS-based information to PDAs (Koua et al 2010; Loffler et al 2007).

6.1 Northern European examples

In Northern Europe (Baltic Sea countries) we find examples of IT and decision support systems in civil protection management that are mainly used as crisis communication tools. We present you here an overview of the systems:

6.1.1 TETRA

The TETRA standard is the only official standard approved by the European Telecommunications Standards Institute (ETSI) for the use of safety authorities. The network enables top level voice quality and data and moving image transmission even in extreme conditions in a safe way. The signal is coded and an outsider cannot have access to the signal.

Denmark and Finland use flexible TETRA networks, of which the Finnish VIRVE is the world's first nationwide authority network based on TETRA (Terrestrial Trunked Radio) technology. Sweden has developed its own system, RIB- an integrated decision support system, which in addition to promoting its emergency prevention and response policies at the national level, is part of a number of international cooperation projects on risk management and humanitarian relief missions. In comparison, the civil protection systems of Estonia, Latvia, Lithuania and Russia are highly centralized and currently under development.

The Danish Emergency Management Agency (DEMA) and the National Telecom Agency lay down the general minimum requirements for the Danish TETRA emergency network. In addition, the National Telecom Agency is responsible for setting the criteria for the commercial TETRA network. The National IT and Telecom Agency determines the regulations for the use of the frequency band 410430 MHz. In its spectrum planning, the National IT and Telecom Agency must take into account both TETRA and the traditional handheld radio equipment LMR**,** "Land Mobile Radio". This implies that radio frequencies for TETRA should not be designated to a greater extent than justified by the actual demand. All TETRA tenders must fulfill the following requirements:

- Certain formal requirements, e.g. documentation, declaration Requirements regarding solvency
- Coverage
- Technical requirements
- Additional requirements laid down by DEMA

The coverage requirements for the emergency network are divided into two different levels:

- Level 1: Densely populated areas (5% of Denmark)

- Level 2: The rest of the country, including areas of high risk (e.g. oil refineries, airports, traffic junctions, bridges, tunnels)

TETRA has also been embraced by public transportation organizations, which require secure and reliable voice and data communications. In Denmark, the Copenhagen Metro was the first organization to choose TETRA, followed by Hovedstadens Udviklingsrråd (HUR) operating more than 1,200 buses, and later also the commuter train services. In October 2005, the Danish State Railways' (DSB) Strain gave Motorola and TetraNet a contract to provide a new TETRA network. The new network will deliver seamless communications to the Danish State Railways' service personnel, including train inspectors and drivers. The contract covers a voice and data network and the provision of Motorola MTH800 portable radios. In addition, equipment for DSB Strain's command and control centers will be provided, as well as airtime service and maintenance. As a result of this agreement, all public transportation organizations in the capital, Copenhagen, will now be relying on TETRA technology and services to meet their communication needs.

6.1.2 VIRVE

Finland has in place a fully integrated network called "VIRVE". The primary users of the VIRVE network are national and municipal authorities responsible for public safety, such as fire and rescue services, police, border guards, customs, defense forces and social and health services. Finland's VIRVE is a pioneer in the world of Professional Mobile Radio, being the world's first nationwide authority network based on TETRA technology. Nokia has and continues to develop the TETRA solution in Finland in order to meet the different communication needs of authorities in charge of public safety. Offering both voice and data connectivity, VIRVE is secure and fast, bringing significant improvements to authority communications. For users, the VIRVE network offers services that are very similar to those on a mobile phone, making it extremely easy to use. In addition, it is an efficient tool for implementing command systems, enabling different operational models to be coordinated effectively. It also improves personnel safety significantly, forms a nationwide platform for communications, and above all, offers a highly cost-effective, complete solution.

Practicalities of VIRVE-network:

- IP based
- 15 exchanges (centers); two of which are exchange nodes
- More than 1,200 support stations have been installed in the network
- Shared services for all user organizations
- Ensures effective cooperation between different authorities
- Provides endless communication possibilities
- Suomen Erillisverkot Oy, a 100% Finnish government owned company, owns the VIRVE-network

Between 2004 and 2005, the following VIRVE update operations have taken place

- Backup centre, which will be used in case of emergencies, has been installed
- Approximately 60 support stations have been moved to ensure radio connection at all times
- Centralized access in the VIRVE IP-network
- Power generators have been repaired as needed
- Mobile backup generators have been acquired
- Backup access to electricity has been secured at important service stations

- Authentication Key Management Server (AKES) and Authentication Customer Key Server (ACKS) are tested

6.1.3 RIB

The integrated decision support system, RIB program of the Swedish Rescue Services Agency (SRSA) includes a vast database of over 3,800 digital documents, 16,000 records, all SRSA publications, symbols and clip art. This computer program began to function as a resource information bank for fire and rescue services in 1987 and is still in place today. In addition, the program was also available to other agencies such as the coast guard, the police, companies and government entities. SRSA has also incorporated and uses a RIB-based “Safe Community” program, an injury prevention model that the World Health Organization uses as well. As well as promoting its emergency prevention and response policies at national level, SRSA is a part of a number of international cooperation projects on risk management. The Swedish approach to risk management incorporates risk inventory and analysis. RIB’s tools for risk management include the RiskERA program, which is a GIS-based program that allows the user to identify a risk source, analyze it, classify it, and predict the outcomes of events (common and worse case scenarios). There are plans to develop a less comprehensive, but equally useful version of RIB in English, as well as access to RIB via the Internet.

Implication: we should explore if and how Indigo can make use of these new technological developments.

7 Tactile tables

7.1 Introduction

In the recent years there has been a development towards the design and adoption of tactile tables. The use of touch screen technology has become more familiar in everyday life. Companies use touch screens for example for ATMs and PDAs. Smartphones and portable game consoles are very popular and driving the demand for touch screens. The use of touch screens is becoming increasingly normal and can be useful in crisis management as well. In this chapter we present you with findings from five companies concerning the use of tactile tables during crisis or crisis management training. We describe the benefits the companies mention themselves, which we can agree with from real-life experience with crisis management (training). We will conclude this chapter with a recommendation about tactile tables for the INDIGO project.

7.2 TNO[1]

One of the problems in disaster management is sharing information and creating an overall picture of the situation. To enhance effective cooperation between the various disciplines, it is important that everyone has the same (multidisciplinary) overall picture (also known as COP, Common Operation Picture) of the situation and that information is available without it being delayed or altered. Therefore, the Dutch government invested in the project **'Netcentrisch Werken'**. This project supports the safety regions in the Netherlands in a structured way to improve the speed and correctness of the flow of information during a disaster.

A multi-touch table can be used as a means to support information exchange or to create an overall picture of the situation. The multi-touch technology is because of the direct manipulation intuitive and has a short learning curve. A multi-touch table is suitable to display an overview of the situation, because navigating and zooming in or out is simple. Since the geographical map is digital, the operational picture is easy to share with other teams. This makes the table more appropriate during a disaster than a paper map and more interactive than a projection of the image.

In the CoPI (Incident Command Post), the table may provide a supporting role, but this should be designed with good understanding of the context of use. It is useful to use the table to create an overview of the situation during a disaster when the area is larger than the leaders can easily overlook. But for example when a decision should be made about which information will be brought out to the media, it is more important that people look at each other, rather than to the image. The table should be turned off at such moments. Besides that the CoPI team can have more participants than the table can accompany for. The number of participants depends on the type of disaster, but to discuss on a comfortable way around the table, a maximum of six or eight people should be held. In some cases it may be better to work with a smartboard and/or projector.

In the Operational Team, the table can be used as an enabling tool to support individuals with their perception of the situation, ad hoc talks or tasks such as media watching. It should be noted that different ways of use require different software. Currently the table is an expensive tool, especially when it is not used as direct support for primary tasks. Though it is expected that the market will develop and offer cheaper versions over time.

For the departmental parties the table is a nice tool to conversate with a limited number of people together around the table and discuss the disaster. This is however no support of their primary tasks. The technology can for example be applied in the conference table to

[1] http://weblog.tno.nl/nui/2009/11/10/how-does-multi-touch-fit-in-crisis-management/

interact with a projection on the wall from the table. It is unknown whether users experience this as more pleasant than a smartboard.
In conclusion, the table can be used as a tool in various contexts of use. If the technology will directly support a task, each use has different demands for designing and implementing software. To embed the table in exercises and observe the context of use, clear guidelines for the use and software will likely emerge.

7.3 Total Petrochemicals Gonfreville[2]

Total Petrochemicals Gonfreville in France has developed a set crisis management tools in a partnership between industry, fire departments, emergency services and academics. For several years, firefighters have been collaborating with the University of Brest in France to compile a Global Emergency Plan tool that encompasses on a single multimedia format (a DVD for the most part) a set of multidisciplinary (e.g. regulatory, scientific) documents written by private and public sector personnel. By theme, the tool covers:

- Presentation and visualization of the site.
- Threats and emergency planning (threats study, internal and external planning).
- Simulation of accidents.
- Emergency resources.
- A crisis preparation/management tool (training, exercises, operations).

Its exhaustive character means it is useful for a wide range of sectors during operations, including company staff, emergency services, and public sector personnel. It has also been designed to assist the incident commander and relevant authorities in decision-making processes.
The relationships between the different types of data have been created logically, allowing intuitive multimedia hypernavigation that enables the display of accident scenarios. One can - for example - switch between a thematic plan and a 3D view and back again, thus toggling between a map and a 3D model.

The multimedia tool was first deployed in e-books in 2002, followed by tough notebook computers and tablet PCs for mobile employees and first responders. Gradually it started winding its way into crisis centers. In 2009 the data was integrated in an interactive whiteboard and shortly afterwards on a multi-touch table, thus enabling the creation of a flexible "hybrid" for crisis and control centers. This shared and highly interactive communication medium, already used in other environments, has the capability to interact with different types of devices (e.g. landline and mobile phones, tablet PCs etc). It consists of three main parts:

- A large touch screen.
- Middleware to interpret the gestures of various users.
- A set of software components. These provide a wide range of functions to build genuine interactive multi-touch applications that communicate effectively, creating a software environment very close to that of iPhone-type smartphones.

The underlying structure consists of a solid hardware platform that links to different applications via multi-touch interaction, enabling the running of the Global Emergency Plan. Anyone can interact with digital content such as photos, documents and maps, using their

[2] http://www.thefreelibrary.com/A+total+approach+to+crisis%3A+Total+Petrochemicals+Gonfreville+in...-a0224248610

hands and fingers as well as gestures, in a natural way ("surface computing").

Pros:

- The size of the screen allows all users to follow and share data as operations develop, potentially assisting in developing new strategies adapted to the here and now.
- The tactile nature of the hardware encourages an intuitive approach. The natural feel of the interface and the screen's horizontal position improves efficiency and makes cooperation almost inevitable.
- The table is able to process the simultaneous input of several persons, making it extremely user friendly. This collaborative work results in a scenario in which people can think together, pool ideas and/or actions and make them easily visible to all, so that everyone acts on the basis of the same knowledge.
- Solid objects can be placed on the table (e.g. maps).
- Lastly, all information is recorded, thus enabling backtracking to an earlier hypothesis or situation and providing a computer log of tactical situations.

7.4 TangiSense RFID interactive table[3]

Description of a new type of tabletop:

- Tabletop based on RFID (Radio Frequency IDentification)
- Technology which enables the user to manipulate tangible objects
- Tangible objects with RFID tags
- RFID Tags which offers the possibility to store data

Some related works in chronological order:

- First researches on interactive table/desk
- Design of an interactive table: DiamondTouch
- SenseTable tracks some tangible objects electromagnetically
- Audiopad : A RF Tag-based Interface for Musical Performance
- ReacTable : A new electronic musical instrument by manipulating tangible objects
- Intelligent Table : An interactive table using a Multi-Agent System
- Presentation of Surface, the interactive table by Microsoft
- mixiTUI : A Tangible Sequencer for Electronic Live Performances

Hardware

- Table composed of 25 tiles (5x5) for 1x1m of surface
- Each tile contains 64 RFID antennas
- Each tile has a DSP processor
- Ethernet link

Architecture in 3 layers:

1. The Capture and Interface layer : handles tangible objects provided with one or more RFID Tags
2. The Traceability layer : handles events associated to the objects and communicates the modifications of objects positions to the applicative layer
3. The Application layer manages the specificities of the application associated to the table

[3] http://fitg10.lille.inria.fr/workshop-data/slides/kubicki-et-al.pdf

Application layer in 2 parts

- Multi-Agent System
  - Establishment and verification of correspondence between agents' roles and behavior
  - One agent is responsible of one virtual or tangible object
- Human-Computer Interaction
  - Direct interaction between users and future tabletop applications
  - Innovation in terms of Human-Computer Interaction in the use of an interactive table

Conclusion of the TangiSense RFID interactive table:

- Tabletop with original characteristics
- Interaction with virtual and tangible objects
- Innovations and new way of research in HCI as well as in MAS
- Development of some applications.

7.5 TNO and University of Groningen[4]

In the paper **Assisting Gesture Interaction on Multi-Touch Screens,** TNO and the University of Groningen present their ongoing work on multi-user touch interfaces with specific attention to assisting gesture interaction by using gesture previews.
The work of TNO and the University of Groningen on control rooms and educational games revealed that designing a touch interface is challenging, especially when collaboration between multiple users is desired. Gesture previews make working with touch screens easier for novice users and support and encourage collaboration. At the same time, they do not limit or distract expert users. TNO and the University of Groningen are experimenting with composed gestures and on-the-fly gesture detection. It is their hope that these concepts can be used to develop a next generation of software that makes working on large touch screens easier and more intuitive.

7.6 CiviGuard[5]

The CiviGuard platform offers a multi-touch interface to first responders and civilian subscribers that allows crisis commanders to direct civilians to safety and manage overall crisis response.

Right now, individual subscribers who sign up for the application on their smartphone will get push notifications, email or SMS messages if they are in an area where a crisis occurs. By launching the application, both users and first responders can get near real-time updates about the status of civilians and crisis response. Additionally, should a subscriber find themselves in need of rescue ahead of one of these notifications or during an event they can notify CiviGuard who will direct first responders to the subscriber. Think of it like OnStar for your pocket. The process also takes into account user privacy by making all location and personal data opt-in and removing that data after a user is reported as safe.

On the command side, first responders can use the touch interface to literally draw out the response area, identify exits, and start moving people. As civilians move out and response teams move in, crisis managers can watch those movements in near real-time on their

[4] http://www.cs.rug.nl/~isenberg/personal/papers/Cleveringa_2009_AGI.pdf
[5] (http://civsourceonline.com/2010/06/03/civiguard-offers-governments-crisis-comms-in-the-cloud/, and http://www.civiguard.com/

screen and adjust as needed. The notification function allows managers to notify as many as one million people in two minutes, with location polling updating every 60 seconds.

7.7 Recommendation for INDIGO

Based on the descriptions of the organizations that study and develop tactile tables and multi-touch interfaces we can recommend that the INDIGO project will develop a multi-touch tool. It is recommended that:

- The table can be used as a tool in various contexts of use.
- The table is useful for a wide range of sectors during operations.
- There is interaction with virtual and tangible objects.
- The table allows crisis commanders to direct civilians to safety.

8 State of the Art: case studies

This chapter provides an overview of the most promising products that we have located in the literature, on the internet and/or through personal contacts with the crisis management community.

8.1 CRIMSON

The CRIMSON system combines the latest Simulation and Virtual Reality technologies for the inter-organizational preparation, rehearsal, and management of security missions in response to major crisis (natural events, industrial accidents, NBRC incidents...). It offers a radically new and integrated approach for:

- The preparation to crisis management
- The training of the different actors
- The command, control and decision support during critical situations.

Developed with the support of the European Commission, CRIMSON has been specified and tested by a group of international end-users. Since, the CRIMSON technology has been adopted by organizations such as the European Space Agency, The Délégation Générale de l'Armement or the Institut de Radioprotection et de Sûreté Nucléaire for operational systems. The CRIMSON system enables the 3D simulation and evaluation of complex crisis and contingency scenarios that would be difficult to recreate and validate in real conditions. By providing an amazingly rich and easy-to-understand common operational picture, the system offers a unique tool for creating, communicating and sharing complex knowledge, in critical time, between users across organizational or cultural boundaries. It dramatically enhances the planning and management of crisis, the preparation of crisis management tasks, and, at the same time, it provides a captivating tool for the collaborative training of the security actors and the information of citizens.

ENVIRONMENT
Mobile PC with an OpenGL 3D graphics board
OS: Windows 2000/XP/VISTA

FEATURES

- Rapid creation of massive geographic databases from multi-source heterogeneous data:
  - Correlation, georeferencing, projection, optimization, spacialisation, compression and fusion of GIS and cartographic data
  - Support of non geometric data (weather reports, documentation, statistics, sensor results, alarms)
  - Interactive 3D visualization of both the crisis environment and the evolving scenario:
  - Support of massive geographic databases (Terabytes)
  - Interactive visualization of heterogeneous data (maps, aerial or satellite images, roads, rivers, CAD models, symbols, weather situation, waypoints, sensor data …)
  - Graphical metaphors for intuitive manipulations
  - Continuous 3D multi-scale visualization from global scale to local scale
- Interactive creation and edition of scenarios:
  - The users can visually crate and modify the parameters of the simulated crisis, e.g. blocking roads, creating incidents, controlling population behavior.
  - The scenario can be controlled by the simulation or can represent the actual crisis situation.

  - Distributed architecture for collaborative sessions.
- Interoperability with third-party systems:
  - The CRIMSON system is open and can interoperate with third-party systems
  - Additional modules enable the interoperability with radiocommunication systems, fleet tracking services or any other input/output data source.
- Extensibility thanks to a plug-in and web service based architecture
  - Crowd & Traffic Simulation module: simulation of population behavior and traffic from MASA <http://www.masagroup.net/>
  - Immersion module: interactive devices and dedicated interfaces for large scale projection, stereoscopic visualization and 3D interaction by Immersion <http://immersion.fr>
  - Reporting module: PDF document generation, videos and screenshots production for information publishing and communication.
  - Messaging module: dedicated messaging system with interoperability capabilities with PMR systems.
  - AVL Module: automated vehicle location for GPS fleet tracking from DIGINEXT <http://www.diginext.fr/>
  - DIS/HLA gateways: gateways enabling the interoperability with third-party simulations.

8.1.1 Pros

- Enables training of high level crisis managers with IT means.
- Supports complex and large geographic environments
- Visual approach (drag/drop, 3D display, etc.)
- Easy production of press releases
- Integrated communication system

8.1.2 Cons

- Insufficiently mature
- Poor robustness
- Office training only
- Limited number of users
- No tracking of field units
- Not exploitable for crisis management and decision support
- Linear scenario only

8.1.3 Recommendations

It is recommended for the INDIGO project to use the knowledge that comes from the CRIMSON project. The CRIMSON framework offers today an effective and generic platform for the 3D visualization and simulation of the behavior of populations evolving in massive urban environments in response to simulated events. CRIMSON enables both the analysis and the evaluation of complex environmental, industrial or man-made events, their impact on the populations and the contingency scenarios that would be difficult to unfold and validate in real conditions. In addition, the 3D visual capability of the system offers a unique mean for creating, communicating and sharing complex knowledge between users with very different educational or cultural background (Balet et al, 2008).

8.2 STATPack

STATPack (Secure Telecommunications Application Terminal Package http://www.statpack.org/) is an e-communication tool for medical labs to share test results during a terrorist attack (Fruhling, 2010, Chapter 6). "STATPack™ is an emergency response system that addresses critical health information and biosecurity needs. The STATPack™ system application is a secure, HIPAA compliant, web-based network system that supports telecommunication connectivity of clinical health laboratories. The system architecture uses client/server technology and operates in a distributed environment. This connectivity allows for immediate communication and data transfer of urgent health information by transmitting images and text" (www.statpack.org).

8.2.1 Pros

"Unique Capabilities of STATPack are:

- Provides macro-visualization of difficult specimens
- Produces specimen image of diagnostic quality (millimeter resolution)
- Compliments a microscopic slide-based system
- Provides a database of electronic messages and corresponding images
- Provides safe handling of biohazardous specimen using an airtight container to house diagnostic specimen and camera" (www.statpack.org).

8.2.2 Cons

The system focuses solely on medical/health threats and has no attention for other hazards. STATPack is a web based system which makes it vulnerable if connections are not accessible during a crisis.

8.2.3 Recommendations

A recommendation for the INDIGO project is to create a possibility to connect with this or similar type of software, which would allow first responders to detect an organism, take a picture and send it to the database to check and test what kind of organisms are in the field.

8.3 DisasterLAN

DisasterLAN is a promising looking emergency response software system (Chen et al, 2010 – Chapter 7, www.DisasterLan.com). "DisasterLAN is NIMS (National Incident Management System)-compliant web-based crisis management solution for use in any emergency operation center. Built around the unique workflow requirements of the emergency management community, DisasterLAN reportedly provides users with a "complete toolset for managing incidents of any size". Based upon the NIMS, DisasterLAN helps emergency managers comply with the mandates of NIMS by:

- providing a formalized standardized documentation process;
- improving both interagency and inter-jurisdictional communications and coordination;
- tracking and managing mission and asset requests;
- collecting, tracking and reporting on incident information and resources;
- developing and sharing a common operational picture;
- maintaining situational awareness.

Since its inception in the late nineties, DisasterLAN has gained wide acceptance in both the public and private sector. Whether used 24/7 on a daily basis in a corporate or municipal command center, or during critical incidents requiring the activation of an emergency operations center, DisasterLAN provides users with tools to maximize efficiency and aid in critical decision making. Because DisasterLAN is highly configurable, it can be fine tuned to meet the unique workflow requirements of our customers.

Core DisasterLAN modules:

- call center
- call center management
- report generator
- briefing notes
- status board
- streaming video
- incident command system (ICS) forms
- message board
- interoperable messaging
- message broadcasting
- incident folders
- incident contacts
- preplanning-personnel, organizations, asset management
- weather

Optional DisasterLAN modules:

- GIS mapping
- Situation reports
- Secure instant messaging
- Incident Action plans
- Reference library
- Watch command
- Joint information Center
- Exercise simulation" (www.DisasterLan.com).

8.3.1 Pros

DisasterLAN has many promising aspects:

- Formulized and standardized documentation process.
- Tracking and managing mission and asset requests
- Collecting, tracking and reporting on incident information and resources
- Developing and sharing a common operational picture

Another pro of the system is that it is designed with the help of emergency managers.

8.3.2 Cons

DisasterLAN misses a link with first responders in the field and tools that can be used by both the operational level and the strategic level.
It is not clear whether it can be used for either training or creating scenarios.
It is very much workflow oriented, and does not facilitate improvisation
It is exclusively US based, which may make it less useful for a European audience.

8.3.3 Recommendations

For the INDIGO project it is recommended to study DisasterLan to see if its workflow features can be translated to a European context.

8.4 E Team

"NC4 delivers Situational Readiness solutions that empower government and businesses with accurate, timely and secure information to manage risks. NC4 takes a comprehensive and integrated approach to both crisis management and security, by focusing on the three main components of Situational Readiness:

- Situational Awareness both for External (ESA) and Internal (ISA) incident/event intelligence monitoring
- Situational Response with an E Team incident management application
- Secure Communication and Collaboration through Extranet Secure Portals (ESP)

NC4's Situational Response solution, E Team, helps organizations meet Homeland Security requirements by enabling government entities to work seamlessly across agencies at all levels to prepare for, prevent, respond to and recover from incidents. It is an incident management system that gives organizations a common platform from which they can enhance their ability to respond to and recover from incidents and events occurring within their jurisdiction. It provides users a common operating picture and resource management tool through a single collaboration platform.

E Team has been successfully used for events such as:

- Hurricanes
- Floods
- Blackouts
- Firestorms
- TOPOFF exercises
- U.S. Presidential Inauguration
- Olympics
- Super Bowls

8.4.1 Pros

E Team enables external support of crisis management teams and offers tools that help create a common operational picture.
The system works as a platform to exchange information and enhance their ability to respond to incidents" (http://www.nc4.us/).

8.4.2 Cons

E Team is a system that is not used for crisis management exercises and simulations. Moreover, it is US based.

8.4.3 Recommendations

The INDIGO project should study 1) if the tools for creating situational awareness work in practice and 2) if the system is effective in allowing information sharing.

8.5 Combined Systems Project

Combined Systems (www.combinedsystems.nl) was a four-year project (2002 - 2006), supported by the Dutch Ministry of Economic Affairs, grant number TSIT2003, a Senter ICT Breakthrough project. The project description reads as follows:

"Combined Systems stands for ***C****haotic* ***O****pen world* ***M****ulti-agent* ***B****ased* ***I****ntelligently* ***NE****tworked* ***D****ecision-support Systems*. Combined Systems envisions future systems to consist of both human actors and artificial agents that work together to achieve their common

goals in sometimes chaotic circumstances. The agents will support the humans, assist them in the process of collaborative decision making, or even take over decisions that will lead to the best global performance. Actors and agents are organized in a network with a specific configuration, not everyone is connected to everyone else. Together the system of actors and agents is considered to be a collaborative intelligent system.

The project selected the domain of crisis response in which multiple parties (police, fire brigade, health services, governmental agencies, etcetera) work together to contain the crisis. Collaboratively they aim to save lives, stabilize the cause of the incident, and conserve the surrounding infrastructure. The Combined Systems project aims to gather essential knowledge required for delivering innovative real-world solutions for crisis management. All phases of the crisis management process cycle are addressed: first making sense of what is going on through *observation* and *orientation*. Then, based on this, making *decisions* and taking *actions*.

The Combined Systems project has developed innovative building blocks that can be used in developing solutions for crisis management. In order to demonstrate the principles of these building blocks a challenging crisis management scenario was created. In this imaginary but realistic scenario a large-scale disaster takes place in the Rotterdam Harbor area" (www.combinedsystems.nl).

8.5.1 Pros

It is not clear whether the system was ever developed, so it is hard to determine the pros of this system. In theory, the system would be an excellent DSS.

8.5.2 Cons

After 2006 the project ended and nothing is heard of it after that.

8.5.3 Recommendations

No recommendations are drawn from this project.

8.6 The Virtual Terrorism Response Academy

The Virtual Terrorism Response Academy (3D) (Dartmouth's Interactive Media Laboratory (discussed by Losh, 2007) is a reusable advanced distance learning environment that supports the development and dissemination of terrorism response courseware. "The Virtual Terrorism Response Academy's first course is "Ops-Plus for WMD Hazmat." This interactive course offers fire, EMS and law-enforcement personnel more than 16 hours of practical, engaging training about CBRNE (chemical, biological, radiological, nuclear, and explosive) threats.

"Ops-Plus" features multiple videogame-style simulations that put you in tactical terrorism-response scenarios. (There's an introductory level, so you don't need previous videogame experience.) The program also includes the Hazmat Learning Lab with extensive training at the latest NFPA 472's Operations level. Now you can demonstrate your vital knowledge of PPE, instruments, rescue, triage, casualty care, and risk management in real-world, life-and-death scenarios. VTRA's "Ops-Plus for WMD Hazmat" can be used individually or be instructor led, and it's designed to run on the older computers found in today's fire houses and police stations. It arrives on three CD-ROMs and installs smoothly on Windows 2000 and XP systems" (http://iml.dartmouth.edu/education/pcpt/vtra/ops-plus/1.0/).

8.6.1 Pros

VTRA can be used individually or instructor led.

8.6.2 Cons

The virtual terrorism response academy can be used for training purposes solely.

8.6.3 Recommendations

The INDIGO project should consider the possibility of developing courseware that can be accessed through Indigo.

8.7 Hazmat: Hotzone

Hazmat: Hotzone is developed by Public Health Games at University of Illinois at Chicago (mentioned by Losh, 2007). “Hazmat: Hotzone is a networked, multiplayer simulation that uses videogame technology to train first responders for chemical and hazardous materials emergencies. It is designed to give the instructor maximum control and flexibility over the scenario. For the first responder trainees, the primary objective of the simulation is communication, observation, and critical decision making. The program begins with an instructor creating the hazardous scenario. They are able to determine such factors as the location of the hazard, its effects, the weather conditions, and the placement and symptoms of the victims involved. Once the scenario has been set by the instructor, the students who are situated at their own computer stations will log into the scenario. One student assumes the role of the incident commander and establishes a decontamination zone. The others students communicate over radios and respond to the situation accordingly.
The instructor has the ability to pause the game or trigger unexpected actions and secondary events at any time. They may even incapacitate a first responder who has taken an unsafe action. When the scenario has been completed, the instructor can then lead a discussion using specific examples of what actions were and were not effective. The scenario can then be repeated to test for lessons learned, or a new scenario can be loaded to train for different situations” (http://www.etc.cmu.edu/projects/hazmat_2005/screenshots.php?page=0).

8.7.1 Pros

The instructor has the ability to pause the game or trigger unexpected actions and secondary events at any time.
When the scenario has been completed, the instructor can then lead a discussion using specific examples of what actions were and were not effective.

8.7.2 Cons

The system is based on video game technology, not on real life images.

8.7.3 Recommendations

The INDIGO project should have the ability as well to pause a training or trigger unexpected actions and secondary events at any time.

8.8 DC-Train

DC-Train is a trainer for ship damage control (Sniezek et al, 2002). The decision making task of ship damage control includes addressing problems such as fire spread, flooding, smoke, equipment failures, and personnel casualties. It is a challenging and highly stressful domain with a limited provision for real-life training.

DC-Train employs artificial intelligence and computer simulation in addition to multimedia and graphical visualization technology to provide students with an intensive, realistic experience of coordinating ship damage control in a large number and wide range of damage scenarios involving fire, smoke, and flooding. DC-Train intelligently simulates other damage control personnel as well as ship systems and the spread of damage. It supports detailed assessment of student actions as correct; error of DC Train successfully approximates the

stressful environment of damage control by bombarding the student with multiple information reports in both audio and video.

8.8.1 Pros

It makes use of scenarios.

8.8.2 Cons

Only focuses on ship damage control. DC-Train has a limited provision for real-life training.

8.8.3 Recommendations

The INDIGO project can take ship damage into account in the development of the scenario and events within the system.

8.9 SAHANA

Sahana is a Free and Open Source Disaster Management system. It is a web based collaboration tool that addresses the common coordination problems during a disaster from finding missing people, managing aid, managing volunteers, tracking camps effectively between Government groups, the civil society (NGOs) and the victims themselves (http://sahanafoundation.org/).

"The **Mission** of the Sahana Software Foundation is to help alleviate human suffering by giving emergency managers, disaster response professionals and communities access to the information that they need to better prepare for and respond to disasters through the development and promotion of free and open source software and open standards.
The Sahana Software Foundation was established in 2009 as a non-profit organization to serve the needs and requirements of a diverse group of customers:

- Government agencies and jurisdictions at the national, provincial or state, and local levels
- UN Agencies, international and local charitable organizations (NGOs)
- Communities & disaster victims
- Technology companies & software developers" (http://sahanafoundation.org/).

8.9.1 Pros

Sahana: successful tool for coordination during humanitarian response efforts (Currion, De Silva and Van de Walle, 2007)
It is a web based collaboration tool that addresses the common coordination problems during a disaster.

8.9.2 Cons

SAHANA is a web based system which makes it vulnerable if connections are not accessible during a crisis.

8.9.3 Recommendations

It is recommended to develop the INDIGO system in a way that it can really be used in crisis response efforts just like SAHANA.

8.10 Symulzub

Symulzub is a new generation of training centre for the French Defense encompassing several innovations to allow the realistic and safe training of fighters in urban environments. Thanks to the instrumentation of trainees and urban infrastructures, the system provides a wide range of factual indicators like the real-time position and the operational state of fighters

and targets or the building attrition. It allows the pedagogic team to focus on the noble aspects of the training rather than on arbitration issues. Diginext is in charge of studying and developing the Operation Centre software.

Key features

- Real-time tracking of all trainees, vehicles and target. The synergic combination of GPS and UWB (Ultra Wide Band) sensors allows the indoor and outdoor localization of all players and the indoor accuracy is suitable to follow the progression of fighters within the buildings floors and rooms.
- Triggering of tactical masks, mines, soundtrack on demand. The effectors on the field and in the buildings (mines, smoke generators, loud speakers, flash lamps) are connected to the operation centre through wired and wireless networks. Thanks to these effectors, the person in charge of the animation has all the means for re-focusing the exercise on its pedagogic objectives and for introducing scenario variations. The computerized operation centre plays its "brain" role by processing ballistic and attrition models before feeding the information back to the effectors e.g. explosion at the adequate volume and places or deactivation of players in the attrition perimeter of a shot.
- 2D and 3D graphical monitoring of the tactical situation. Animation, analysis and pedagogic responsible can rely on a user-friendly representation of the situation, which combines 2D cartography, APP6 symbols refreshed in real-time, 3D representation of building floors (popping-out on demand) and colored zones / paths to catch at a glance who is controlling which area, progressing, etc. The system logs voice and data commandment networks and monitors the action through a CCD network.
- Mobile terminal for on-the-field instructors. A tactile tablet powered with a lighter version of the software allows instructors to monitor the situation, to communicate in a quiet mode with the centre, and thus to be in the right place at the right time. They have the facility to pause the exercise because of safety issue or to do a "warm briefing" in order to refocus the action thanks to the log of video camera flow and cartographic representation.
- Simulation facility for scaling up the operation centre HMIs (100's of trainees). In order to design future training applications, mainly with higher capacities in terms of players, the terrain instrumentation can be unplugged and replaced by simulation means. This facility will ease ergonomics studies to optimize cognitive load of operators and thus, to maximize the trainees / trainers ratio.

8.10.1 Pros

Added value of Symulzub:

- Instructors focus on observation rather than arbitration.
- Arbitration and valuation of fighter and commandment based on factual information (log of moves, shot, tactical messages).
- Safety vs. realism ratio of the training system optimized.
- Simulator of terrain interactions can be plugged to the operation centre software for study purposes (ergonomics of HMI, scalability, etc.)
- Really immersive for the persons "on the field".
- More data for debriefing.
- Automated "Refereeing".
- Many less Referees on the field, maybe none
- Users cannot blame a Referee during an exercise
- Debriefing/replay with video, geolocalisation, ..., much data to analyze.

- Simulated events/persons

8.10.2 Cons

- Need to have specific hardware.
- Cannot move the training field.
- Expensive.
- User interface tailored for the militaries
- No scenario editor

8.10.3 Recommendations

It is recommended for the INDIGO project to have a look at Symulzub to see how this simulator works and how the added value can be used for the INDIGO projects.

8.11 Simulation tool Civil Protection application School of Valabre

The Civil Protection application School of Valabre (ECASC, France) has been, since its creation, mandated by the Ministry of the Interior to implement national forest fire trainings in order to enable forest fire interveners to carry out their interventions in a common and coherent framework,

These trainings, essentially based on the learning of commandment, contain terrain maneuvers and simulation exercises which enable trainees to be confronted, through virtual reality, to situations close to those they will experience on the terrain.

The aim of the simulation tool, based on a 3D map system, is to organize the fight by integrating outside events (weather, accidents, obstacles, etc.), use a radio system to practice transmissions identical to those used on the terrain, enable each trainee to experience his own operational situation, according to his position and ground and aerial actions he/she conducts. Several rooms are used to represent the different areas of the operational situation: one room represents the site Post Commandment, one room is used to simulate aerial drops and some others for ground means. Each First Responder Unit has its own screen which represents the view it has from inside each vehicle. The vehicle evolves on DCFI paths; landscape and environment are represented identical to terrain (vegetation, roads, houses, etc.). The full range of forest firefighting equipment is also integrated as well as fire hydrants and water tanks. On the screen, the first responder unit can also see the action of the other ground and aerial means, with the weakening of the fire front.
This solution, used since 2002, is the core of the training and assessment program for 3 national firefighting diplomas delivered by the school of Valabre. It enables to train and assess firefighters for the following functions: Incident Commander, Aerial Means Officer, Group Chief, Sector Chief, Site Chief and different operating functions used in the command posts.

8.11.1 Pros

The advantages of this simulator are:

- Robust: more than 2000 trainees have been trained on the two simulators. Multipurpose: the simulators are also used for topography trainings and for exercises linked to technological risks.
- Realistic: the simulators enable officers to maintain their operational knowledge by virtually training themselves on their geographical intervention area.

- Pioneer: the system has already been used several times for international cooperation exercises, thus foreshadowing the future of European trainings.

8.11.2 Cons

Focus is only on forest fires, not on other hazards.

8.11.3 Recommendations

It is recommended that the INDIGO project provides users as well with a realistic tool.

8.12 ENSOSP: A simulation and management tool (National School for Firemen Officers)

Based on the same principle as the forest fire simulator of Valabre, the simulation and management tool the ENSOSP (National School for Firemen Officers) has acquired in the framework of its collaboration with private companies represents a huge progress for the quality of the trainings, and more specifically, for the work done on decision-making and commandment in an evolving operational situation. The current version is dedicated to chemical risk training.

The aim is to provide a commandment and decision-making training in an unstable situation, in an emergency and crisis context, by closely recreating the operational context through a realistic visualization of the events, while staying in contact with authorities, victims and interveners.

It is a virtual reality simulator integrating several models:

- visual models: virtual 3D mock-ups
- mathematical models, physico-chemical describing phenomenon kinetics
- operational models describing the actions, condition and evolution of the resources
- pedagogical models having a specific interface enabling to check the knowledge level of the trainees.

Real time interaction between the users and the different models enables to provide dynamic representations associated to complex realities.

The results obtained by this concept prove all its relevance and potential. It is really worthwhile to develop training using this type of tool and it is easily conceivable to create other themes in order to cover the full range of civil protection operations.

8.12.1 Pros

The advantages of this solution are mainly based on the following elements:

The Cost of this type of system is much lower than for big systems (that cost between 5 to 10 times more).

The modularity of this system enables to link all the developments together; there is not a specific simulator for urban fires, technological risks and Commandment and operational management. The platform integrates all these elements in a homogenous and scalable environment which enables an easy evolution with no technical incompatibilities or theme compartmentalization. This offers a great freedom for the use of the tool.

The required equipment configuration does not need a big expensive calculator, specific and unique (thus highly vulnerable in case of breakdown and maintenance) but only classic computers (with a graphic card) put in parallel and sharing calculations. Equipment investment is lighter and it is easy to set up the maintenance, upgrades and machine reconversion.

The simulator / trainee interactivity is total as the « crisis events are intelligent » and react to the actions of the trainees who can visualize in real time the efficiency of their actions. This is a main and fundamental component of the tool as it is not necessary to continuously program the simulator during the exercises. This offers great latitude to the training team: they can concentrate on pedagogical aspects.

The simplicity of the tool handover for the training team enables to train the users (trainers) of the simulator without them having to be computer specialists. It is the same type of training as for office software. A one week training course is needed to be able to pilot exercises.

8.12.2 Cons

Focus is only on forest fires, not on other hazards.

8.12.3 Recommendations

The INDIGO tool should aim to be a simple tool just like the ENSOSP. The simplicity of the tool handover for the training team enables to train the users (trainers) of the simulator without them having to be computer specialists. It is the same type of training as for office software.

8.13 Swedish Decision Support System RIB

“RIB - Integrated Decision Support System - is a system for prevention and emergency management that combines an extensive library, a chemical database with dispersion models, risk management tools and a command and control system” [MSBa]. “RIB is a source of information for everyone working with civil protection and prevention of emergencies and crises, such as fire fighters, the police, transporters, medical personnel and officials within the municipalities” [MSBb]

By connecting databases, RIB is able to provide comprehensive information regarding how an accident or incident can be managed and where resources are located (both material and in form of expertise), how prevention planning can be conducted, and what the risks are once an accident has occurred [MSBc]. Using the Command and Control function of RIB, it is possible to register events during an operation. It is also possible to create and maintain graphic oversight of operations in progress.

RIB also has an educational component and contains a variety of educational programs such as hazmat and fire training and training on what measures that need to be taken during an accident involving radioactive substances. A number of tools, for example calculation tools, and a modeling of distribution tool, and GIS-tools are also included in RIB [MSBc].

About LUPP
LUPP 6.0 is a part of the Decision Support System RIB. LUPP is a computer system and tool for decision-making and follow-up of emergency response operations. The system is especially developed in response to the needs of emergency services personnel working in Swedish municipalities.
LUPP is however only a partial system within the comprehensive support system for emergency services and other organizations. This implies the necessity for exchange of data between different systems. A recurring comment from system users has been: "I don't want

to write in the same information in several different places". Thus, during 2010 the next updated version of LUPP will be developed and one of the goals is to increase the capability to exchange information with other systems.
Integration with other systems: LUPP version 6.0 will be integrated with several other systems, SOS ZeRed and Zenit, RAKEL positioning, alarming systems such as 112, etc. The aim is that data will be able to both flood in, and be retrieved from, the Decision Support System.

Function: The system's primary task is to function as host for different services and thereby communicate messages between different processes. The processes can concern the same machine, different machines, and in extreme cases, also in different networks. Whereas RIB Exchange does not have its own support for synchronizing data between several different units, this support is built in to LUPP Services.

Technical Basis: RIB Exchange can work as the host process for working threads, for example positioning and SOS-import. It can also act as a host for WCF-services, several of which are built into LUPP Services. (see Windows Communication Foundation) The API-function is planned to be implemented as a WCF service in LUPP Services.

8.13.1 Pros

End user contacts and needs analysis have helped ensure that RIB really contains what users want, which ought to impact usage positively [MSBd].

RIB is also used by other agencies than first responders. For example, road engineers have used RIB to do certain calculations. In a particular incident, RIB graphics were shown to the Swedish Transport Administration, which according to involved engineers provided clearer more precise information than their previous reports. In this particular instance, RIB was used to assist decision makers, who ultimately decided to close the road in question to traffic completely [MSBb]. Wide usage across levels increases a common understanding and is thought to assist in overall increased understanding of decision makers working in civil protection.

The interactive encyclopedic function of RIB implies that the police, who are not specialized in chemicals, can quickly get hold of updated information fit for their purposes, without having to contact the fire fighters that traditionally have this information. An example may be, if, when, and how the police should approach a chemical incident [MSBb].

8.13.2 Cons

RIB and Op-RIB, the operative system of RIB are commercially available services promoted by the Civil Contingencies Agency, MSB. The number of municipalities, agencies and organizations that subscribe to the RIB system is therefore dependent on their ability to finance usage. Disproportional usage of the system may lead to disparate civil protection capability and potentially reduced socio-technical interoperability.

8.13.3 Recommendations

It is recommended to develop the INDIGO system with the help of end-user contacts and needs analysis to make sure the system contains what end-users really want.
We will need to ensure that INDIGO is a system that is compatible and can be "plugged in" to existing systems.

9 Conclusion: A validated need for Indigo

This state-of-the-art report captures the research findings in the separate fields of crisis management research and information studies. We have combed the academic literature and studied the findings. We have followed up any mention of actual working systems. Our first conclusion is rather straightforward: much thinking has been done, but very little (in terms of working systems) has materialized in practice.

One of the key problems that becomes obvious in reading the literature is the disconnect between the fields of crisis management research and information systems design: crisis researchers have little “feel” for the possibilities of ICT, while ICT designers clearly lack knowledge of crisis management practices and needs. A second conclusion therefore pertains to our team, which contains a unique blending of crisis management experts and ICT designers. We have a unique (and necessary) combination of required expertise.

We are facing a fantastic opportunity to produce a unique simulation/DSS tool through the INDIGO project. In section 9 we present the most important recommendations for the project group. These recommendations follow from the findings of this report.

10 Recommendations for the INDIGO project

Recommendation for the implementation of the INDIGO project:

1. System training and simulation: An emergency system that is not used on a regular basis before an emergency will never be of use in an actual emergency.
2. Crisis memory: learning and understanding what actually happened before, during, and after the crisis is extremely important for the improvement of the response process.
3. Information validity and timeliness: establishing and supporting confidence in a decision by supplying the best possible up-to-date information is critical to those whose actions may risk lives and resources.
4. Free exchange of information: crises involve the necessity for many hundreds of individuals from different organizations to be able to freely exchange information, delegate authority, and conduct oversight, without the side effect of information overload.
5. Notifications: relevant alerts to a user of changes in status, data, and/or information of concern to the given user.
6. Hypertext: possibility of multiple two-way linkages with semantic meanings that allow a person to utilize any item in the content of the application as a set of menu alternatives to move to other content or functionalities in the interface.
7. System directory: the system directory should provide a hierarchical structure for all the data and information currently in the system and provide a complete text search to all or selected subsets of the material.
8. Information source and timeliness: in an emergency it is critical that every bit of quantitative or qualitative data brought into the system dealing with the ongoing emergency be identified by its human or database source, by its time of occurrence, and by its status. Also, where appropriate, by its location and by links to whatever it is referring to that already exists within the system.
9. Open multi-directional communication: a system such as this must be viewed as an open and flat communication process among all those involved in reacting to the disaster.
10. Up-to-date information and data: data that reaches a user and/or his/her interface device must be updated whenever it is viewed on the screen or presented verbally to the user.
11. Link relevant information and data: an item of data and its semantic links to other data are treated as one unit of information that is simultaneously created or updated.
12. Psychological and sociological factors: encourage and support the psychological and social needs of the crisis response team.
13. DSS should be able to “mine” these data sources (wiki, twitter, etc) to help create an accurate picture of the situation.
14. We should explore if and how Indigo can make use of these new technological communication developments.
15. Create a possibility to connect with Statpack or similar type of software, which would allow first responders to detect an organism, take a picture and send it to the database to check and test what kind of organisms are in the field.
16. Study DisasterLan to see if its workflow features can be translated to a European context.
17. Study 1) if the tools for creating situational awareness work in practice and 2) if the system is effective in allowing information sharing.
18. Consider the possibility of developing courseware that can be accessed through Indigo.
19. Develop the ability as well to pause a training or trigger unexpected actions and secondary events at any time.

20. Take ship damage into account in the development of the scenario and events within the system.
21. It is recommended to develop the INDIGO system in a way that it can really be used in crisis response efforts just like SAHANA.
22. Develop with the help of end-user contacts and needs analysis to make sure the system contains what end-users really want.
23. Ensure that the system is compatible and can be "plugged in" to existing systems.
24. Use the knowledge that comes from the CRIMSON project. The CRIMSON framework offers today an effective and generic platform for the 3D visualization and simulation of the behavior of populations evolving in massive urban environments in response to simulated events. CRIMSON enables both the analysis and the evaluation of complex environmental, industrial or man-made events, their impact on the populations and the contingency scenarios that would be difficult to unfold and validate in real conditions. In addition, the 3D visual capability of the system offers a unique mean for creating, communicating and sharing complex knowledge between users with very different educational or cultural background (Balet et al, 2008).
25. Have a look at Symulzub to see how this simulator works and how the added value can be used for the INDIGO project.
26. Provide users with a realistic tool.
27. Aim to be a simple tool just like the ENSOSP. The simplicity of the tool handover for the training team enables to train the users (trainers) of the simulator without them having to be computer specialists. It is the same type of training as for office software.
28. Develop a multi-touch tool/tactile table. It is recommended that:
    a. The table can be used as a tool in various contexts of use.
    b. The table is useful for a wide range of sectors during operations.
    c. There is interaction with virtual and tangible objects.
    d. The table allows crisis commanders to direct civilians to safety.

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