ISEM — An Information System for Emergency Management

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Abstract

In an Esprit II-project partly funded by the European Commission a prototype of a generic information system supporting the preparedness organization in severe industrial accidents has been developed. Based on a thorough analysis of functional and information and communication needs within the preparedness organization two demonstration systems were set up. The ISEM consortium involved participants from seven European countries, which enabled the project to draw on knowledge of and experience with a wide spectrum of European emergency management practices.

1. Introduction

The potential risk of critical situations at industrial plants, still increasing in complexity and size, has drawn increased attention to emergency organizations coping with such situations. Experience gained from previous incidents and emergency drills has revealed the complexity that must be faced in making these organizations work properly. To meet the requirements of a distributed emergency management, capable of coping with seriously critical situations, puts heavy demands on the kind of preparedness system supporting such efforts - on the accessibility of information, situation assessment support, resource allocation, and communication support.

2. Conceptual model

The consortium has developed a number of conceptual models describing various aspects of emergency management and the relevant organizations.

The organizational model has been the basis of the organizational structure for the demonstrators developed within ISEM.

We have found that the organizational set-up for emergency management in process industries is characterized by (see Fig. 1)

- the goals involved: economic operation, plant integrity, and public protection
- the extent of authority involved: on-site, off-site local environment, national environment

Figure 1 shows how the organizational set-up is changing as an accident (e.g. in a nuclear power plant) turns into a larger emergency. The chart can be interpreted as follows:

- In a normal situation the goal is economic operation of the plant and the unit in charge of this is the control room staff.
- An accident may cause the technical management to be alerted to take the overall responsibility. The overall goal is plant integrity.
- A severe accident may require the on-site emergency operation centre (EOC) to be set up and the local off-site EOC to be notified.
- If there is any risk of adverse consequences outside the plant the situation will change from a site emergency to a general emergency. The organizational set-up will rapidly escalate to comprise many different organizations. The overall goal is now public protection.

3. Functions

At each stage of the emergency the entire

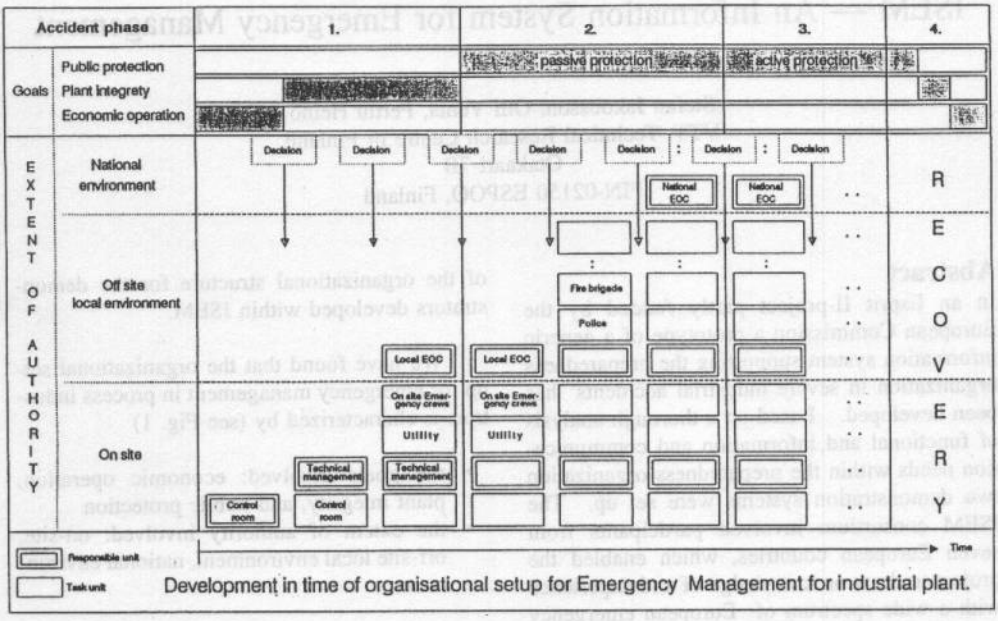

Figure 1. Generic representation for the process industry.

emergency organization has to fulfil the following general functions or tasks:

- assessment of the current state and current prognosis for the plant/environment
- assessment and possible revision of the current priority of overall goals
- assessment of the need for additional actions and agents: decision whether to alert additional agents
- establishment of communication links with units and agents
- distribution of tasks and the co-ordination of information to relevant units and agents

These general functions may be seen as methods for the entire present organization to define specific functions for each part of the organization. The general functions are the framework within which decisions are made whether to shift from one level of activity to the next.

An extensive list of functions useful for support of the users in critical situations has been elaborated based on interviews with end users and experts. These functions have been decomposed into activities and regrouped into a set of composite functions, called *functional modules*, which have been developed in the project.

The group of functional modules chosen to be developed was the following, each characterized by a short description:

Situation assessment, on-site and off-site.

Get and create the data needed in order to be able to understand the current situation,

- get the available information relevant for

managing of the emergency. Pieces of information can be either readily available or they must be actively fetched as indicated by the preparedness plan
- get information about all plant data of vital importance for emergency evaluation
- interpret and update the emergency situation by calculations, analysis, and diagnosis
- make predictions of what will happen.

Part of this module is a radioactive dispersion and dose calculation model.

Extended preparedness plan

In this module all events, decisions, actions, procedures etc., which can be planned in advance be entered, changed, updated and compared to the actual situation to benefit from foreseen resembling situations. Well structured parts of the preparedness plan (emergency procedures etc.) were implemented as a database application, while textual background data was implemented in hypertext. Links between the two formats allow direct jumps in between.

Activities and resources

Here decisions on actions to be taken and allocation decisions are recorded as a response to evaluation using information from the situation assessment module. All decisions are made by human operators, the system provides the necessary information.

Information exchange

This is basically an E-mail system specially adapted to the needs of the emergency management domain. E-mail on X.400 and fax services are supported. For more information on this matter see [2].

Apart from the functional modules above a few other were also partly implemented, the training module most notably.

4. Database

An extensive data model was developed including data relevant for a wide range of emergency management activities. The data model describes e.g.

- data from the plant (a subset of the most important data)
- event and actions related data
- organizations and agents
- procedures to be followed
- decisions
- resources
- environmental monitoring.

Many of the data items can be described as having a quite complex life cycle: all static data that can be planned in advance is called preparedness plan data. With a real situation at hand this may be updated and turned into 'actual' data describing the current situation. Other states of the data are data on predicted situations, and even scenario data for training purposes.

5. Platform

ISEM is implemented on standard UNIX workstations and PCs using standard relational database technology. Two demonstrator systems were set up, one for the nuclear sector and one for a chemical plant. A schematic view of the architecture and set-up for the nuclear demonstrator including the data is shown in figure 2.

5.1 Software

The ISEM programs run on an Oracle relational database, MapInfo GIS system (Geographical Information System), Xantippe hypertext, X.25/X.400 communication, Unix sockets and the OpenWindows graphical interface.

The hypertext environment used was partly developed within the project. The Xantippe hypertext system is built on top of Eiffel and can run both on DOS and UNIX platforms. Xantippe was used for the following purposes

- to implement the help facility
- to provide the information navigation tool
- to provide a textual presentation of background information (also images)

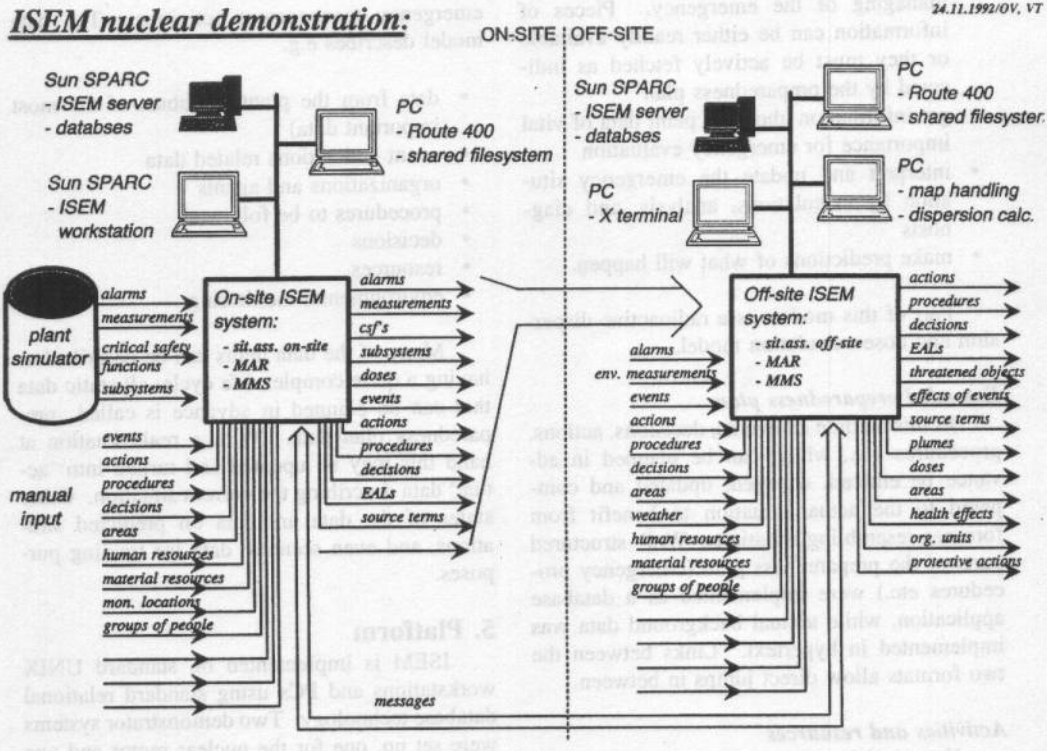

Figure 2. Set-up for the nuclear demonstrator.

- to execute database and other applications from within Xantippe.

The GIS of choice is MapInfo, which was used for display of dispersion and dose calculation data, population data, environmental monitoring data and certain infrastructure data. The dispersion model running on a PC gets the input data from the database.

5.2 Hardware

Each site with an ISEM system has a central database connected to a local area network, LAN, which is an Ethernet in our case. The database is running on a Sun SPARC server. XTerminals running the database applications are connected to the LAN. Also PCs running special applications, like GIS and dispersion calculation, are on the LAN and can access the database where appropriate. The demonstrators with several ISEM sites were connected over the X.25/X.400 network.

6. Conclusions

The key points describing ISEM:

- integrates on-site and off-site emergency management support
- provides integration and capability of
  - resource management
  - access to preparedness plan
  - on-site and off-site situation assess-

ment
  - a dedicated information exchange system
  - training
- provides integrated support for co-ordinated emergency management efforts among different types of organizations
- has been validated across two typical emergency management domains, the nuclear and chemical sector, in terms of demonstrator tests
- has had its data model validated for the domains in question in a similar way

ISEM is, however, still a prototype. MEMbrain, a EUREKA project, which will develop and make commercially available a system to support the major activities of emergency management organizations, will use ISEM as one of the building blocks.

7. References

[1] ISEM Consortium: ISEM Esprit Project 2322. Final report. December 1992, pp. 24 + 10.

[2] Andersen H., Andersen V: MMS: Brief Overview of an Electronic System for Supporting Communications Requirements of Emergency Management Organizations. TIEMEC 1994 Proceedings.