SYSTEMS IMPROVING COMMUNICATION IN CASE OF A NUCLEAR EMERGENCY

Two information exchange systems in the Belgian Nuclear Research Center

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Abstract: Creating a 'common view' between all stakeholders on the course of an emergency situation and the possible consequences is a challenge for any crisis management organisation. In the SCK•CEN nuclear emergency preparedness research two projects address two different and particular communication or information management challenges. The HINES system aims at creating a common view by using an information system as a communication tool in an on-site nuclear emergency response room. The MODEM project uses XML-technology to stimulate communication between scientific experts from different countries and institutes by facilitating the exchange of information used in decision support models used to assess the impact of a release of radioactive material in the environment. Both systems are implemented in prototype phase and used regularly during exercises.

1 INTRODUCTION

During an emergency situation it is important that emergency workers, management and governmental decision makers share a common view on the course of the crisis situation, the risks and possible consequences. Creating this common view is a difficult issue, as communication between the stakeholders is limited both by the stress of the urgent emergency response work, and by the lack of implicit communication channels or existing teamwork experience due to the exceptionality of this group collaboration

Lack of information, or differences in views and incoherence of the countermeasures are frequently quoted issues in the evaluation reports of emergency exercises. Living in an information society, this incoherence can undermine the acceptability of countermeasures and the authority of the authorities.

Several projects are addressing this issue, in this paper we describe two projects, starting from difference angles, both tackling a part of this common view challenge.

The first system, HINES, is a communication tool used in an on-site nuclear emergency response room (NERR). This information system aims at capturing information in a structured system at the origin of the situation. As entering information in an information system is a supplementary task for the NERR workers, added value in the NERR itself is a prerequisite for the acceptability of such an internal NERR system.

The second system targets a need for information exchange at the other extreme of the collaboration spectrum: the communication

between experts from different countries during a nuclear emergency situation. During a crisis, experts and decision makers use decision support systems to assess the off-site impact of a radiological thread. The MODEM project facilitates information exchange between such systems based on XML technology.

2 HINES: A COMMUNICATION TOOL IN AN ON-SITE EMERGENCY RESPONSE ROOM

In this paragraph we highlight the use of the HINES communication tool in the on-site nuclear emergency response room of the SCK•CEN Belgian nuclear research centre. The structure and the utilization of the tool is described and feedback is given on its performance during emergency response training sessions and the exercises.

The SCK•CEN is a nuclear research centre and contributes as such to the research in the field of nuclear safety and radiation protection, medical and industrial applications of radiation and the backend of the nuclear fuel cycle. In order to perform these tasks the centre is equipped with two research reactors BR1 and BR2, a critical facility and a series of hot-cells in the laboratories. As a nuclear installation the SCK•CEN needs to be prepared to deal with situations involving possible consequences to the workers and the public. This involves the implementation of emergency response procedures and the gathering of the on-site nuclear emergency response room (NERR) and the organisation of full scale emergency response exercises where all procedures and communications with the authorities are practiced.

The emergency room is staffed by the site management and a group of experts. The management assisted by the experts make an assessment of the situation; propose actions, interventions and countermeasures on-site. The management has the responsibility to communicate, the information on the type, size and possible consequences of the accident to the controlling authorities of the government who will in turn co-ordinate the actions off-site.

The NERR is organized in eight sections with specific responsibilities and expertise:

- Radiological measurement, safety and access control
- Meteo and radiological impact prognoses
- External communications
- Internal communications
- Medical emergencies and first aid
- Fire fighting and technical support
- Radioactive waste handling
- Advisors from the control authorities
- Public Relations

All of these sections report their findings to or perform actions under the control of the site management.

It is clear that the information exchange during an emergency situation can be very divers and complex. The information needed by the management to assess the situation is prepared in the different sections of the NERR and can roughly be characterized as static or dynamic information. Static information does not change during the emergency situation and group's data such as the technical site description, the safety assessment reports and procedures. The dynamic information groups data that changes during the emergency, it contains information on the evolution of the incident, the radiological survey data, the radiological impact prognoses based on the type of accident, meteorological information, information on casualties, deployed and available resources etc.. The forms of the communications are mainly questions and answers, orders or actions, status reports or advice.

In the past the communication in the NERR was oral and paper messages transmitted between the different sections described above. This way of communicating has the advantage of being very direct between the sections but has the disadvantage of traceability and visibility for other sections or members of the NERR. Participants in exercises also reported difficulties keeping overview when there is an overload of information and a need for tools to organise their priorities. In order to improve the availability of the communication we developed a computer mediated communication tool called HINES.
The communicating system in the NERR requires an easy traceability of the communication. A possibility to make a

selection in the communications adapted to the needs of the user and a possibility to associate priorities to the communications. The first communication system we are using since 1999 in the NERR is based on the following main concepts:
A communication has a fixed lifecycle and possesses meta-information allowing filtering.
All the expert groups of the NERR have access to all communications exchanged.

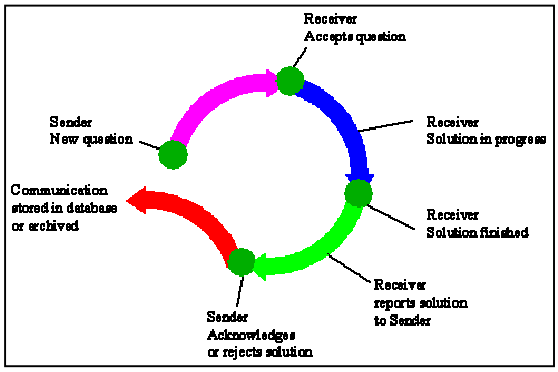

Figure 1 Life cycle of a communication object

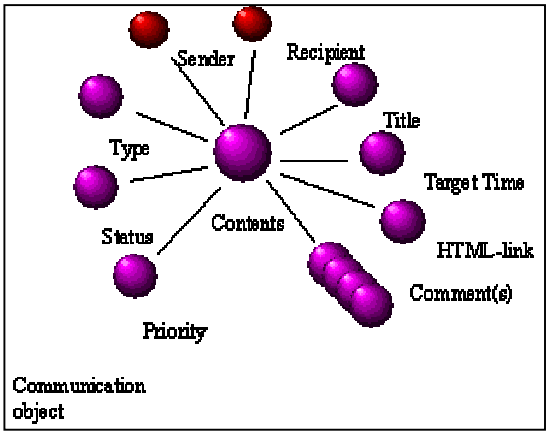

Figure 2 Attributes of a communication object.

The first concept allows a thorough structure of the communications and allows easy traceability and filtering of the communication. The attributes are a mix of these found in messaging systems (sender, date, title, message text, etc.) and others found typically in project management applications (due time, status of task, etc.). The basic filter setting are “Follow up” and “To do”. The “follow up” setting selects all the communications issued by the sender that are in progress or are finished. The “To do” setting selects all messages addressed to the receiver demanding an action or solution.

A special communication object is the “Synoptic situation”. This communication object can only be issued by the management and allows giving a concise update of the emergency situation and is addressed to all members of the NERR. The filtering on these objects allows the users to get a chronological synoptic description of the emergency situation.

The second concept on which the communication tool is build is the free access of the different expert groups to other communications in the NERR. This has the advantage that expert groups who are not solicited for a specific problem can freely read the communications exchanged in the NERR and if possible participate in the problem solving process. This allows to temporarily enhancing the number of people tackling a problem under consideration.

Another advantage of this approach is the free access to information related to a specific topic distributed over the communications in the NERR i.e. if someone needs information on contamination’s he can perform a search in the set of communication objects and group al the information on the screen to get a general view on the topic.
Every expertise section has also the possibility to make comments on the contents of communication objects without being the recipient of the communication. This feature allows gathering some feedback from other members in the NERR on the topic discussed without disturbing the main communication flow. It allows experts to consider some issues in-depth while not disturbing other the communication glow of 'urgent messages' typically for an emergency situation.
The system was used during emergency exercises and was evaluated positively. The main feedback of the user was that they had now more information available during the emergency and that they could retrieve it easily. The use of the system however also involves a training process for the user and a discipline to enter the information they obtained in the system.

In general we can conclude that the equipment of the on-site Nuclear Emergency Room with the HINES-system allows a flexible way to consult and communicate data during emergency situations. The computer mediated communication system as developed, provides us an easier way to implement return of experience from emergency situation exercises and lead to a better emergency preparedness.

3 MODEM: A PLATFORM INDEPENDENT PROTOTYPE FOR DATA AND INFORMATION EXCHANGE BETWEEN DECISION SUPPORT SYSTEMS

A survey amongst participants in the Decision Support System network (DSSNET) community, a European network of scientific institutions, government agencies and authorities and operators of nuclear installations using DSS in nuclear emergency preparedness, showed that the use of DSS and the information flows between participants and stakeholders in nuclear emergency are too disparate to be defined in one well-defined procedure or analysis.
Looking at the organisation of the national emergency response organisations, and especially when modeling the information flow, diversity is the most striking finding:
originators of the information are different,
decision making organisation is country specific, especially the roles of and relations between local, regional and national decision making authorities are different,
the approval and publishing of information to press and wider public is dealt with in different ways
And the responsibilities for the information flow to other authorities, international organisations or neighboring countries differ as well.
Moreover, the place of decision support systems (DSS) in the emergency response organisation varies for the different countries. This variation can be found in the way one of the 'big three' DSS systems (RODOS, ARGOS & RECASS) is implemented, and even more in the way other, often country-specific systems, are in use and function more integrated with the particular emergency response organisation of the country.

None of the decision support systems manage information flows, they are all focused on data collection, assimilation and model calculations needed to assess or forecast the severity of a contamination, the (potential) consequences for people and food chain, and the effects of considered countermeasures.

The functions and scoop of the different nuclear emergency decision support systems is also

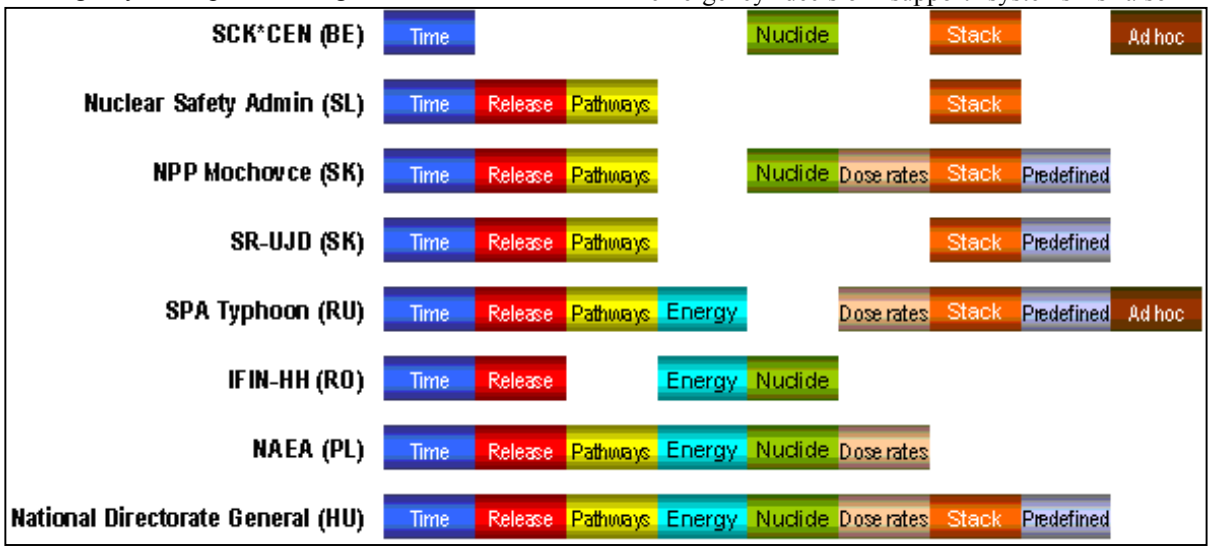

Figure 3 Function and scoop of nuclear DSS in use in Europe are very diverse

divers, as illustrated in fig. 1 where we see the Availability of results from decision support software (top graph) and different parameters used in source term assessment (bottom graph) considered by the systems.
Hence we can conclude that there is a need to structure the information exchange system, but this has to be flexible enough to work with the above described variety of existing organisations and procedures. Though it may not be feasible to agree on all specifications of information to be exchanged, we can define at least a minimal set.
A prototype for data and information exchange is under development under the project MODEM (Monitoring data and information exchange among decision support systems), a collaboration between the Belgian Nuclear Research Centre (SCK•CEN), the Bundesamt für Strahlenschutz in Freiburg, , the Danish Emergency Management Agency, SPA Typhoon in Obninsk, Russia, and VUJE Engineering in Slovakia, sponsored by the European Commission. It establishes links between the decision support systems RODOS, ARGOS and RECASS. For setting up this data exchange, the use of xml-based data specifications allows a flexible integration with existing applications.

The power to include metadata in a structured way allows the use of automated transformation tools and limits the modifications to existing applications to relatively simple generic import/export functionality, leaving existing data models untouched. For the first implementation, standard W3 XMLschema definition (.xsd) was chosen.

The modem project implements an application layer for the communication between running DSSystems, such as rodos, Argos and recass. The protocols and formats are open to other decision support systems; the aim is that any system can integrate with the modem exchange network.

Design options

The existing notifications and early phase information exchange systems, setup by IAAA and EC, ecurie, eurdep and emercon, are valuable but only used by small number of participants (> 40%). From a technical view, the current notification systems use specific communication technology and are not connected to any DSS. Therefore it is useful to integrate these communications with the information available in de DSS, and define the specifications for the exchange of information between decision support systems in such a way that as much of the existing formats and information are re-used.

The EURDEP format is a well-designed data format for data exchange. It is very ambitious with respect to its extendibility and flexibility, and it is a commonly supported format by a lot of measurements and modeling systems. The emercon and ecurie systems are messaged based systems designed for use in emergency situation.

The use of an eXtensible Markup Language allow re-use of existing standard formats for information exchange. The eurdep 2.0 format will be the underlying format for measurement related data-exchange, while both the ECURIE C.I.S structure and the EMERCON notification forms are re-used in the modem notification messages.

Modem facilitates data exchange between these systems in emergency situations. The identification of the emergency situation, the key data about the emergency and the relation of all exchanged decision support information with these key emergency data is part of the Modem architecture. For the data communication layers, the choice for a layered protocol stack is eminently clear. Our goal is implementing SOAP messaging using the standard http service layer on the internet network (IP protocol). The communication between decision support systems can be made comfortable using Webservices.

First things first: from the questionnaire we learned that the added value for the modem network was in the first place in exchanging source term information and results of the decision support systems. The first modem implementation focuses on exactly this. Both sets of information are dealt with in different ways, so we defined a minimal set of

information to be exchanged, together with a series of optional fields.

Use of the software.

The data and information exchange prototype was tested during the DSSNET exercise in May 2003. One cluster of DSSnet exercise participants used modem software and file formats to exchange the information during the exercise. The countries were running different decision support systems for assessing the impact of the radioactive release in a neighboring or far-away country. During the exercise, both the messaging system and the source term exchange was successfully used.

Several technical choices are to be elaborated later in the MODEM project. Domains such as ownership, validation, security, and integrity of data, a structured format for (geo-) graphical rich information or the organization of a redundant exchange infrastructure with optimized replication functionality are not yet dealt with in the first modem prototype.

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