CASE STUDIES

A KNOWLEDGE-BASED SOFTWARE SOLUTION FOR RISK MANAGEMENT IN A RESEARCH ENVIRONMENT

1. Case metadata

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20641D	Worker participation
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56441D	Researchers
58321C	Laboratories
18601D	Competencies
09681D	Internet
04161D	New technology

2. Organisations involved

Delft University of Technology

3. Description of the case

3.1. Introduction

In research institutions, most uncontrolled safety risks are to be found in the scientific experiments themselves rather than in the logistics processes or the supply of main services. The predictability of risks at transport and storage of materials enables traditional risk assessment methods by safety experts. Safety management of scientific experiments is different to that of support processes. One of the features of scientific experimentation is the search for the unknown and the application of new knowledge, techniques and materials, often in a complex relationship to one another. In such situations researchers are faced with safety issues they are not adequately trained to deal with and whose extent and significance they are not aware of. It is even more difficult to devise realistic safety scenarios for new research groups that arise at the interface of existing disciplines. Examples of these areas are to be found in nanotechnology, where biology, chemistry and physics come together, and in the development of new adhesive materials by aviation scientists and materials experts. New situations and technologies of this kind can result in the introduction of risks that have not previously occurred or not on such a scale, and which no-one has experience of. This unfamiliarity increases the likelihood of unsafe situations not being recognised, or being underestimated, or even being overestimated. Furthermore, there are hundreds of projects running parallel that makes it impossible to carry out risk assessment for each as an outsider. There can be, for instance, especially dangerous substances in unusual conditions, and very expensive devices that do not allow margin of error. Producing something new and unexpected, involving unexpected materials and methods is the innate characteristic of research. In figure 1, 2, 3 and 4 some real settings are depicted.

The researcher has knowledge on these issues, but he/she may be unaware of safety and health aspects. Whether scientific researchers make a correct assessment of the safety risks involved in their experiments depends on personal knowledge of the subject matter, alertness and attitude; the organisation has little control over these factors. Research institutions therefore need a method for integrating scientists and their experiments into their safety management plan as well. The Delft University of Technology developped a management tool in which the above mentioned issues are incorporated.

Figure 1. Example of an experimental setting

Source: Delft University

Figure 2. Example of several dangerous substances

Source: Delft University

Figure 3. Example of a disastrous experiment

Source: Delft University

Figure 4. Highly complex research environment with multitude of chemical substances, biological agents and machines on a single workbench.

Source: Delft University

3.2. Aims

The university wanted to develop a tool that enables the scientist in the easiest possible way to independently assess the risks associated with his experimental set-up, and guarantee that the assessment is well-done by giving the line organisation a control function. The tool should be developed in such a way that:

- involve researchers into the safety planning of their own research activities;
- is easy to use and provide practical help for scientists in research planning;
- it covers further technological aspects of research, not only chemical processes;
- it is not only to assess the risk, but would also help in the management thereof; introducing safety already at the planning phase.

3.3. What was done, and how?

Development of a safety report system

The university developed an on-line safety report system enabling researchers to make their own safety assessment for the experimental set-ups under their control. The overall concept of the method is to delegate safety issues to the researcher that has the deepest knowledge on the research process. The researcher receives all the information necessary and is guided through the risk assessment procedure. The safety report is based on a paper inventory method developed between 1973 and 1975 by the Chemical Technology Department to integrate safety thinking into its scientific research and education. This original safety report focused particularly on the safety of chemical processes. To make the safety report suitable for use university-wide and in a health and safety context more generally, the report system was expanded in 2004 to include non-chemical topics such as laser safety, biological safety, ergonomics and environmental safety. At the same time the role of line management was strengthened and the report system was digitised; reports can now be completed and consulted on the Internet.

The system was developed in 2004 in consultation with researchers in laboratories (prototyping). Scientists were involved in the development of the tool to adapt it to their needs. This also made it acceptable and welcomed by them. The gradual and smooth introduction helped to make amendments in the course of the process. At first, people preferred the traditional method. But when they got to know the benefits of digital safety reports and when they were involved in the development process barriers were soon overcome. After the programme of demands was completed, programming and implementation took about 6 months. An external software company was involved and Delft University ICT did play a significant role as a partner for the programme part.

The system has been operational at TU Delft since 2005 as a digital tool the report writer can use to process his basic information into information about the risks involved in his experiment and their associated control measures. It forms a steadily growing database of best practices in experimental safety. Although TU Delft management regards the system as a compulsory instrument, implementation has been solely at the request of work units.

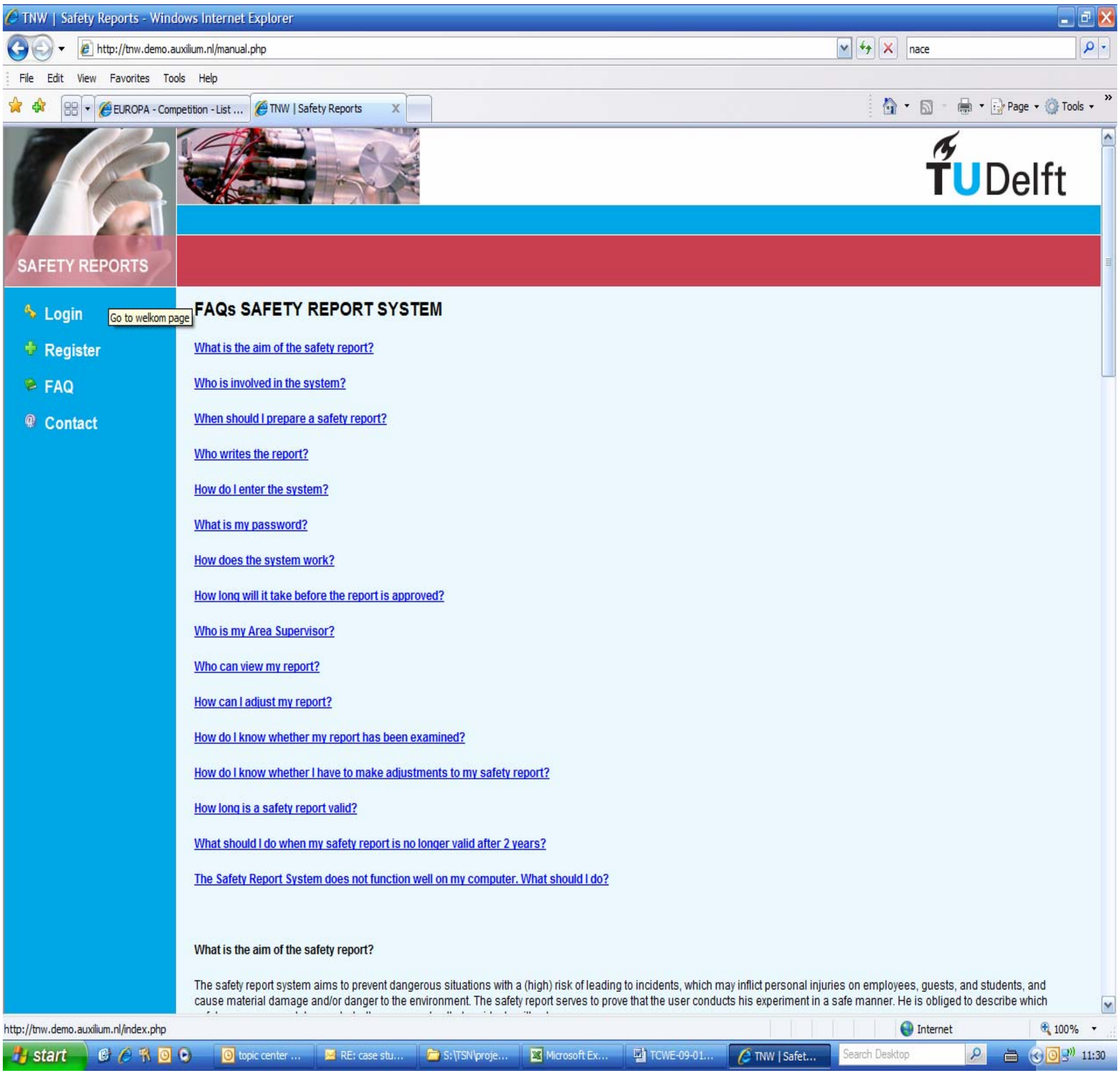
How does it work?

The person who constructs or modifies the experimental unit has to write the report. This can vary from student to professor. When more than one person is concerned, the main user should write the report in mutual consultation.

During the process of writing he/she is encouraged to informally consult experts to solve safety issues. The tool systematically provides checklists and it assists the researcher with a guidance side-kick. The systematic approach starts with ‘General Information’ and guides the researcher from ‘Chemicals, gasses, solvent & organisms’, ‘Equipment used’ and ‘Special and external conditions’ via ‘Process’ and ‘Labour aspects’ to ‘Disposal and waste’ with finally saving the report. The scientist is warned e.g. to read material safety data sheets of components and is reminded to take into account waste management issues. The software draws attention to risky characteristics and procedures, and is proposing solutions to tackle or minimise these risks. Researchers may not know certain features of a component. For example the chemical substance intended to be used at an experiment focusing on mechanical engineering may be carcinogenic or highly flammable. The software warns the researcher of procedures that pose too much risk, enabling the scientist to find an alternative method. This is the way of eliminating risk at source. If there is no appropriate alternative the researcher is advised how to treat risk. For the above mentioned risks recommendation can be e.g. to organise appropriate ventilation, respiratory protective equipment, or replacing the atmosphere with inert gas.

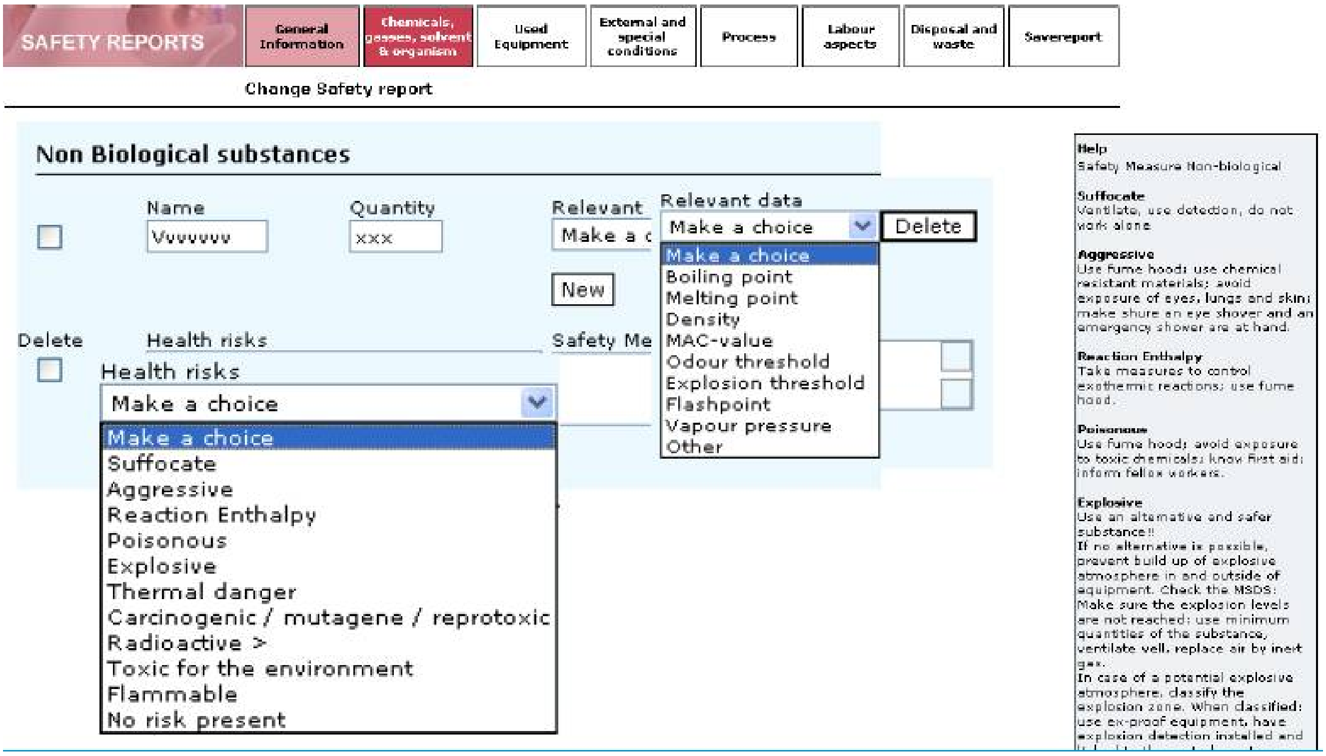
The system contains a frequent asked questions page (see figure 4) which provides extra information and technical support to the user. Figure 5 gives an example of one of the pages of the program.

Figure 5. The FAQ's page of the Safety Report System



Source: Delft University

Figure 6. Software at work



Source: Delft University

There is always an opportunity to ask for safety expert opinion. The researcher has an access to former safety plans in the database. This database forms a wealth of information how to tackle risks and it may also give ideas for other aspects of research planning, thus creating a creative platform of scientist networking.

The head of the laboratory supervises and approves the safety plan. If he/she has concerns about the safety of the experiment, he/she may forward the case to higher authorities. This provides the management line an insight to the safety issues of their departments and it also enhances responsibility. The "extra" work of the researcher on the safety plan is proportional to the risks of the investigation.

An approved safety report is valid for two years. After this period a new version of the report is required. The system will inform the user in advance by email when the report expires.

The following costs were made for the design, building and maintenance of the system:

- Software development: EUR 100 000
- Implementation costs per user's group: EUR 12 500
- Service and maintenance costs: EUR 3 000 for a quarter of a year for all users together
- Project manager: EUR 5 000 a year. There is still a project manager, who is now the controller of the system.

The system is evaluated by keeping in close contact to the users, visiting them on the work floor and using the management function of the system. Fot the last 5 years, the tool has been updated once. In the future Delft University will make a rebuild of the system, in order to increase flexibility, include suggestions of researchers and to improve the management function.

3.4. What was achieved?

The achievements are grouped in three topics: safety and health in practice, participants and contribution to research.

Safety and health in practice:

- A safety, health and welfare-wide safety tool suitable for an international setting.
- Increase in preventive safety at the operational level (participation).
- Integrated and transparent decision making.
- More integrated decision-making on safety versus production.
- Diminished number of forgotten steps (like waste treatment).
- Growing report database that mobilises available knowledge.
- Improved education curriculum about safety and health.

Participants:

- Development of safety competences at the operational level.
- The system has increased the involvement of researchers and line management in the question of safety and strengthened line responsibility. Safety issues are talked about more openly.
- Safety professionals have an advisory role, and as a result are brought in more often.
- Safety information is available to management (search functions in database) and is used in connection with safety inspections.
- The database creates a platform of networking and cooperation between scientists.

Contribution to research:

- Database of reports foster work on new assessments. High satisfaction rate among user, e.g. researchers are more rapidly authorized to go ahead with their experiments.
- Safer research and more pragmatic solutions.
- More assured progression of research (considering safety bottlenecks/problems in advance).
- Experimental research set-ups became manageable and the compliance with statutory legislation has enhanced.

3.5. Success factors

The following succes factors were mentioned by the company:

- The tool was produced as an answer to a real demand.
- The involvement of users (researchers) in the development process enabled the output to be tailored to the specific needs and taste of the scientist community.

- The tool is not just an assessment of the risks involved in a new experiment, it is a way of initiating change at source, which is through the researchers themselves.
- Students, the managers of the future, are also involved in the process, which means that they already cultivate an awareness of health and safety and learning how to handle risks.
- There is a good consultation between management and trade unions/workers.
- The decision to programme a 'slim' tool, without sophisticated databases or computation. This ensured a stable system in which the researcher himself is stimulated to be in charge of his risk assessment.
- The system can be easily adpated over time and implemented in other organizational settings.

3.6. Further information

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3.7. Transferability

The system has been tested for suitability in an international setting. The tool can be transferred to sectors of research and development. Various sister institutions in the Netherlands and elsewhere are interested in it. The Dutch union of universities is in a process of adopting the system as a best practice to control work with dangerous substances. Also several foreign and international research institutes have shown interest in the system. Because the safety report is always implemented at the work-unit level, the system will also be applicable to smaller companies that operate in an innovative market.

4. References, resources:

Information provided by the company/organisation in the framework of the Good Practice Award Competition 2008/2009.

Safe Reports webpage: http://www.safetyreports.tudelft.nl/manual.php