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The digital representation of safety systems at "Seveso" plants and its potential for improving risk management

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ABSTRACT

At Seveso plants, duty holders must have a complex system for assessing and managing risks. The pillars of this system are the safety report and the safety management system, with a number of underlying documents. The strength of the system is the high standardization of these documents. Regulations, standard codes and guidelines define content, structure and formats. The weakness is the high complexity. Managers and workers perceive documents as difficult to understand and far from actual operations. Major threats for the credibility of documents (and therefore for the safety systems) come from the continuous organizational and technical changes, which in a short time can make most documents obsolete; as well as by near misses, which continuously show the holes in safety systems. A big effort is required to follow up the plant changes and the near misses. In order to help safety managers, a new software has been developed. At Seveso plants, it has been possible build an integrated digital representation, because all documents are perfectly structured. This representation may be used both for updating the relevant documents after a change and to improve documents after a near miss or an accident. In this way, safety documents are always up to date and trustworthy and the huge knowledge, which is usually hidden inside safety documents, is clearly revealed and revived. The approach is basically "knowledge based" and the intention is to provide safety managers with an easy and simple tool. IRISonLine is a software that has been developed by ISPESL to provide safety managers of "Seveso" establishments with a tool for improving the management of change and of near misses.

1. Introduction

At industrial facilities, safety management systems have provided great benefits, but they have also dramatically increased the number of documents, both in digital and in paper format. Even in a small-sized facility, hundreds of individual documents have to be produced. In order to maintain the benefits of the management system over time, it is essential that these documents are always kept up to date. Change, which happens continuously in products, regulations, equipment, personnel and organization, makes safety documents become obsolete quickly. Everyday failures, anomalies, deviations and near misses highlight the weak spots of the system and challenge the credibility of safety documents. As workers perceive safety documents as far from real operations they do not care for them. A gap between safety documents and real operation is a major drawback for a successful safety management system and has to be carefully prevented.

This is an urgent problem in most industries, but the focus of this paper is solely on those industries where the legislation for the control of major accident hazards is enforced. In these industries, where accidents may affect employees, third party workers, citizens and the environment, the formal structure of documents is much better defined than in other industries and, consequently, the document organization is easier. This paper is based on the EU major hazard legislation, the so-called "Seveso Legislation", and namely on the Directive 96/82/EU (Seveso II) and its implementation (Ham et al., 2006). This legislation is applied in all member countries, as well as in other countries in the European Economic Area. Most OECD countries, including the USA, Korea and Canada, have analogous legislations, which require duty holders of major hazard sites to produce structured safety documents (Beals, 2008). Seveso legislation is enforced in many industries, and establishments range from small and simple plants owned by individual entrepreneurs (e.g. LPG depots, chemicals warehouses, fireworks facilities) to huge and complex plants owned by large corporations (e.g. refineries or petrochemical plants).

The job of continuously reviewing safety documents and keeping them alive is an essential duty of the safety managers in Seveso

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establishments. Simple tools for this job can be very useful, particularly at small and medium-sized facilities, where large resources are not available. Items already present in the safety system should be exploited in a better way. In this way, the continuous changes and the results of near miss studies could be completely transferred into the safety documents and procedures, in order to prevent accidents.

ISPESL has a long experience in industrial safety. For decades it has been the national certification body for the safety pressure equipment.

Since the first Seveso European Directive, it has participated in the system of inspections at the establishments, organized by the Italian competent authorities, according to art. 18 of Seveso II Directive. ISPESL duties also include the development of tools for accident prevention, such as guidelines, training packages and software products.

From this experience ISPESL was inspired to implement a software tool, named IRISonLine. It aims to help the operators of the Seveso establishments to update the safety documents and to exploit their potential for accident reduction. IRISonLine also supports workers in automatically reporting flaws in safety documents, encouraging them to take stewardship.

IRISonLine is based on the idea of representing all equipment, safety documents and procedures in a unified digital model. This is possible because "Seveso" industries are ruled by a number of regulations and standards, which define the structure for most documents. Basically, in the safety digital representation, all items of the safety systems are connected to each other. After any single change (or near miss), all the affected documents can be immediately retrieved and updated.

The paper is organized as follows: Chapter 2 is about the documents in Seveso Legislation; Chapter 3 talks about the need for living documents, with the need to update and revive them continuously. Chapter 4 discusses the theoretical basis of the "safety digital model", which is the core of the proposed solution. Chapter 5 describes in detail how the digital model is built in IRISonLine. Chapter 6 discusses the application of IRISonLine for the management of changes; Chapter 7 demonstrates the suitability of the tool for near miss analysis. The potential and limits of the proposed model are discussed in the last chapter.

2. Safety documents in Seveso industry

The two pillars of the Seveso Legislation are the Safety Report (SR) and the Safety Management System (SMS). Both the SR and the SMS are based on numbers of documents. In the following paragraphs the documents in the SR and in the SMS will be discussed separately, but it has to be stressed that the two matters are always interdependent.

2.1. Safety report

The structure of the SR is basically defined in Annex II of the Directive. Detailed guidelines are provided by the European Communities (Fabbri et al., 2005). Most Member countries, including Italy, have national guidelines, customized according to the features of their industries.

In the SR the risk assessment process and the measures selected to prevent, control and limit major events are described and defended by the duty holder (Wood, Fabbri, & Struckl, 2008). An SR must have a description of the hazardous installations, including activities, processes and dangerous substances; the identification and evaluation of hazards; the top events with accident scenarios and consequence evaluation; the description of technical and organizational measures for preventing accidents and the measures for limiting the consequences of accidents. A number of secondary documents must be enclosed in the safety report, including the first risk ranking, the detailed hazard identification and hazard analysis, the list of critical equipment and the emergency plan. For the risk ranking, the available methods are Dow Fire & Explosion index (AIChE, 2005), Dow Chemical Exposure Index (AIChE, 1998), ICI-Mond Fire, explosion & Toxicity index (ICI, 1985). In Italy ICI-MOND method is the most popular method, as recommended by national guidelines. ICI-MOND basically obtains, for every part (or logical unit) of a process plant, a risk level (split into fire, explosion and toxic). It is based on a check list, which deals with essential issues, such as hazmat quantities and features, processes and equipment, layout, material containment, control system, safety culture, fire engineering and emergency preparedness.

IEC 61882 HAZOP (IEC, 2001) and IEC 61025 FTA (IEC, 2006) are the most popular methods, respectively, for hazard identification and analysis. A complete discussion about hazard identification methods applied in Seveso industries may be found in Gould, Glossop, & Ioannides, 2005 and in Demichela, Piccinini, & Romano, 2004. It has to be stressed that in the case of small-sized facilities, with a high standardization level, simplified methods may be used. Methods are customized for single national industries. As the LPG industry is very important in Italy, in the framework of the SEVESO legislation, a tailored method for LPG depots and bottling facilities has been enforced in all LPG establishments since 1996. It was derived from the ICI-MOND, taking into account standards and practice of the national LPG industry.

2.2. The safety management system

The SMS organizes all activities that ensure the prevention of accidents and the mitigation of consequences, according to the well known PDCA model (Plan – Do – Check – Act). Issues addressed by the SMS include personnel organization, operational control, management of change, emergency planning. Requirements are defined by Annex II of the Directive. Detailed Guidelines are provided by the European communities (Mitchison & Porter, 1998). At the moment, a standard code for SMS at Seveso establishments is only available from the Italian Standardization Institute (UNI, 2009). In many sites the standard code OHSAS 18001 (BSI, 2007), which was developed for occupational safety, may be extended to include major accident prevention. A complete discussion about the SMS in Seveso industries may be found in Porter and Wettig, 1999, Mitchison and Papadakis, 1999 and Hurst, Young, Donald, Gibson, and Muyselaar (1996). Basically the SMS is a framework which holds a huge number of documents including organizational charts, job descriptions, operating procedures, technical manuals, inspection program records, material safety sheets, emergency plans, near misses and accident reports.

3. The need for living documents

Safety documents are not aimed at increasing bureaucracy, but at preventing accidents. Unfortunately most documents are developed according to a top–down approach, which implies that knowledge is the property of just a few experts. In practical experience, there is a huge implicit knowledge that is often hidden. Operating personnel at all levels can provide an efficient contribution to developing the safety documents. A bottom–up approach has therefore to be definitely encouraged. The following paragraphs discuss a few issues on how to keep the SR and the SMS alive and up to date.

3.1. Updating the safety report

Once the SR has been produced, it needs to be reviewed regularly in order to remain relevant and up to date. Duty holders are required to provide a new release of the SR at least every five years.