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MINI PROJECT

A review of past, present, and future of the European loss prevention and safety promotion in the process industries

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CONTENT

Executive Summary.....(3)

Introduction and Theory
..... (4 - 7)

- Problems and Their Importance.....(7 - 10)

Objective.....(11)

Scope.....(11)

Results.....(11)

Methods..... (12)

Assumptions and Their Role in
Result..... (12 - 13)

Conclusion
.....(13)

References.....(14 - 15)

EXECUTIVE SUMMARY

In this period the Loss Prevention Symposia series has been successful in stimulating and sharing both theoretical and practical knowledge among the Loss Prevention community and considerable progress has been achieved in the field of safety in the chemical and process industries worldwide. Even more industries are involved and have been profiting from advances in safety knowledge. Industries such as oil and gas, energy, pharmaceutical, food, manufacturing companies and the related service industries also use chemicals daily and are very much involved as well. We are experiencing challenging times due to exciting technological advances, for instance in communication and social media, as well as fast-developing societal developments, for example in the field of security, which will require further research and applications for improvement to adequately cope with them. Exchanging information, disseminating data, and stimulating the development of new methods to reduce the risk of incidents/accidents in the process industries, is indeed a must and a need. EFCE European Federation of Chemical Engineering (EFCE) has continually promoted scientific collaboration and supported the work of engineers and scientists in thirty European countries. As for its mission statement, EFCE helps European Society to meet its needs through highlighting the role of Chemical Engineering in delivering sustainable processes and products. Within this organizational framework the Loss Prevention Symposium series, organized throughout Europe on behalf of the Loss Prevention Working Party of the EFCE, represents a fruitful tradition covering a time span of forty years. The tri-annual symposium gathers experts and scientists to seek technical improvements and scientific support for a growingly safer industry and quality of life.

INTRODUCTION AND THEORY

From 1953 onwards, the European Federation of Chemical Engineering (EFCE) has continually promoted scientific collaboration and supported the chemical engineering work of engineers and scientists in thirty European countries. As an organization the EFCE was initiated in the Western part of Europe, but Central and Eastern European countries joined. As for its mission statement, EFCE will help European Society to meet its needs by highlighting the role of Chemical Engineering in delivering sustainable processes and products. The EFCE Working Party on Loss Prevention and Safety Pro- motion in the Process Industries (WP Loss Prevention) began in 1971 as a group of very motivated professionals, who decided at the symposium “Major Loss Prevention in the Process Industries”, held in Newcastle.

The first international symposium was organized by an international committee and officially labelled “on Loss Prevention and Safety Promotion in the Process Industries” was held on 28–30 May 1974 in the Aula of the Delft University of Technology in Delft, The Netherlands. From the accident histories in the 1960s, much was learned, as summarized in the following:

- The conditions that lead to an accident are often complex and difficult to reproduce.
- Test methods were often inadequate for making reliable pre- dictions.
- The effect potential for large mass was often underestimated.
- A system approach appeared crucial for successful prevention.

20th Century evolution – Risk analysis as a methodology to describe and delimit the risk of chemical process operations was introduced in the mid-seventies to the then newly founded community of Loss Prevention in the process industry. The second and third Last Planner System (LPS) reflected this debate, focusing on what quantification is worth with definite pros and cons, with a wide diffusion of Quantified Risk Analysis (QRA). Loss Prevention Working Party covering in a systematic and comprehensive way the up-to-date emerging issues related to risk analysis in the process industries, i.e., hazard identification procedures; consequence analysis; quantification of risk, and application of risk analysis. In the Eighties, "human factor" became an up- to-date issue and with good reason it was not believed by all people that this could ever be quantified. With equipment and single components becoming more and more reliable, emphasis is moving towards human factors not only in running the plant/process, but also in performing activities like maintenance for good quality of which ergonomics, prevention of error of omission, or lack of attention are important. Human factors must be considered already at the design stage.

Loss prevention –

- There is more concern with those accidents that arise out of the technology.
- There is more emphasis on foreseeing hazards and acting before accidents occur.
- There is more emphasis on a systematic rather than a trial-and-error approach, particularly on systematic methods of identifying hazards and of estimating the probability that they will occur and their consequences.
- There is concern with accidents that cause damage to plant and loss of pro t but do not injure anyone, as well as those that do cause injury.
- Traditional practices and standards are looked at more critically.

Safety promotion – Means, processes and procedures that ensure that aviation personnel are trained and competent to perform their safety management duties and are prepared for effective two-way communication of safety issues between operational personnel and the organization's management. Processes and procedures that are used to develop, sustain, and improve aviation safety through awareness raising and changing behaviors. Safety Promotion is also about sharing best practices from the authorities and the industry.

Progress in 21st Century – The concept of sustainability (operationally defined through the term "sustainable development" was explicitly related to safety, health, and the environment as a complement and expansion of Loss Prevention, by adding design criteria that take ecological, economic, and social aspects into account. The aviation industry provided useful indications for the development of a just culture in the process sector.

- The Personal factor. It emphasizes the inadequate capability, lack of knowledge, lack of skill, condition of stress, or improper motivation leading to an unsafe act or condition and resulting in personal injury.
- The Workplace factor. It includes inadequate supervision, engineering, purchasing procedure, maintenance, and work standards. The workplace factor has its origins in reliability engineering and emerges from (Hazard and Operability Analysis) HAZOP operations and risk analysis.
- The Organization factor. This model views human error more therefore rather than a cause, and it evolves from latent inadequacies and failing leadership or management systems.

In the last few years, new pressures and related safety threats have been developing rapidly, e.g., cost cutting and downsizing, plant complexity and ageing, early retirement, outsourcing, job-hopping, and complacency. Despite previous efforts, high profile process accidents still happen and emphasize the importance of process safety performance metrics to enable and maintain good safety management.

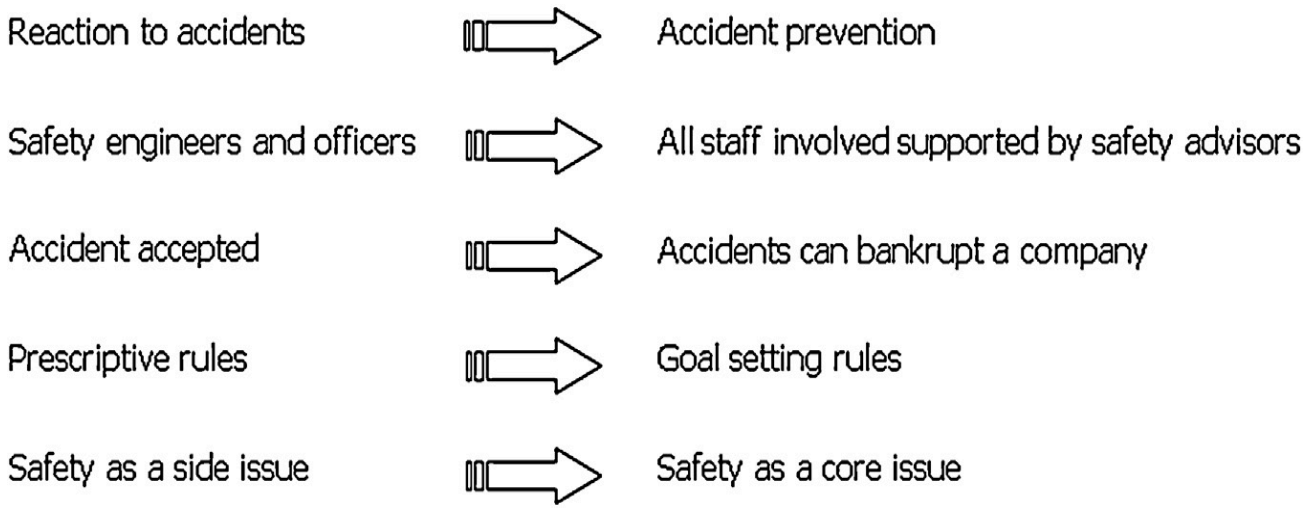


Fig .1 - Past and future trends in process safety

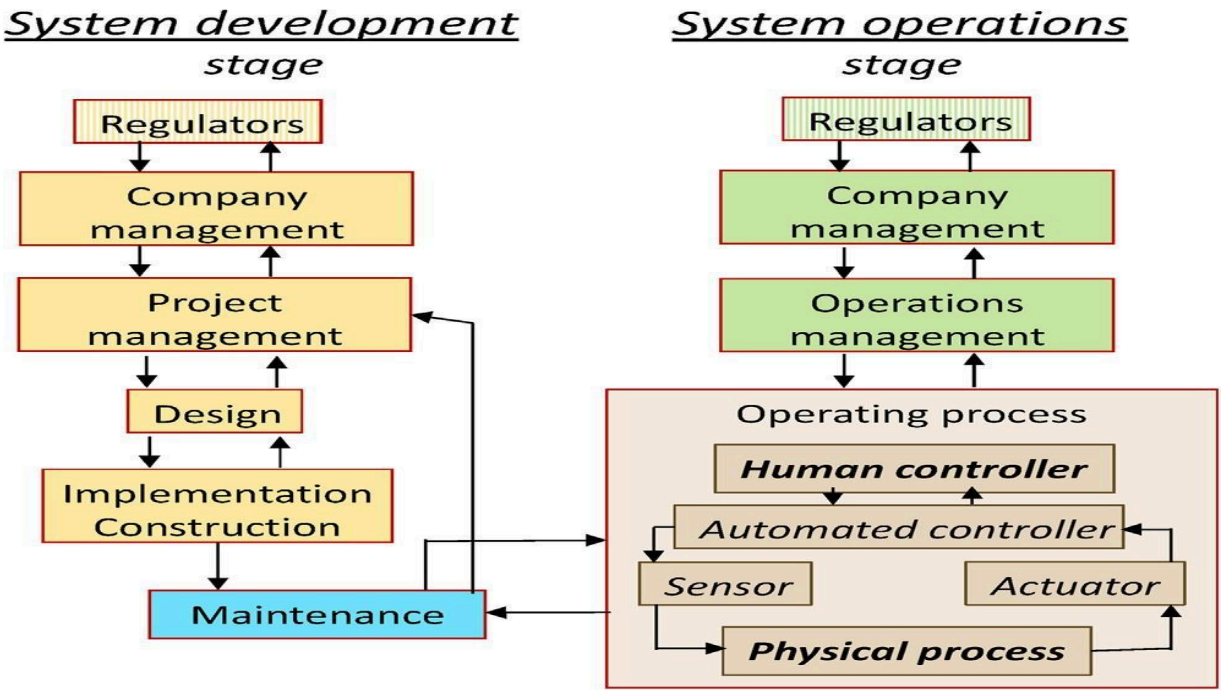


Fig .2 - Hierarchical socio-technical system with levels connected by control flows.

PROBLEMS AND THEIR IMPORTANCE

1. **Material hazards -** Hazardous materials are chemical substances that if released or misused can pose a threat to the environment or personal health. Such chemicals are prevalent in many industries and products, including agriculture, medicine, research, and consumer product development. There are several very toxic materials that may be used in workplaces. Some examples include carbon monoxide, hydrogen sulfide, chlorine, and sodium cyanide. Extreme care and caution must be used if there is potential for any form of exposure to very toxic materials. Certain hazardous substances also have the potential to explode or cause a fire, threatening both animals and human populations. Some hazardous substances produce toxic effects in humans or the environment after a single, episodic release. These toxic effects are referred to as the acute toxicity. Hazardous Materials Training is Important for Health & Safety. The most important reason for hazardous materials and dangerous goods training is to ensure the health and safety of workers, workplaces, properties, and the environment. Each hazard comes with its own side effects and damage potential.

2. **Process safety engineering -** Due to complexity and cost, human and management aspects became very important in process safety. New approaches and methods are proposed to tackle the new challenges. Due to economic crises, aging has become a major concern in the process industry, due to the high cost of investing in new equipment and consequences associated with failure. Many challenges still need to be addressed to make further progress in the safety and sustainability of plants and processes towards Safety. Reduce the likelihood of risks by providing more or more effective layers of protection. Reduce the consequence of risks by employing mitigating systems. Apply Human Factors principles to reduce the error potential at the interfaces of people with equipment and Instrumentation. Addressing process safety prevents serious injuries and illnesses, property damage, lost production, and negative environmental impact.

3. **Risk Management -** A lack of risk decision making structure and lack of accountability for risk decisions in an organization. Big risk decisions are

being made too low in organizations, with people who are not incentivized to make the right decisions for the organization. Good communication between loss prevention and risk management can help prevent a bad decision from being made or avoid an oversight regarding the failure to identify a particular risk. Loss prevention's connection to store operations should help contribute knowledge about new risks or exposures as they develop. Risk management is important in an organization because without it, a firm cannot possibly define its objectives for the future. If a company defines objectives without taking the risks into consideration, chances are that they will lose direction once any of these risks hit home.

4. **Human factor -** Human factors is an interdisciplinary area of psychology that focuses on a range of different topics, including ergonomics, workplace safety, human error, product design, human capability, and human-computer interaction. It gives a simple introduction to generic industry guidance on human factors, which it defines as: "Human factors refer to environmental, organizational and job factors, and human and individual characteristics, which influence behavior at work in a way which can affect health and safety". Human factors are the most appropriate approach for redeveloping and enhancing manual and cognitive skillsets to prepare workers for changing work environments and new task demands in future production systems. For new systems to be successful, we need to ensure that people are not only able, but keen to work with them.

5. **Learning from accidents -** Often accidents lead to increased caution. Negative events tend to grab attention, lead to more thorough and detailed-oriented processing of information, and motivate cognitive activity aimed at understanding what went wrong. Understanding the events that led up to an accident can help to determine the cause. Each accident should be treated as a learning opportunity. Once the cause of the accident is determined, corrective actions can be taken to prevent the same or similar losses from occurring again. It is also useful to learn from incidents of others. Knowledge from these incidents allows for comparison with the own situation and systems and enables you to generate creative solutions and take time to prioritize the measures.

Immediately after an incident occurs in an organization, the situation has changed. Lessons are learned from previous incidents so that identical or similar accidents arising from work activities can be prevented in the future is central to the Health and Safety Executive (HSE) mission, to protect people's health and safety by ensuring that risks arising from work.

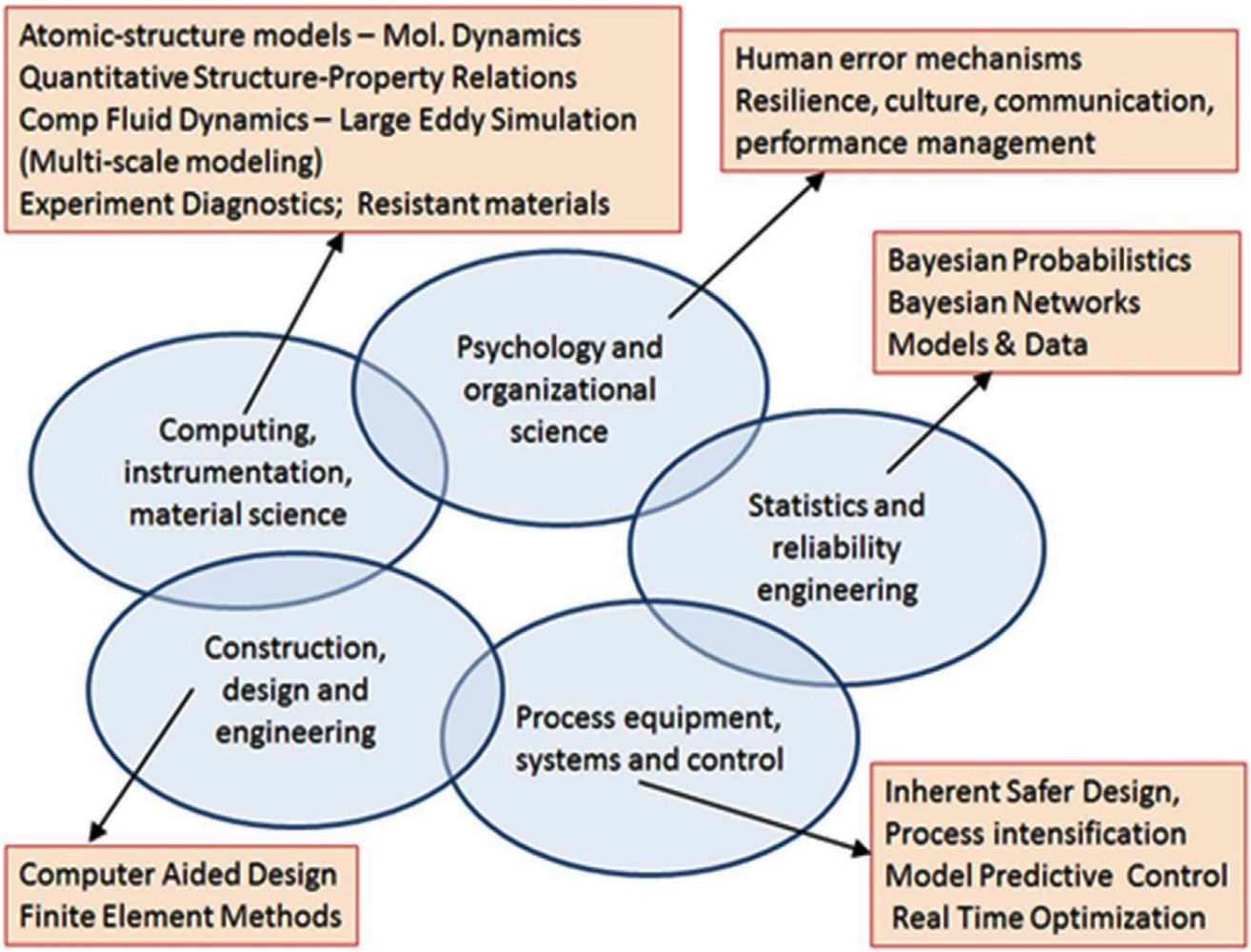


Fig .3 - Developments in science and engineering relevant to process safety.

OBJECTIVE AND SCOPE

They provide a centralized management framework designed to detect and prevent the unauthorized use and transmission of your confidential information. DLP (Digital light Processing) protects against mistakes that lead to data leaks and intentional misuse by insiders, as well as external attacks on your information infrastructure.

RESULTS

We can thus claim that the loss prevention movement has prevented many hundreds of deaths, perhaps over a thousand. The number of major injuries, those causing serious and permanent injury, prevented is probably comparable and, in addition many other injuries and much damage to plant have been prevented. During the 1970s the size of the chemical and oil industries roughly doubled but the number of incidents killing live or more people remained the same. Many, probably most, of the accidents that did occur could have been prevented by using knowledge that was available. Accidents do not, overall, occur because we do not know how to prevent them but because we do not use that knowledge. Nevertheless, there has been a significant improvement. But we should keep it in perspective. If some of the resources devoted to loss prevention had been devoted to discouraging smoking, many more early deaths would have been prevented. There was, of course, no social mechanism for transferring the resources and the loss prevention specialists might not have been very good at this task. A reduction in damages and pain and suffering in the workforce (from both acute and chronic injuries and illnesses) and a resultant reduction in the financial burden to the organization due to such accidents, processes and procedures that are used to develop, sustain, and improve aviation safety through awareness raising and changing behaviors due to safety promotions.

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METHODS

- Techniques, and technology exist to pre- vent and to rule out accidents, i.e., the loop from operational experience back to design has not been closed sufficiently. Preventing accidents and incidents starts with clear communication. Make sure personnel receive the right information about risks and relevant safety measures. Use clear, simple language and hold frequent team meetings. Use these meetings to cover the latest safety points. Data, information, and insight are crucial to preventing accidents and incidents. Thoroughly investigating a company's working conditions, processes, and operating procedures can help pinpoint potential risks and hazards before something goes wrong.
- Few methods help to make plant operations safer, i.e., methods to identify systematically possible incident precursors in a running process, methods to analyze the installation, and operation top-down risk reducing measures have not been developed.
- Development of sufficiently detailed models for emergency response planning is required to plan emergency operations and to support decision making in actual situations. Brainstorm a list of potential risks, hazards, and threat scenarios.

ASSUMPTIONS AND THEIR ROLE IN RESULTS

One of the most ubiquitous safety models has been the Safety Pyramid, originally proposed more than 80 years ago. The pyramid model's early success was due to the elegant display of simple statistical relationships between the types and severity of incidents and injuries — from near misses to fatalities. Although the model has been seriously critiqued over the years, it persists as the primary model for explaining safety problems. he models proposes that the probability of serious or fatal accidents (at the top of the pyramid) is correlated with less severe injuries or near misses (at the bottom). If true, then a remedy for serious accidents would be to reduce the number of less severe incidents. Up until recently, safety leaders have indeed interpreted spikes in near misses or lost workdays as an indicator that a more serious injury is more likely to occur, and that drops in near-misses and minor events indicated a major incident was less likely to occur, and the system was working as planned. Safety systems are then examined and modified, or validated and maintained as sufficient, based on such information feedback. Yes, they are realistic. But the foregoing assumptions are now being proven false. Fatalities and catastrophic events have remained constant or, in some places, have increased while minor injuries have continued to decline. This result is likely since work today is increasingly complex, and failures which occur in these complex situations cannot be easily explained or understood by looking through the lens of simple tools developed for simple systems. For this reason, there exists a systemic risk that companies may conflate consistently low, adverse-outcome numbers on low-level incidents with the adequacy of the overall safety system to control fatal or catastrophic events. Where the data indicates low-incident count, the conclusion may be that the system is working as planned (i.e., "safe"), and therefore not be subject to as intensive a review and audit as may be prudent under the circumstances.

CONCLUSION

In this report, the Loss Prevention symposia series has been successful in stimulating and sharing both theoretical and practical knowledge among the Loss Prevention community for a time span. Although judging fatality and injury levels in general, the process industry can be regarded as a safe industry, the potential of major hazards is present, and risk control is certainly not guaranteed. Process safety has always been required to respond to the demands of innovations in

technologies and societal developments, and the next decade will be no exception to this. Currently, there are new challenges. The EFCE loss prevention working party is committed to the exchange of safety information among specialists, between research and practice and between academia and industry. Exchanging information and stimulating the development of new methods and dissemination of data, implementing process safety and security management which may reduce the risk of fires, explosion, and loss of containment in the process industries, is a must and need. Moreover, innovation leads to new process under yet unknown condition and introduce potential new hazards from emerging technologies, and materials with a continuous need for further research and development. In this respect, the international symposium on loss prevention and safety promotion in the process industries will remain a regular milestone in the exchange of safety know-how and highlight new developments.

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