



Review

Developments in the safety science domain, in the fields of general and safety management between 1970 and 1979, the year of the near disaster on Three Mile Island, a literature review



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ABSTRACT

Objective: What influence has research conducted by general management schools and safety research had upon the causes of accidents and disasters in relation to the managing of safety between 1970 and 1979?

Method: The study was confined to original articles and documents, written in English or Dutch from the period under consideration. For the Netherlands, the professional journal *De Veiligheid* (Safety) was consulted.

Results and conclusions: Dominant management approaches started with (1) classical management starting from the 19th century incorporating as a main component scientific management from the early 20th century. The interwar period saw the rise of (2) behavioural management which was based on behaviourism, this was followed by (3) quantitative management from the Second World War onwards. After the war it was (4) modern management that became important. A company was seen as an open system, interacting with an external environment with external stakeholders. These management schools of thought were not exclusive, but existed side by side in the period under consideration.

Early in the 20th century, it was the U.S. 'Safety First' movement that marked the starting point of this knowledge development in the sphere of safety managing, with cost reduction and production efficiency as the key drivers. Psychological models and metaphors were used to explain accidents resulting from 'unsafe acts'. Safety was managed by training and targeting reckless workers, all in line with scientific management. Supported by behavioural management, this approach remained dominant for many years until long after World War II.

Influenced by quantitative management, potential and actual disasters occurring after the war led to two approaches; loss prevention (up-scaling in the process industry) and reliability engineering (inherently dangerous processes in the aerospace and nuclear sectors). The distinction between process safety and occupational safety became clear after the war when the two evolved as relatively independent domains. In occupational safety in the 1970s human error was thought to be symptomatic of mismanagement. The term 'safety management' was introduced to scientific safety literature alongside concepts such as loosely and tightly coupled processes, organizational culture, disaster incubation and the notion of mechanisms blinding organizations to portents of disaster scenarios. Loss prevention remained technically oriented. Until 1979 there was no clear link with safety management. Reliability engineering that was based on systems theory did have such a connection with the MORT technique that served as a management audit. The Netherlands mainly followed Anglo-Saxon developments. In the late 1970s, following international safety symposia in The Hague and Delft, independent research finally began in the Netherlands.

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1. Introduction

This article is one in a series on knowledge development of the safety domain. Previous publications in Safety Science examined periods extending from the late 19th century until the 1970s (Swuste et al., 2010, 2014). According to the authors, these reviews should provide historical insight into the development of the scientific safety domain. They demonstrate how era-linked knowledge on the causes of accidents is relevant and important and why ideas can emerge, disappear or lay dormant for some time. In this contribution the rate of knowledge development for managing safety at company level is mapped out. The terms safety management and safety management system were only introduced in the 1970s.

The authors base their assumptions on the idea that managing safety, as reflected in the literature, is fed both by knowledge about the causes of accidents, severe or otherwise, and by more general ideas on the managing of companies and their production. However, the authors do not suggest that these relations will clearly emerge during the period under discussion.

All the articles published before the early 1970s are briefly summarized but the post-1970s discussion will be more extensive. In conjunction with these publications the questions below were crucial:

1. What are the general management schools, theories and models for accident causation that have been developed over the years?
2. What has been the influence of such developments on safety management knowledge?
3. What was the context within which this development took place?
4. What are the consequences of this for the field of professional safety in the Netherlands?

2. Materials and methods

The questions posed and answers given in this study are based on extensive literature research involving documents and scientific articles, both in English and Dutch. The research was mainly limited to developments seen in the safety domain in the United States, the United Kingdom and the Netherlands. Original references and sources were accessed via the Delft University of Technology library and through internet. The national professional journal for safety specialists *De Veiligheid* (Safety Journal) was studied to discover more about the various consequences for the Dutch professional field of safety.

The period under study has been divided into five subsections including: general management schools, safety theories and occupational safety models, process safety theories and models, knowledge development related to managing safety and finally, the development in the Netherlands. General management schools are based on the common format of management literature that distinguishes between the classic, the behavioural, quantitative and modern management (Pindur et al., 1995).

The relationship between general management trends, safety theories and models, and safety management is not completely obvious. General management developments are based on market developments and production efficiency, whilst the other two aspects originate from developments in occupational and process safety. The discussion and conclusion section will provide a suitable synthesis between these topics.

In this article the developments seen in safety legislation are only cursorily discussed. Although legislation remains the primary consideration in many companies, including in the introduction of safety management and such systems, and even though legislation can have a pivotal role in knowledge development, it is still predominantly based upon previously acquired knowledge.

Tables 2 and 3 at the end of this article will present an overview of the knowledge development observed in safety theories, models, metaphors, safety management and general management approaches from the 19th century onwards. The tables will also integrate information from two previous articles (Swuste et al., 2010, 2014).

3. General management approaches

This chapter will start with a short description of different management schools, already starting in the 19th century onwards, because these schools still had their influence in the period under consideration.

3.1. Classical management and behavioural management

The classical management school began in the late 19th century and placed top company managers in the centre of decision-making, which at that time was a revolutionary concept. The classical management trend has two fundamental movements – scientific management and general administrative management. Scientific management centres on ways of improving industrial and labour productivity by redesigning tasks and working methods. By contrast administrative management theory examines

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