



The quality of the post academic course ‘management of safety, health and environment (MoSHE) of Delft University of Technology



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A B S T R A C T

Objective: This article discusses the rise of European postgraduate courses in safety science and the content and quality of the Management of Safety Health and Environment (MoSHE) course of Delft University of Technology. **Materials and methods:** Literature search, document analysis, interviews.

Results: The different MoSHE years show a varied picture of this post academic program. In the Netherlands the course is unique with a central focus on risk management and sustainability, supported by scientific developments in the areas of safety, health, environment, organizational science and psychology. In all year-groups the quality of the course was assessed with a short questionnaire, collecting opinions of course members on individual presentations and the course as a whole. Quality of the course was regularly discussed through the contacts of the course coordinator with module leaders, and at meetings of course committees, and leading to changes in content of modules. After MoSHE 1 (1989), 14 (2008), and 17 (2012) the courses' structure, organization and content was changed radically. Only, the quality system of the course remained implicit. Using the model of the European Foundation for Quality Management a first set-up for a quality system is presented.

Over the years the academic nature of the program has changed substantially. This is one of the challenges for the future to find a balance between the domains taught and between an academic approach and practical skills. The course could benefit from a greater input of process safety and safety in high-tech-high-hazard sectors.

1. Introduction

From the 1970 s onwards some European countries organized post graduate courses on safety, sometimes combined with health and/or environment. At Delft University of Technology (TUDelft), such a program was started 1988 under the title ‘Management of Safety, Health and Environment, Risk Assessment and Control (MoSHE-RAC)’. This article focusses on the quality system developed for the MoSHE course. The following research questions have been leading:

1. How postgraduate programs on safety, health and environment did come about in and beyond Europe?
2. How was educational quality defined, and measured at the MoSHE course?
3. Which activities ensure the required quality of future MoSHE courses?

2. Methods and techniques

Three sources were used for this study; publicly available literature,

internal MoSHE documents and interviews with former course members, module leaders, lecturers, and members of course committees.

A literature search was conducted from 1950 till present, using ‘safety’ AND ‘education’, AND ‘graduate’ AND ‘postgraduate courses’ as search terms. Articles from the following professional and scientific journals appeared: Chemical Health and Safety, Education for Chemical Engineers, Journal of Engineering Education, Journal of Loss Prevention in the Process Industries, Journal of Occupational Accidents, Journal of Safety Research, Reliability Engineering and System Safety, Safety Science, and Safety Science Monitor. References from these articles were consulted in the Dutch Chemisch Weekblad (Chemical Weekly), Industrial and Commercial Training, Journal of Occupational Health and Safety Australia and New Zealand, National Safety Council Transactions, Monthly magazine for Labour, and Plant / Operations Progress.

The development of the MoSHE course over the years was studied, using internal information sources. Including the results of the independent audit of the Association of Dutch Universities (VSNU) (VSNU, 1998; Hale and Vergouw (2009)). MoSHE courses were divided into three groups, related to changes in the course structure and course

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management of the Safety Science Group. The first group were MoSHE 2-14, the second group MoSHE 15-17 and the last group MoSHE 18-19. The first MoSHE course was treated separately. After the first course drastic changes were introduced. While writing this article, MoSHE 19 was not yet completed.

A total of 27 interviews were conducted and five final course evaluations of course participants were used in this study. The interviews were semi-structured and covered topics such as the quality and updating of the course, the role of committees in the organization of the course, certification and the future of the program. From each group of MoSHE courses the number of participants and educational goals will be discussed, giving information of the endpoint for graduates. Separate paragraphs on structure and organization of the course will show how this endpoint is reached. The paragraph on results of interviews and comments from committee is dealing with the positive and negative criticism on the curriculum.

3. Development of postgraduate courses SHE in Europe and the Netherlands

Surprisingly, postgraduate safety courses do have a history. In literature, sixty years ago these types of educational programs were mentioned for the first time, which was seen as an important step towards a recognition of industrial safety as a separate domain (Heinrich, 1956). This was an important issue, due to the high incidence of occupational accidents during WWII production (Gulijk et al., 2009). Heinrich, the author, considered safety as a 'state, free from danger'. Because such a state is almost unreachable, he suggested to use the term 'accident prevention'.

3.1. The start of academic safety courses

In scientific literature however, (post)academic safety courses were hardly a topic for publications. This paragraph will provide a general overview, without the intention to be complete. In the 1970s of the last century this slowly changed, when some university programs in occupational safety opened their doors. The Wuppertal University in 1974 was the first with a pre- and post-bachelor program, followed by similar programs in Finland, and at Aston University in Birmingham in 1978. The course in Industrial Safety at the Imperial College London started a few years later, comparable to initiatives at the University of Leuven, at Stockholm and the safety officer course at the Federation Ballarat University in Australia in 1980 (Nedved and Booth, 1982; Nolan, 1989; Culvenor and Else, 1997; Hale and Kroes, 1997; Arezes and Swuste, 2012). Major accidents as well as legislation were powerful promoters for these courses. A known report on safety regulation was the UK Robens report (Robens, 1972). The report had a twofold message. First, those who cause the risks should manage them, and secondly, legislation was far too complex. Now companies from the process industries and upcoming nuclear sector had to move. Private parties had to become active in this domain.

At universities and colleges safety courses had a hard time because regular programs of the Chemical Faculties were already overcrowded. Furthermore, scientific attention to this domain was only taken seriously in the mid-70s, after the major accident at Flixborough. Also, Loss Prevention conferences were regularly organized from that period onwards, and the Briton Frank Lees published his well-known series of books on 'Loss Prevention in the Process Industries, hazard identification, assessment and control' (Lees, 1980).

The Chemical Engineering Department of the then Technical Highschool of Delft (THDelft) started in 1976 with the course Chemistry and Society, drawn according to a similar initiative at the Subfaculty Chemistry of the University of Leiden, eight years earlier. At the Delft course social and societal aspects of the process industry were also discussed. Three years later an optional course on Industrial Hygiene started, later changing its name to Chemical Risk Management (1985).

Similar to Lees' concepts, risk identification, assessment and management were the main topics of the course. In Delft, the courses Chemistry and Society and Chemical Risk Management were compulsory at pre-bachelor level (Lemkowitz and Zwaard, 1988; Lemkowitz, 1992).

3.2. Requirements for (post) academic courses on safety

The 1978 symposium 'University Education and Research in Safety', organized at THDelft was exerting pressure to organise an academic group on safety. One year later the Safety Science Group was established. The Symposium concluded with the statement that a separate and comprehensive course on safety at university level was necessary. 'University level, because other experts in working conditions, like the occupational physician, and the occupational hygienist were academically trained'. And 'comprehensive, because safety experts should co-operated with many disciplines, as he or she should be able discuss from a safety point of view arguments with other disciplines' (TH Delft, 1978).

Halfway 1980s the Safety Science Group started a survey on Dutch safety issues in regular courses of Dutch educational institutions. Surprisingly safety was neither at technical universities, nor at polytechnics part of the curriculum (Hale et al., 1989). Also at TU Delft there was no room for safety topics in mainstream education. Therefore preparations for a postgraduate course started, the 1988 'Management of Safety, Health and Environment, Risk Assessment and Control (MoSHE-RAC) course. Already existing safety courses abroad were structured along two axes; hazards and vulnerable objects, including humans. High-tech-high-hazard sectors were emerging, with their low probabilities and disastrous effects. And a growing focus on environmental impacts of industries was emerging. However, a third axis received too little attention, being identification, analysis and solutions, including behavioural and organizational aspects. These three axes became part of the structure of MoSHE-RAC (Hale, 1987, 1989).

The 90s of the last century showed a steady production of scientific papers on (post)academic safety education, boosted by the 1994 Amsterdam International Conference 'Education and Training in Occupational Health: the Gateway to Quality in Occupational Health and Safety'. The title of the conference suggested a focus on 'occupational', but safety of high-tech-high-hazard industries was addressed as well. Three topics were dominant in this period, tasks of professional safety and health experts, certification of these experts, and including occupational safety, and high-tech-high-hazard safety in regular academic programs, mainly at technical universities.

Tasks of professional safety and health experts in companies in various European countries were investigated by ISSA, the International Social Security Association. This overview was a major input for the second MoSHE-RAC course design (Hale, 1995; Storm and Hale, 1995). Next to duties and tasks of professional experts, certifying bodies also had their demands (Oortman Gerlings and Hale, 1989a,b). Due to budget cuts and, more in general to a withdrawing government, certification of persons, and courses was a means of government to keep some level of control on safety in companies (Swuste et al., 2016a). Certification of courses had a major disadvantage, concerning the topics addressed in the course. From universities one might expect they kept track of the state of the art in their domain, or were a major player. Lacking this overview, certification bodies could put different emphases. Another disadvantage of certification was the demarcation of disciplines, allowing compartmentalization of safety professionals which was inconsistent with a desired flexibility in the fast-changing world of market forces, technology development and regulation (Hale and Storm, 1996; Swuste, 2008).

The previously mentioned resistance of universities against educating safety related topics was not only related to overcrowded programs, but also with the low quality of the academic safety research. Safety research was too descriptive and hardly analytical (Nolan, 1991; Grosse, 1992; Gute et al., 1993). This changed in the 1980s, a time

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