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Quantifying occupational risk: The development of an occupational risk model

B.J.M. Ale [a,*], H. Baksteen [b], L.J. Bellamy [c], A. Bloemhof [d], L. Goossens [a], A. Hale [a], M.L. Mud [e], J.I.H. Oh [f], I.A. Papazoglou [g], J. Post [b], J.Y. Whiston [h]

[a] *TU Delft, Safety Science Group, PB 5015, 2600 GA Delft, Netherlands*
[b] *National Institute for Public Health and the Environment (RIVM), P.O. Box 1, 3720 BA, Bilthoven, Netherlands*
[c] *WhiteQueen, P.O. Box 712, 2130 AS, Hoofddorp, Netherlands*
[d] *Consumer Safety Institute, P.O. Box 75169, 1059 GK, Amsterdam, Netherlands*
[e] *Abbott Risk Consulting, The Hague, Netherlands*
[f] *Ministry of Social Affairs and Employment, P.O. Box 90801, 2509 LV, The Hague, Netherlands*
[g] *National Center "Demokritos", Aghia Paraskevi 15310, Greece*
[h] *Whiston Computing, 32 Brookers Court, Off Baldwin Gardens, London EC1N 7RR, UK*

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Abstract

Each year eighty-five people are killed on the job in the Netherlands and 167,000 are injured to the extent that they are at least a day absent from work. Their death and injuries occur during the approximately seven million person years that the Dutch workforce spend on their job.

The ministry of Social Affairs and Employment (SZW) has as one of its main tasks to reduce and control occupational risk. Recently it commissioned a project to determine the risk and its causes following the same principles as used in quantified analyses of the third party risks of nuclear and chemical plants. To this end a model has been constructed: the occupational risk model (ORM). With this model authorities, industries and experts can evaluate the occupational risks for individual workers, for companies and for projects.

The project has four major parts: assembly and analysis of accident and exposure data, generalisation of these data into a logical risk model, deriving improvement measures and their costs and developing an optimiser that supports cost effective risk reduction strategies. The model is a further development of previous work executed with support of SZW and the European Union, such as IRISK and AVRIM.

This paper describes the concepts used in the model and the overall structure. Some of the results are also given. More detail and more results are given in other papers in this conference.
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* Corresponding author. Tel.: +31 15 2786353; fax: +31 15 2783177.
E-mail address: B.J.M.Ale@tudelft.nl (B.J.M. Ale).

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1. Introduction

In the Netherlands occupational health and safety is the concern of the ministry of Social Affairs and Employment (SZW). This ministry has developed and executed many programs to reduce these risks ever since the Fabriekswet (Factory Act) came into force in 1875 (Gorter, 1889). The reduction of human suffering that results from occupational accidents was the main reason for these concerns. In the era of market economy however the economic loss in the form of absence from work, reduced family income and medical cost is a significant secondary issue that supports the drive towards reduced risk (Arbeidsinspectie, 2002). Dutch parliament now demands that prioritising of measures is judged on the basis of cost effectiveness. This defined the context and boundary conditions of the project (SZW, 2004).

SZW's policies used to consist of the traditional ingredients of governmental action: legislation, regulation, standards, supervision and – if necessary – prosecution and punishment. A more modern approach is to have workers and industries develop and maintain their own safety policies and safety management systems. The idea is that companies take care of their workers, providing a safe and healthy working environment. By putting the costs of safety and of accidents back to the employer, economic forces will make safety management systems in companies work correctly and guarantee a more acceptable – cost effective – level of risk. Interestingly this was also the idea behind the Fabriekswet of 1875 mentioned earlier, and regulations and laws passed since were deemed to be necessary to repair the shortcomings of the market. The Fabriekswet specified that occupational safety in principle is a matter between workers and their employer. The task of the government is to create a level playing field by setting boundary conditions. SZW seeks to shape their current policy along the lines of current policies regarding third party risks (Ale, 1987, 1991, 2002; NN, 1988, 2004). The components of this policy are quantitative analysis of risk, determination of dominant paths to accidents from these quantifications and analysis of underlying scenarios and reduction of risk by addressing the dominant threats first and by using the most cost effective method of risk reduction (Jongejan et al., 2006). Just as was done in the early 1980s for third party risk (Ale and Whithouse, 1986, 1990, 1992), a modelling approach for occupational risk had to be developed to support the specification and deployment of such a policy.

In order to develop such a method a consortium of organisations was formed. The members of the consortium were previously involved in other efforts for SZW to improve the understanding of safety in the workplace and safety management systems (Ale et al., 1998; Bellamy et al., 1999; Papazoglou et al., 1999, 2003). Based on this previous work and work done for the Health and Safety Executive in the past (Bellamy and Geyer, 1992; Papazoglou et al., 2000) a system is developed to perform the needed quantification and optimisation, the occupational risk model (ORM).

2. Occupational risk

The quantification of occupational risk is approached in a similar fashion as the approach taken when calculating the risk of a chemical plant (Ale and Uijtdehaag, 1999). The risk profile of a chemical plant is constructed from the risks of its components: vessels, pipes, reactors etc. The risk of a job is constructed from the risks associated with the hazards a worker has to face when he or she performs his job. For example a fisherman is exposed to the risks of a fall overboard, entanglement in nets, being crushed between moving objects, cuts from handling catch or fishing tackle and cleaning fish (EASHW, 2003; Murray and Dolomont, 1994). To this end the jobs or job-profiles in the Netherlands were decomposed according to the accident statistics in the Netherlands "GISAI". GISAI is the "Gezamenlijk Informatie Systeem Arbeids Inspectie" (SZW, 1997), in which among other things, the reports of the inspectors on investigations into occupational accidents are kept. From these records a list of hazards or causes of accidents could be derived. This list is partly based on a classification of accident types used by the Labour Inspectorate in their reporting on occupational accidents (ESAW, 2002), classifications form the UK (HSE, 1995) and from previous Dutch studies (Swuste and Hale, 1993). This list is shown in Table 1. Accidents are assigned to the class of the hazard that caused the injury. In case of a complicated accident such as a fall (class 1) followed by a drowning (23), the Storybuilder allows transfer points to be included in the Storybuild from one class to another. The "fall" accident would then have no victims, as the victims will be assigned to the drowning. Double counting is avoided by a coding mechanism

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