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European Network Education and Training in Occupational Safety and Health

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A new model of accident prevention – how to manage the "central event"

ENETOSH Fact Sheet, written by Paul Swuste

Management of occupational risks

Occupational risk prevention from a management perspective is rather simple, at least in theory; apply management techniques based upon a Deming circle, be sure all parts of the circle are filled in adequately and make the circle go round. One cannot deny the merits of this message, and its pleasant simplicity. For some time now occupational risk prevention was based on this management technique and the incidence of (major) accidents has been reduced in level and number. At least if one looks at corresponding mortality rates in the so-called Established Market Economies, which represent the industrialized world. But it is questionable whether or not this decline is the result of a successful application of various management tools. When comparing mortality figures between industrialized and developing countries, a phenomenon known as 'export of hazards' could explain at least part of the differences observed.

Occupational accidents

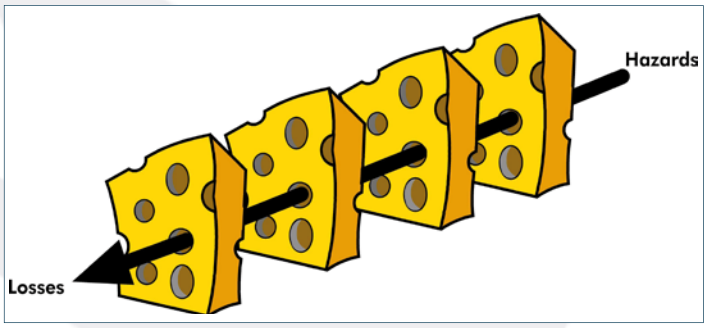
Looking more closely at accidents, we now believe they are not only caused by direct physical events, nor by human errors alone. They have their roots in organizational settings and in the socio-technical system, companies are active in. However diffuse their causes, we know that accidents almost always take us by surprise. Despite all our efforts and systems we seem unable to foresee or predict these events. It seems our management systems, our audit techniques and our certification schemes are looking at the wrong items.

Administrative risk prevention

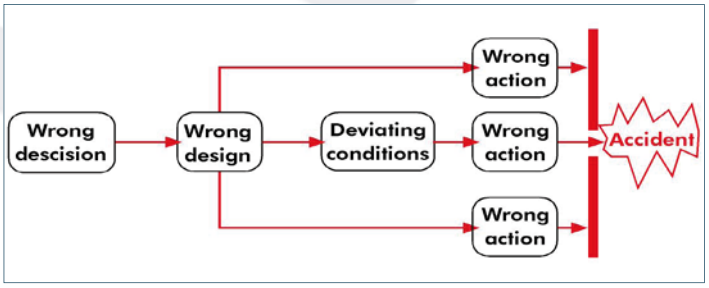
Critics from small and medium sized enterprises also point in that direction; audits only focus on the presence of documentation, management systems are too bureaucratic and lack a focus on hazard and risk identification. Apparently, we fail to incorporate accident models of causation into our management systems. In the two boxes below two models are discussed, which link management systems to accident causation. By doing so occupational risk prevention becomes the centre of safety management.

Box 1, Accident causation, Swiss cheese

The Swiss cheese model of Reason, shown here, is a graphical presentation of accident causation. It enables us to understand the difficulties companies encounter in preventing hazards from becoming risks, thus creating losses, or damage to humans and/or material. The different slices of the cheese represent the layers of defences, like barriers or safeguards, a company has installed as part of its risk prevention program. The model refers to long latency periods of the so-called latent conditions. This is represented by the holes in the first slices. Examples of latent conditions are poor design, gaps in supervision, undetected manufacturing defects, defects or maintenance failures, unworkable procedures, clumsy automation, shortfalls in training, or less than adequate tools and equipment. Like pathogens in the human body, latent conditions may be present for many years before they combine with local circumstances and activate failures to penetrate the many layers of defences. Unsafe acts are mostly situated in the last slices, while latent conditions are the holes throughout the cheese.



Accidents are not only caused by direct physical events. The biggest threat are not the isolated human errors of workers at the sharp end of an accident or disaster sequence, but the accumulation of latent failures. Human errors and failures are not seen as causes, but as consequences.

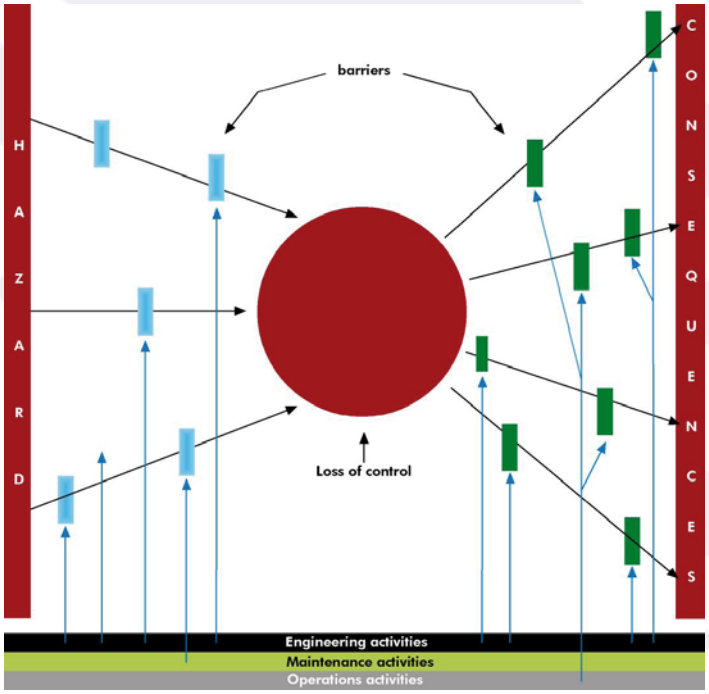


Box 2, Bow-tie model

A bow-tie is a combination of a fault tree and an event tree, linked together by a 'central event'. Like the Swiss cheese – model, the name of this model reflects its presentation. The fault tree represents a scenario starting from exposure to hazard, or energy, and following a path of critical events to the central event. This central event can depict a loss of containment in, for instance in the process industry, or a 'loss of control'. A falling object from a crane, for instance, is an example of a loss of control. From the central event onwards the event tree describes the scenario's pathways leading to different kinds of damage.

This way of presenting accident causation has a few advantages. First of all it focuses risk prevention activities on central events. And companies can focus their attention on those central events they would like to avoid most, either guided by past experience, or guided by the notion that certain central events will jeopardize their production. It is astonishing to see that most companies only have vague ideas of central events they need to avoid.

The bow-tie model directs the attention towards various barriers to prevent scenarios from propagating. This is a second advantage of this model. These barriers block the stream of energy, and are hard ware devices, or human interventions. But the quality of these barriers is determined by management factors, shown by the blue arrows in the model. These management factors provide a clear link with management systems, because management decides which type of barrier is relevant for which hazard and which scenario. At the bottom line, management of safety is nothing more than managing barriers to provide, install and maintain them, to develop procedures and training when necessary as well as inspection.



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