A conceptual model, methodology and tool to evaluate safety performance in an organization

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Abstract

In our modern society, rapid technology development and concepts such as lean production produce new and more complex risks. Therefore, companies aiming at working successfully in a more sustainable way have to proactively lower their negative impact on the economy, environment and the society to an acceptable level. The quality of an organisation's safety work is one aspect that can affect the economy, the environment and the society.

The aim of this thesis is to develop and test a concept that can be used to evaluate safety performance in an organization. A concept including a safety model, methodology and a computer-based tool was developed by reviewing adequate literature, interviewing experts and conducting a pilot study. In the thesis, safety performance is defined as "the quality of safety-related work". Safety performance improvements in an organization can increase its resistance or robustness and lower the risk of accidents. On the other hand, poor safety performance can increase the organization's vulnerability and hence increase the risk of accidents. Latent conditions are thought to cause accidents in organizations and they include for instance poor design, gaps in supervision and unworkable procedures (Reason, 1997, p 10). Latent conditions can be found in attitudes, beliefs, perceptions, and values of employees (safety culture), in the environment that affects the employees (working environment) and in the routines and procedures (safety activities). The total performance in safety culture, working environment and safety activities is, in the thesis, regarded as the safety performance. Safety culture, working environment and safety activities constitute the proposed safety model.

Four questionnaires, one for each area of the safety model and one for the top management, were developed to evaluate an organization's overall safety performance. The questionnaires consist of a total of 246 questions and they were designed to identify latent conditions through leading indicators. To evaluate the methodology, a pilot study was conducted at a medium-sized company. The results from the pilot study identified potential strengths and weaknesses in the safety work, which indicate that the proposed methodology can be used to evaluate the safety performance. To test the reliability of the questionnaires regarding safety culture and working environment, a Cronbach's coefficient alpha test was performed on the data from the pilot study. The test indicated that the reliability was sufficiently high for most aspects. A computer-based tool was constructed in order to illustrate the results from an evaluation in a pedagogical way. The results were presented in "spider diagrams" on a common scale, ranging from one to five, and on three different detailed levels (*LEVEL 1, LEVEL 2 and LEVEL 3*). Three different detailed levels were used since professionals often need different detailed information. At *LEVEL 1*, the total safety performance status can be viewed. At *LEVEL 2,* the performance of each aspect of safety culture, working environment and safety activities is presented. The most detailed level, *LEVEL 3,* consists of all the questions that constitute each aspect as well as the raw data.

The conclusion is that the proposed concept, including a safety model, methodology and tool, can present a relatively fast and easy way to evaluate an organization's safety performance. Moreover, the concept can be used as a tool for risk identification and be a part of a safety management system by providing assistance in the monitoring and revision of safety work. Thereby, it could ease safety-related strategic planning and decision-making and thus facilitate continuous improvements and enable more sustainable and enlightened decisions.

Further research is necessary to validate the concept, including evaluation of the relationship between the three different areas of the safety model; evaluation of the relationship between results based on the proposed concept and statistics such as accident rates.

Sammanfattning

Komplexa risker kan uppkomma i vårt moderna samhälle till följd av snabb teknisk utveckling och koncept som exempelvis lean production. För att uppnå en mer hållbar utveckling måste organisationer arbeta med att minska sin negativa påverkan på ekonomin, miljön och samhället. En aspekt som kan påverka dessa tre områden är kvaliteten på säkerhetsarbetet i en organisation.

Syftet med detta examensarbete är att utveckla och testa ett koncept som kan användas för att utvärdera en organisations kvaliteten på säkerhetsarbete. Konceptet innefattar en modell som illustrerar viktiga parametrar för säkerhet, en metodik för att utvärdera modellens komponenter samt ett datorbaserat verktyg för att presentera resultat. Konceptet togs fram genom litteraturstudier, intervjuer med experter samt en pilotstudie.

Ett dåligt säkerhetsarbete kan leda till ökad risk för olyckor. Genom att förbättra kvaliteten på säkerhetsarbetet kan risken för olyckor minska. Latenta förhållanden i en organisation kan skapa situationer som kan ge upphov till olyckor och de inkluderar till exempel undermålig design, otillräcklig tillsyn och icke fungerande arbetsrutiner (Reason, 1997, p 10). Latenta förhållanden kan återfinnas i anställdas attityder, uppfattningar och värderingar (säkerhetskultur), i den fysiska och psykiska miljön där anställda vistas (arbetsmiljön) samt i rutiner och procedurer (säkerhetsaktiviteter). Kvaliteten på säkerhetsarbetet avspeglas, i detta examensarbete, i organisationens säkerhetskultur, arbetsmiljö och säkerhetsaktiviteter. Säkerhetskultur, arbetsmiljö och säkerhetsaktiviteter utgör den föreslagna modellens tre ingående parametrar.

Totalt togs det fram fyra stycken frågebatterier med syfte att utvärdera kvaliteten på en organisations säkerhetsarbete. Det togs fram ett frågebatteri för varje parameter i modellen samt ett frågebatteri för högsta ledningen. Totalt användes 246 frågor för att identifiera latenta förhållanden. En pilotstudie utfördes, på ett medelstort företag, med syfte att testa den framtagna metodiken. Resultaten från pilotstudien indikerade att metodiken kan identifiera potentiella styrkor och svagheter i säkerhetsarbetet. Ett Cronbachs coefficient alpha test utfördes för att undersöka reliabiliteten på frågeformulären rörande säkerhetskultur och arbetsmiljö. Testet visade på en hög reliabilitet för de flesta aspekter. Vidare konstruerades ett datorbaserat verktyg för att pedagogiskt illustrera resultat från en utvärdering baserad på metodiken. Resultat presenteras på en gemensam skala, från ett till fem, och på tre olika detaljnivåer (*NIVÅ 1, NIVÅ 2 och NIVÅ 3*) i ”spindeldiagram”. Syftet med de tre olika detaljnivåerna är att tillgodose olika informationsbehov. *NIVÅ 1* visar den totala kvaliteten på säkerhetsarbetet som en kombination av statusen på de tre parametrarna säkerhetskultur, arbetsmiljö och säkerhetsaktiviteter. På *NIVÅ 2* återfinns statusen för varje enskild aspekt av de tre parametrarna. På den mest detaljerade nivån, *NIVÅ 3,* återfinns alla ingående frågor för varje aspekt samt rådata.

Slutsatsen är att det framtagna konceptet, innefattande en modell, metodik och verktyg, är ett relativt snabbt och enkelt sätt att utvärdera kvaliteten på en organisations säkerhetsarbete. Konceptet bör kunna användas som ett riskidentifieringsverktyg. Konceptet kan också vara till hjälp i arbetet med ett säkerhetsledningssystem eftersom det kan underlätta kontroll och revision av säkerhetsarbetet. Sammanfattningsvis bör konceptet kunna underlätta strategisk säkerhetsplanering och beslutsfattande och därigenom bidra till ständiga förbättringar samt mer hållbara och informerade beslut.

Fortsatt forskning bör inriktas mot att validera konceptet. Det kan göras genom att exempelvis utvärdera sambandet mellan de tre ingående parametrarna säkerhetskultur, arbetsmiljö och säkerhetsaktiviteter samt utvärdera sambandet mellan resultat baserade på det föreslagna konceptet och statistik, exempelvis olycksfrekvens.

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Björn Nevhage and Henrik Lindahl

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List of Abbreviations

COSO	*Committee of Sponsoring Organizations of the Treadway Commission*
CCPS	*Centre for Chemical Process Safety*
DNV	*Det Norske Veritas*
F&EI	*Dow fire and explosion index*
IEC	*International Electrotechnical Commission*
IVF	*Institutet för verkstadsteknisk forskning*
I2SI	*Integrated Inherent Safety Index*
ISO	*International Standard Organization*
LTI	*Lost Time Injuries*
OECD	*Organization for economic co-operation and development*
SMM	*Safety management manual*
SMS	*Safety management system*
SWeHI	*Safety Weighed Hazard*
WEST	*Work Environment Screening Tool*
WHO	*World Health Organization*

1 Introduction

In our modern society rapid technology development and concepts such as lean production produce new and more complex risks. Therefore, companies aiming at working successfully in a more sustainable way have to proactively lower their negative impact on the economy, environment and the society to an acceptable level. The quality of an organisation's safety work is one aspect that can affect the economy, the environment and the society.

There is a need in the industry to manage risks and prevent accidents. Major organizational accidents, such as Chernobyl and Bhopal, have shown what effects insufficient safety work may lead to (Harms-Ringdahl, 1993, pp 240-242). However, most accidents that happen are less severe and have smaller geographical impact. Last year a total of 75 people were killed on their jobs in Sweden and the level is increasing (AV, 2008). Furthermore, disruptions in a production, due to for instance an accident, can also have devastating economic effects (ÖCB, 1999, p 3).

Accidents are believed to have multiple causes and involve people at different levels in an organization (Reason, 1997, p 1). Accidents are results of a complex mixture between insufficiencies in technology, human performance and organization (Hollnagel, 2004, p 47; Grimvall et al., 2003, p 239). These insufficiencies, or latent conditions, could be difficult to identify and eliminate. Latent conditions in an organization could be for instance poor design, gaps in supervision and unworkable procedures (Reason, 1997, p 10). Latent conditions can be found in attitudes, beliefs, perceptions, and values of employees (safety culture), the environment that affects the employees (working environment) and the routines and procedures (safety activities). It is important to identify latent conditions in order to prevent future accidents, since only risks that are identified can be managed (Khan et al., 2003). Latent conditions can be identified by measuring and evaluating performance in safety culture, working environment and safety activities. The total performance of these three aspects is, in the thesis, regarded as the safety performance or the quality of safety-related work. A concept that can evaluate safety performance and identify and illustrate strengths and weaknesses in the safety work may assist an organization in the monitoring and revision of safety work, and thereby contribute to continual improvements. What gets measured gets done (Ingalls, 1999).

In this thesis, a concept including a safety model, a methodology and a computer-based tool is developed. The aim of the concept is to evaluate the safety performance in an organization. The concept is also tested in a pilot study at a medium-sized company.

2 Thesis objectives

In this chapter the aim of the thesis and the target group will be presented.

2.1 Aim of the thesis work

The aims of the work presented in this thesis were to develop a holistic safety model and, based on this model, develop an evaluation methodology that can be used to evaluate an organization's overall safety performance. Another aim was to develop a computer-based tool that presents the results from an evaluation. Furthermore, the aim was also to test this concept in a pilot study. There is no universal definition of safety performance. In the thesis, safety performance is defined as "the quality of safety-related work". Safety performance will be evaluated as the combined performance in safety culture, working environment and safety activities.

2.1.1 Aim of the model, methodology and tool

The aim of the safety model is to illustrate important components that affect the overall safety performance in an organization.

The aim of the methodology is to present a way to evaluate the model's components.

The aim of the computer-based tool is to identify and pedagogically illustrate the strengths and weaknesses in a company's safety performance. It should ease safety-related strategic planning and decision-making and thereby facilitate continuous improvements and enable more sustainable and enlightened decisions.

2.2 Target group

Although the concept, including the safety model, methodology and tool, has been constructed mainly with industrial organisations in mind it can be applicable in many different types of organizations. Potentially, the concept could be of interest to a broad range of professionals, especially managers in charge of safety and safety-related issues. The concept can provide assistance in the monitoring and revision of safety work and thus be of interest to professionals involved with safety management systems (SMS).

Depending on the aim of an analysis, the scope could be determined differently. Managers could for instance use results from an analysis, based on the concept, to evaluate their own safety performance at a specific site, plant, division or even the entire company. Potentially, the concept can also be used to evaluate suppliers and thereby help to choose safe suppliers.

Additionally, to work with safety performance evaluations may also be used as a marketing tool, by showing commitment to safety, when communicating safety work and corporate responsibility to customers.

3 Theoretical framework

In the theoretical framework chapter an orientation of relevant safety theories and models will be presented. The aim of this chapter is to guide the reader towards the proposed model of safety performance which incorporates three areas: safety culture, working environment and safety activities. The theoretical framework starts in section 3.1 by introducing how safety can be defined and the concept of safety space. Accidents and incidents are central aspects in all safety work. Accident definition, mechanisms and two examples of major accidents will be described in section 3.2. In the next section, 3.3, it will be discussed how safety can be seen as a part of sustainable development. In the following section, 3.4, a systematic approach to manage risks and continuously achieve improvements in safety will be described. Measuring safety and identifying accident causes are essential parts in order to continuously achieve improvements in safety and this will be described in section 3.5. In the last section of the theoretical framework, section 3.6, the proposed safety model's components (safety culture, working environment and safety activities) will be presented.

3.1 Safety

Numerous definitions of safety exist in the literature. Definitions such as “the condition of being safe from undergoing or causing hurt, injury, or loss” (MERR, 2008) may not be applicable in hazardous technologies since an absolutely safe technology does not exist (Reason, 1997, pp 107-108). Therefore, a more appropriate definition of safety, applied in the thesis, would be “freedom from unacceptable risks” (IEC, 2002, p 12). In this thesis risk is defined as the combination of the probability of an event and its consequence (IEC, 2002, p 2).

3.1.1 Safety space and safety performance

Reason (1997) introduced the idea of a safety space with extreme resistance and extreme vulnerability as two opposite sides of the safety space. An organization’s location within the safety space depends on how well the organization manages its hazards (Reason, 1997, pp 110-111). Safety performance improvements in an organization can increase its resistance or robustness and lower the risk of accidents. On the other hand, poor safety performance can increase the organization’s vulnerability and hence increase the risk of accidents. There is no common definition of safety performance. For instance safety performance may include; safety organization and management, safety equipment and measures, accident statistics, safety training and evaluation, accident investigations and safety training practice (Wu et al., 2008). In this thesis, safety performance will be defined as “the quality of safety-related work”. Safety-related work is regarded as the efforts made to achieve safety. In the thesis, safety-related work does not include financial risks. Safety performance can be considered as a subset of the total performance of an organization (Wu et al., 2008).

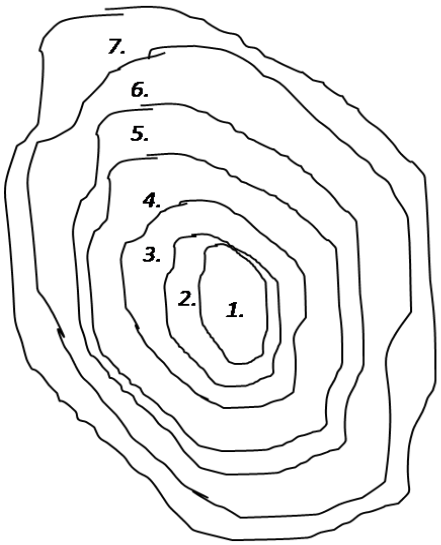
In order to improve safety performance an organization must identify the different defensive barriers that protect the organization.

3.1.2 The safety hierarchy and total safety

The total safety of an organization depends on the quality of the different defensive barriers or layers. Several models apply this approach, for instance James Reason’s famous Swiss-cheese model, which is described in more detail in 3.2.1 and the total safety model represented as an onion with many different layers. The layers could include both technical and organizational factors. The core defensive layer, from a technical perspective, is the design of the process (Jacobsson, 2001, p 9), see

. A similar model including organizational factors can be illustrated with safety culture as the core (Jacobsson, 2001, p 33), also seen in

. Safety culture will be presented in section 3.6.1.



Technical aspects

1. Process design
2. Basic Controls, process alarms, and operator supervision
3. Critical alarms, operator supervision, and manual intervention
4. Automatic action
5. Physical protection (relief devices, dikes)
6. Plant emergency response
7. Community emergency response

Organizational aspects

1. Safety culture
2. Competence
3. Education
4. Procedures, Management systems
5. Detailed instructions
6. Instructions for critical situations
7. Routines for emergencies

Figure 1. The safety onion.

In order to achieve a higher level of safety it is common to talk about a safety hierarchy. According to Kletz (2003) the hierarchy is as follows:

- Whenever possible avoid the hazard.
- Keep the hazard under control by adding passive protective equipment. Passive protective equipment does not contain moving parts or does not have to be manually or automatically commissioned.
- Control the hazard by adding active protective equipment, that is, equipment containing moving parts or that is commissioned automatically.
- Control the hazard relying on operator actions.

Kletz (2003) suggests that the options at top of the hierarchy should be considered first. However, often the only practicable (cost-effective) option is to control the hazard by changing and/or enforcing routines and procedures (Kletz, 2003). Therefore, the quality of an organization's safety routines and safety procedures can be argued to be important features in the total safety performance.

If a hazard is able to penetrate all the different defensive layers, including both technical and organizational layers, and get in contact with the asset (e.g. human being, property, environment etc) an accident will occur.

3.2 Accidents and incidents

An accident is defined as a short, sudden, and unexpected event or occurrence that results in an unwanted and undesirable outcome (Hollnagel, 2004, p 5). An incident, also called a near-accident, is an undesired event that might cause an undesirable outcome (Harms-Ringdahl, 1993, p 1)

3.2.1 Accident models

One of the most famous and easy to understand accident causation models is the Swiss-cheese model (Figure 2), which was created by James Reason. On one side there is a specific hazard (e.g. a chemical) and on the other side there is a loss of some kind (e.g. loss of a human being). Between the hazard and the potential loss there are numerous defence barriers, illustrated as Swiss-cheese slices.

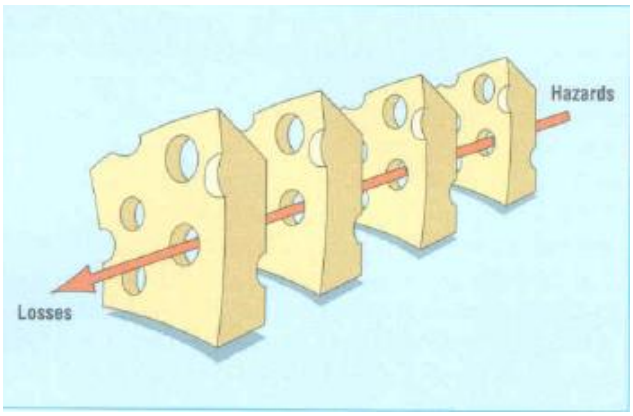


Figure 2. The Swiss-cheese model (from Reason, 2000)

Deficiencies in a barrier, latent conditions, are illustrated as holes in the slices. If all the holes are lined up an accident could happen (Reason, 1997, p 12). Latent conditions will be described in section 3.5.2.

3.2.2 Relationship between near misses and accidents

Studies have shown that there exists a relationship between the number of near misses and the number of accidents in an organization. The relationship is often illustrated as a triangle, where the bottom part is made up of all the near misses and the top part is made up of the accidents (Jones et al., 1999). Thus, prevention of near misses plays an important role in predicting and preventing accidents in organizations.

3.2.3 Individual accidents and organizational accidents

Two kinds of accidents can be said to exist: Individual and organizational accidents (Reason, 1997, p 1). The first kind of accidents happens to individuals and these are more frequent than the second one. Organizational accidents are accidents that happen to organizations and these are often more severe than the individual accidents because they have the potential to cause harm to uninvolved populations, assets and the environment (Reason, 1997, p 1). In this thesis a broad perspective on accidents is applied. The proposed model will include factors that are known to cause both individual and organizational accidents.

3.2.4 Effects of accidents

Organizational accidents can lead to a decrease in human capital and can cause catastrophic damage to the environment (Fernández-Muñiz et al., 2007, p 54). Furthermore, the economic effects of an accident can be severe and may include for instance:

- Compensation payments, care and rehabilitation of the injured person (or the environment).
- Increased production cost (e.g. destroyed equipment/material, interruptions, less skilled replacement worker, recruiting costs, investigation costs etc).
- Higher insurance premiums.
- Demands for safety measures and routines.

(Harms-Ringdahl, 1993, p 10)

Even near misses can disrupt the workflow and generate economic losses (Heinrich 1959).

Here follow short summaries of two of the most well-known organizational accidents, the Bhopal and the Chernobyl accidents. Both these accidents are examples of organizational accidents with catastrophic effects (Lee, 1996, Appendix 5 & 22).

Bhopal

In 1984, Bhopal, several events led to the release of highly toxic methyl isocyanate from a plant owned by Union Carbide India Ltd. 2000 people were killed and many thousands were injured which makes the accident by far the worst in the chemical industry. Accident causes included, for instance, unsuitable and incompetent management, insufficient maintenance, insufficient plans for emergencies, runaway reaction in tank, insufficient control of plant and process modifications, insufficient information to authorities and public, too much inventory at the site and disabling of protective systems (Lee, 1996, Appendix 5).

Chernobyl

In 1986, a power surge in a nuclear power plant in Chernobyl, Ukraine, created a series of explosions which led to concrete containment destruction. This resulted in nuclear release that could be traced at least 800 miles from where the accident took place. The immediate effects were that about 31 people were killed and 203 were injured but these figures are very uncertain. Most of the effects were long-term effects such as increased cancer death but there are no exact figures regarding the magnitude. Accident causes included for instance lack of adherence to safety-related instructions, poor safety culture, disarming of protective systems and unsafe design (Lee, 1996, Appendix 22).

The Bhopal and Chernobyl accidents show the importance of safety-related work in organizations. Both accidents had negative impact on the environment, the economy and the society. Safety-related work, such as accident prevention, could be regarded as a part of a sustainable development (see Figure 3).

3.3 Safety and sustainable development

In the thesis the following definition of sustainable development will be used: "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987, p 43).

In order to achieve a sustainable development, a balance between environment, economy and social aspects is needed. This balance can be illustrated as in Figure 3. The area in the middle, connecting the environment, economy and social aspects represents sustainable development. As argued previously, improvement of the safety related work in an organization is a way to ensure that the development is sustainable, by lowering the risks of negative impact on the environment, the economy and the social aspects.

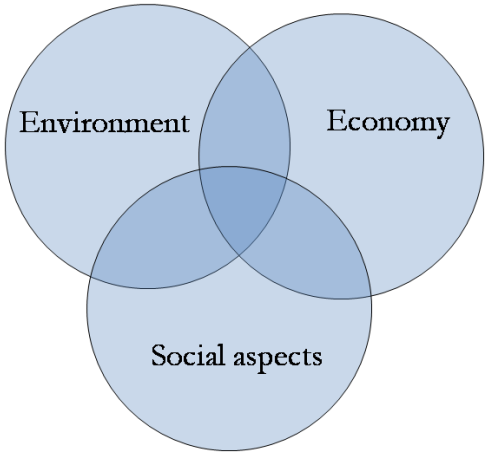


Figure 3. Sustainable development represented by the area connecting the environment, economy and social aspects (from Ammenberg, 2004).

A way to coordinate safety-related work and to lower the risks in an organization is to work with risk management.

3.4 Risk management

There are several definitions of risk management. International Electrotechnical Commission's (IEC) definition will be used in the thesis. Risk management is defined as the coordination of activities to direct and control an organization with regard to risk (ISO/IEC, 2002, p 4). A schematic picture of the risk management process is shown in Figure 4. The proposed model in the thesis could serve as a source identification tool during the risk analysis phase by identifying insufficiencies in the defensive

barriers. The risk analysis part of risk management is one of the most important steps since only the risks that are identified will be managed (Khan et al., 2003).

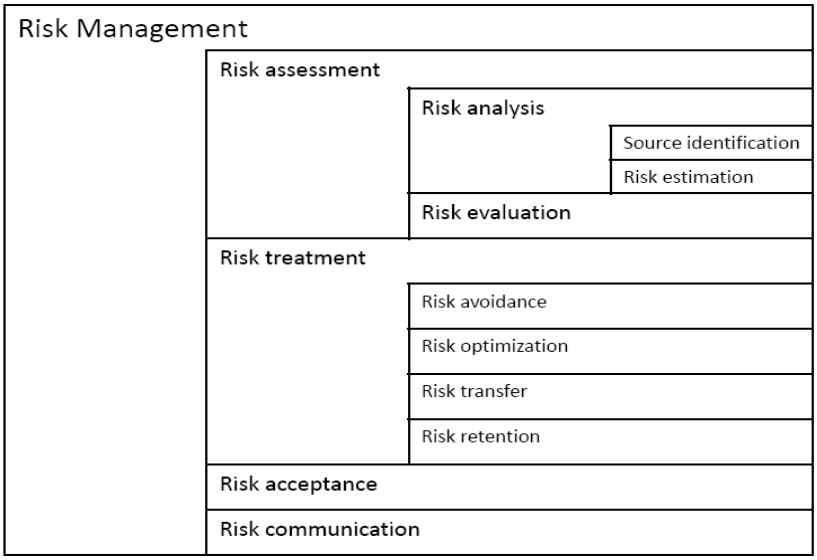


Figure 4. Risk management process (from ISO/IEC, 2002)

Risk management enables more efficient operation in hazardous environments (COSO, 2004, p 2). Risks are identified and controlled so that the organization can achieve its goals with a minimum of disturbance at the lowest possible cost (ÖCB, 1999, p16). An efficient risk management can:

- Ease decision making and strategic planning and increase the precision of investments.
- Increase business performance, less likely to encounter disturbance in production which is increasingly important with lean production.
- Reduce cost from accidents
- Be used in marketing and increase reputation, customers pay more for safe shipments.
- Optimize insurance level.

(ÖCB, 1999, p 16).

Besides the positive economic factors stated above, risk management can result in a lower level of negative impact on health and environment.

Risk management on different levels

A broad range of practitioners are actively working with risk management and it takes place on many levels in our society. A holistic model of the relationships between different levels and their risk management in our dynamic society, Figure 5, is given by Rasmussen (1997). The socio-technical system is divided into different levels and these levels need to have a functioning coordination for safety. In the system there are stress factors that affect safety. These factors include changes in public regulatory practices, public pressure, fast pace of technological change, increasingly aggressive and competitive environments. For managing the stress to the system, strong connections between the levels are vital. The connections should include goal-directedness with feedback, learning and action within and across the levels. This will help control the risks in the system by updating the system, by better understanding of the characteristics that cause accidents and by identifying weak links.

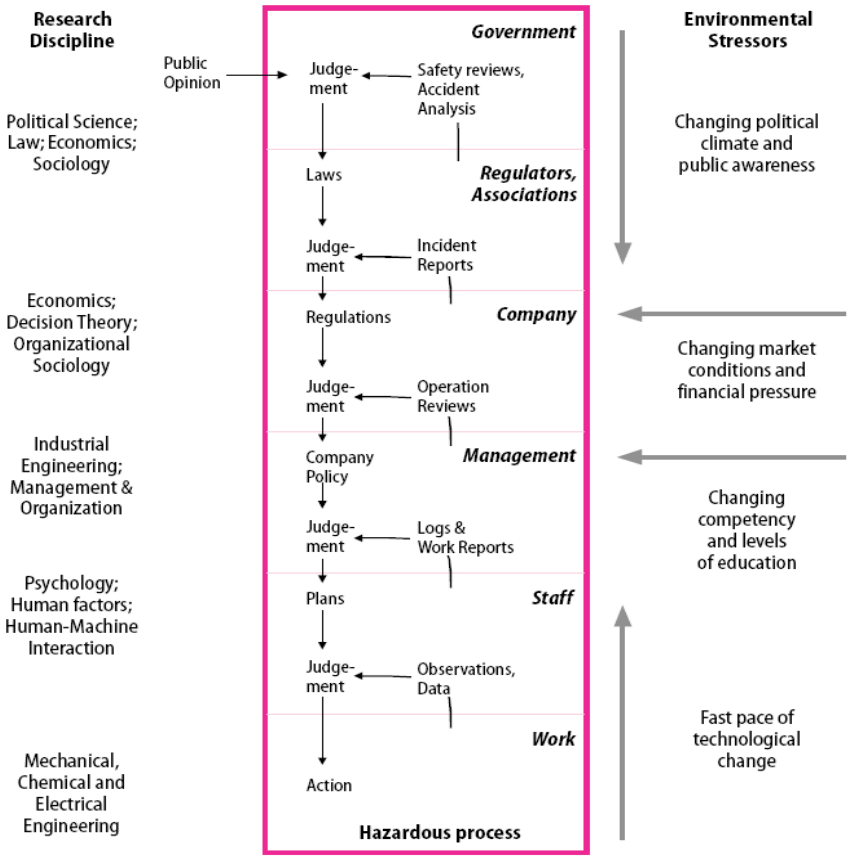


Figure 5. Risk management in a dynamic society (from Rasmussen, 1997).

Risk management is usually a part of a company's safety management system.

3.4.1 Safety management system

A safety management system (SMS) is a set of elements of an organization's management system concerned with managing risks (ISO/IEC, 2002, p 4). All companies have some kind of SMS, whether it is a formal version with documentation or an informal one. The SMS can aid the organization by showing its ability to act safely and follow the authority's regulations (Akselsson, 2007, pp 121-122). A well functioning SMS can also contribute towards continuous improvements and the structuring of the safety work (Kemikontoret, 1997, p 4).

The structure of an SMS is documented in a safety management manual (SMM) and may include the following, according to Akselsson (2007, p 122):

- A description of the organization.
- The organizations safety policy.
- The organization's structure and how responsibilities are divided.
- Competence, training and appropriateness.
- Risk Management (procedures for risk assessment and risk treatment)
- Safety assurance.
- Incident and accident reporting. Learning.

- Emergency Management.
- Safety Communication
- Guarantee that rules and standards are known in the organization and are followed by the employees.
- Procedures for monitoring, revision, measures and reporting.

Integrated management system for Safety, Health and Environment

A safety management system can be designed solely with safety in mind or it can be integrated with other management systems. Because of the similarities between safety, health and environmental management it is beneficial to integrate them (Figure 6). Less documentation, updating and training are needed and it is easier to follow by employees (Kemikontoret, 1997, pp 7-8). Additionally, it is cheaper to manage one system compared to several separate systems. (Kemikontoret, 1997, pp 7-8). The system can also be integrated with quality management systems, such as ISO 9000 (Akselsson, 2007, p 114; Kemikontoret, 1997, p 8). Furthermore, an integrated management system should minimize goal-conflicts and make the work towards sustainable development more efficient (see discussion in section 3.3)

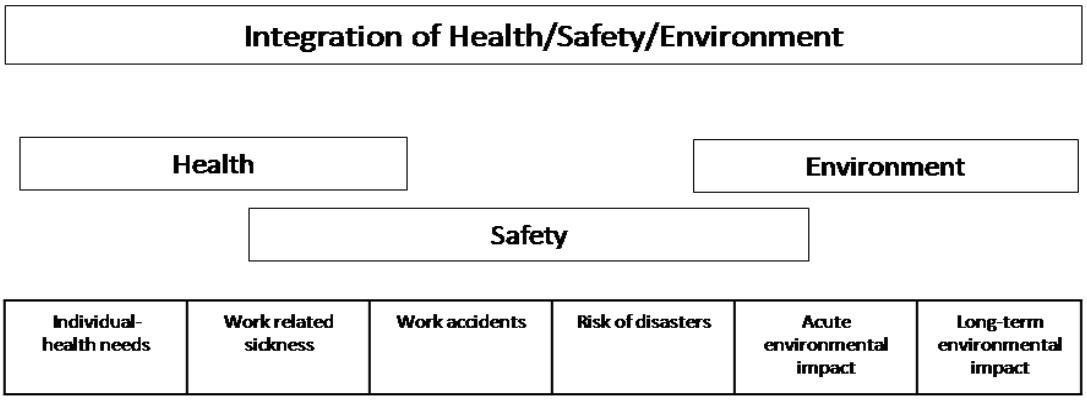


Figure 6. Integrated management system (from Kemikontoret, 1997).

To continually improve the performance a key element is to verify improvements, to ensure that the right actions have been taken. To verify improvements the status has to be measured over time. Therefore, in order to continually improve safety it is vital to know how to measure safety performance.

3.5 Evaluating safety

A cornerstone in risk management is the risk analysis. Without identifying risks you cannot prevent them (Khan et al., 2003). Without measuring the risk and the lowered risk from a mitigation option, no enlightened decisions can be made (Ingalls, 1999). Measuring the performance allows comparison with previous performance. It also makes it possible to compare the actual performance to planned performance (Ingalls, 1999). Furthermore, in order to improve the performance it is important to verify that improvements have been made and had a positive effect.

3.5.1 Methods for measuring safety performance

According to Toellner (2001) there are two basic safety metrics:

1. Leading indicators, which are linked to preventive actions.

2. Trailing/lagging indicators, which are linked to the outcome of an accident.

Most organisations measure their safety performance by trailing indicators such as number of accidents, LTI (Lost Time Injuries) and accident costs (Ingalls, 1999). Such statistical indicators may show the nature, the frequency and the severity of the accident but they reveal little about why it happened (Ingalls, 1999). To prevent an accident it is of importance to identify its cause. Trailing indicators may also have a low confidence level, since it is affected by a large number of variables such as the willingness to report and how to report an accident (Toellner, 2001). Therefore trailing indicators may not accurately reflect the organization's safety performance or reveals only little about it. (Toellner, 2001; Ingalls, 1999). Another drawback with lagging indicators is that it is a reactive measurement method. That is, an accident or incident must happen before the organization can identify what changes are needed in order to improve safety (Ingalls, 1999).

The drivers of the trailing/lagging indicators are the leading indicators. Leading indicators are a proactive measurement method associated with individual or system behaviour linked to accident prevention (Toellner, 2001). Examples of leading indicators could be housekeeping and safety walks. By developing such indicators the organization can improve the performance in each area and ease strategic and organizational change (Ingalls, 1999). By improving the performance of the leading indicators related to safety the overall safety performance can be improved. The status of these leading indicators in an organization may be measured or evaluated using the methodology proposed in the thesis. Insufficiencies in leading indicators are in this thesis thought to be synonymous with latent conditions.

3.5.2 Identifying latent conditions

One way for an organization to evaluate the safety performance could be to evaluate how strong its safety barriers are. These barriers could, as discussed in section 3.1.2, consist of both technical and organizational factors. Insufficiencies in these barriers are usually a combination between different latent conditions. Latent conditions in an organization could be for instance poor design, gaps in the supervision and unworkable procedures and they arise from decisions at management levels. (Reason, 1997, p 10).

The stages in the development of an organizational accident are, in a chronological order: organizational factors, local workplace factors and unsafe acts (Reason, 1997, p 17). An unsafe act is defined by the American Society of Safety Engineers (ASSE) as a "departure from an accepted, normal, or correct procedure or practice which has in the past actually produced injury or property damage or has the potential for producing such a loss in the future; an unnecessary exposure to a hazard; or conduct reducing in the degree of safety normally present. Not every unsafe act produces an injury or loss." (Michaud, 1995, p 10). Latent conditions may be identified in every stage stated previously. As shown in

, the process design is the core defensive barrier of the technical aspects. Avoidance of the hazard is, as stated in section 3.1.2, the first step in the safety hierarchy.

Identifying and measuring hazards

A hazard is defined as a chemical or physical condition that has the potential for causing damage to people, property, or the environment (CCPS, 2000). There exist several methods and approaches in evaluating hazards. Examples include, for instance, Dow fire and explosion index (F&EI) and safety weighed hazard index (SWeHI). These methods generally determine the fire, explosion and chemical hazards (Suardin et al., 2007). The concept of inherent safety may also be applied when evaluating

hazards in the industry. Inherent safety was first defined by Trevor A Kletz in the article "What you don't have can't leak" from 1978 (Kletz, 1978). An inherent safe process or plant is completely safe and cannot under any circumstances cause harm to people and environment. However since no or few processes are completely safe it is more common to talk about inherently safer designs (ISD). The concept of inherently safer design is constructed of three basic guidewords:

Intensification or minimization: using as little of the hazardous material that there is no significant risk if it all leaks out.

Substitution: using a material that is less hazardous or a process that is less likely to develop into a runaway reaction.

Attenuation: using the hazardous material in the least hazardous form.

(Kletz, 2003)

By using these guidewords an inherently safer process can be obtained. The more inherently safe a process is the less add-on safety equipment is needed. A process with a high inherent safety needs less add on safety from the bottom of the safety hierarchy and may thus avoiding the latent conditions these can produce. An example of a method that evaluates safety based on the concept of inherent safety is the I2SI index constructed by Khan and Amyotte (2004). All the methods mentioned above in this section (F&EI, SWeHI and I2Si) focus entirely on technical aspects such as design, toxicity and quantity. However, according to Adebiyi (2007), a majority of all accidents are caused by what employees do or fail to do. Therefore, it is important to identify all latent conditions in an organization and minimize the likelihood of unsafe acts. A safety performance evaluation model needs to take into account both technical aspects (e.g. inherent safety aspects), as well as non-technical aspects (e.g. unworkable procedures, workload, psychosocial environment). The proposed model in the thesis, which includes safety culture, working environment and safety activity, includes both technical and non-technical aspects.

Incorporating non-technical aspects

Safety culture is thought to play an important part in an organization's overall safety performance (Cooper, 2000; Arezes and Miguel, 2003). Further information on safety culture can be found in section 3.6.1. In an attempt to create a model of safety culture, Cooper (2000) included three elements; Person, Situation and Behaviour. The person element represents the subjective internal psychological factors (attitudes and perceptions) while both the situation and the behaviour elements represent external observable factors. Cooper (2000) suggests that the person element is assessed by safety climate questionnaires, the situation element by a safety management system audit and the behaviour element by behavioural sampling. Cooper (2000) argues that the three elements (person, situation and behaviour), originally found in a model by Bandura, precisely mirrors those accident causation relationships found by numerous researchers (Cooper, 2000).

A similar safety culture model is found in Geller (1994). The model includes the three elements: Person, Environment and Behaviour. The environment element includes equipment, tools, machines, housekeeping, heat/cold and engineering. Cooper (2000) and Geller (1994) both state that their chosen elements are dynamic and that changes in one element may have an impact on the other two elements.

Cooper (2000) and Geller (1994) have different views on what constitutes a safety culture compared to the one that will be presented in this thesis. However, the proposed model in this thesis can be seen similar to a combination between the *person* and the *situation* elements found in Cooper (2000) and the *environment* element found in Geller (1994). In this thesis, safety culture is considered as one of the main factors affecting safety performance.

3.6 The proposed safety model in the thesis

The proposed model in the thesis includes the three areas safety culture, working environment and safety activity (Figure 7). These three areas were chosen in order to be able to identify as many latent conditions as possible in an organization. The presence of latent conditions is, in this thesis, thought to affect an organization's overall safety performance, i.e. the quality of safety-related work.

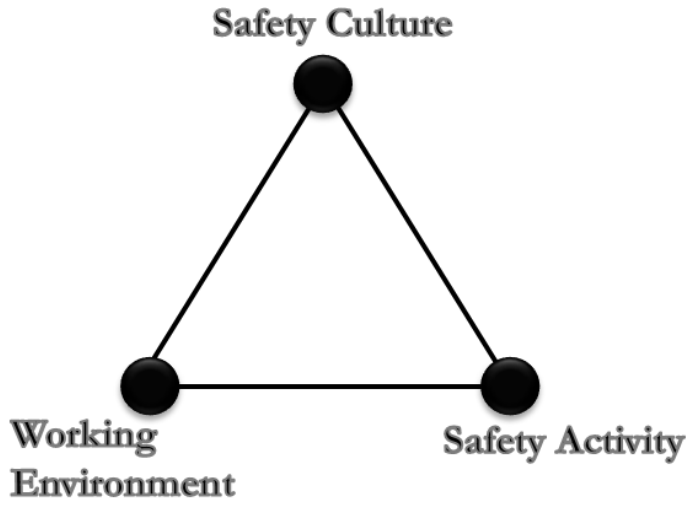


Figure 7. Illustration of the proposed model.

In the following section the three chosen areas are presented.

3.6.1 Safety culture

The first area in the model, safety culture, was first introduced in the 1986 OECD Nuclear Agency report on the nuclear power plant disaster in Chernobyl 1987 (Cooper, 2000).

Subculture of total organizational culture

Choudhry et al (2007) state that the organizational development community might have borrowed the term "culture" from anthropologists. Choudhry et al (2007) refer to the American heritage dictionary definition of culture as "the totality of socially transmitted behaviour patterns, arts, beliefs, institutions, and all other products of human work and though considered as the expression of a particular period, class, community, or population". According to Reason (1997) there is no general definition of an organizational culture. It usually refers to the shared behaviours, beliefs, attitudes and values in an organization (Williams et al (1989); Cooper (2000)). Choudhry et al (2007) summarize that the organizational culture is the interaction between an organization and individuals, where employees' behaviour can change through mutual interaction. Safety culture is generally regarded as being a subculture of the organizational culture (Cooper, 2000).

The "is" and "has" approach

One of the controversies among the (safety) culture researchers is whether or not an organization "has" or "is" a (safety) culture. The "is" approach, preferred by the academics and social scientists, regards culture as a global property that is a result of the values, beliefs and ideologies of the organization's entire membership. The "has" approach, preferred by managers, puts emphasis on the power of management in changing the culture by introducing new measures and practices (Reason, 1997, p 193-194)

Safety culture definition

Haukelid (2008) concludes that safety culture has different meanings to different professionals, managers, subgroups etc. and that there is little common understanding of the concept. Guldenmund (2000) presents over 16 different definitions of safety culture in a literature review. One of the most used definitions, which will be applied in this thesis, is given by the UK´s Health and Safety Commission in 1993:

"The safety culture of an organization is the product of individual and group values, attitudes, competencies, and patterns of behaviour that determine the commitment to, and the style and proficiency of, an organization's health and safety programmes. Organizations with a positive safety culture are characterized by communications founded on mutual trust, by shared perceptions of the importance of safety, and by confidence in the efficacy of preventive measure" (Reason, 1997, p 194)

The definition above incorporates both the "is" approach and the "has" approach (Cooper, 2000).

Sub goals in engineering a good safety culture

The purposes, or sub goals, of engineering a good safety culture, according to a review by Cooper (2000), can be broken down to:

1. producing behavioural norms
2. reductions in accidents and injuries
3. ensuring that safety issues receive the attention warranted by their significance
4. ensuring that organizational members share the same ideas and beliefs about risks, accidents and ill-health
5. increasing people's commitment to safety
6. determining the style and proficiency of an organization's health and safety programmes

Dimensions/aspects of safety culture

Guldenmund (2000) found that the number of dimensions, called aspects in this thesis, when assessing safety culture ranged from 2 to as much as 19 in the safety research area. Management, training and risks were among the most frequently used. Choudhry et al (2007) stated that a positive safety culture must include five components: management commitment to safety; management concerns for the workforce; mutual trust and credibility between management and employees; workforce empowerment; and continuous monitoring, corrective actions, review of the system and continual improvements to reflect the safety at work. According to Reason (1997), an organization must engineer the sub cultures *reporting, just, flexible and learning culture* in order to achieve an informed (safety) culture (Reason, 1997, pp 195-196).

Ek et al (2007) and Ek and Akselsson (2007) included nine different aspects in a safety culture assessment of Swedish air traffic control (Ek et al, 2007) and a ground handling company (Ek and Akselsson 2007). In addition to Reason's four subcultures stated previously the two studies included the following aspects: *working situation*, *communication, attitudes towards safety, safety related behaviours* and *risk perception.* Choudhry et al's (2007) five components of a positive safety culture were all indirectly assessed in Ek et al (2007) and Ek and Akselsson (2007).

Safety culture aspects used in the evaluation methodology

The nine different aspects of safety culture used in this thesis are based on the nine aspects used in Ek et al (2007), Ek and Akselsson (2007) and Ek (2006).

Working situation

The working situation aspect includes issues such as adequate training in work practices, staff sizes and having an influence in the design of the work. These issues may affect the work performance and hence affect the ability to carry out the work in a safe manner (Ek, 2006).

Flexibility

If an emergency occurs, a flexible culture is able to transfer power to the most knowledgeable person even if it means that someone else instead of the manager is in charge during the emergency (Reason, 1997, p 196)

Communication

Communication involves to what extent information reaches all the levels in the organization (Glendon and Stanton, 2000) and has been recognized as an important dimension in safety culture studies (Guldenmund, 2000; Hale, 2000). The issues of communication applied in this thesis include "receiving of and clarity of information; communication between people and between work groups; training in communication during accidents; and clarity about whom to contact concerning safety issues" (Ek, 2006).

Reporting

A reporting culture constitutes an organization where the employees are not afraid of reporting their errors and near-misses (Reason, 1997, p 195). A prerequisite for a reporting culture is a well-functioning reporting system.

Justness

In order to achieve a just culture an organization must first draw the line between acceptable and unacceptable behaviours and then act upon violations accordingly (Reason, 1997, p 195)

Learning

An organization with a learning culture is able to draw the right conclusions from its safety information system and make appropriate changes accordingly (Reason, 1997, p 196).

Safety related behaviours

Several studies have identified safety behaviours as an important aspect in safety culture (Cooper, 2000; Geller, 1994). This thesis includes safety behaviour issues such as "general discussions about improvements leading to increased safety; encouragement of orderliness from supervisors; encouragement from fellow workers to work safely; pressure from different levels to take short cuts; taking unnecessary safety risks; usability of safety rules; and sufficient training for emergency situations" (Ek, 2006).

Attitudes towards safety

Attitudes are incorporated in the very definition of safety culture stated above. Guldenmund (2007) found several safety culture studies where attitudes towards safety were included, both worker, management and group attitudes. In this thesis, attitudes towards safety include "individual and organizational attitudes regarding the importance of safety" (Ek, 2006).

Risk perception

Risk perception is the way in which a stakeholder views a risk based on a set of values of concerns (IEC, 2002). The perception can vary due to different factors such as experience, how dreaded and how unknown the risk is and if people feel that they have control over the risk (Riskkollegiet, 1993, pp 6-11). Risk perception may affect the behaviours of employees which in turn can affect the likelihood of accidents (Rundmo, 1997). In this thesis it includes issues such as "how safe the employee think their work is; the perceived likelihood that they will get injured or cause injury to others; the experience of having influence on safety at work; trust for middle management

concerning safety at work and the belief that work is carried out with good safety margins" (Ek, 2006).

Maturity – awareness level

Fleming (2001) presents a safety culture maturity model with five steps, see Figure 8. By building on the strengths and removing weaknesses of the previous level the organization sequentially progress through these levels. However, to be relevant for the application of the safety culture maturity levels he suggests that a number of criteria have to be met. These criteria are; implementation of a Safety Managements System (SMS); behavioural and cultural failures causing the majority of the accidents; compliance with health and safety laws; and safety driven by the desire to prevent accidents – not prosecution.

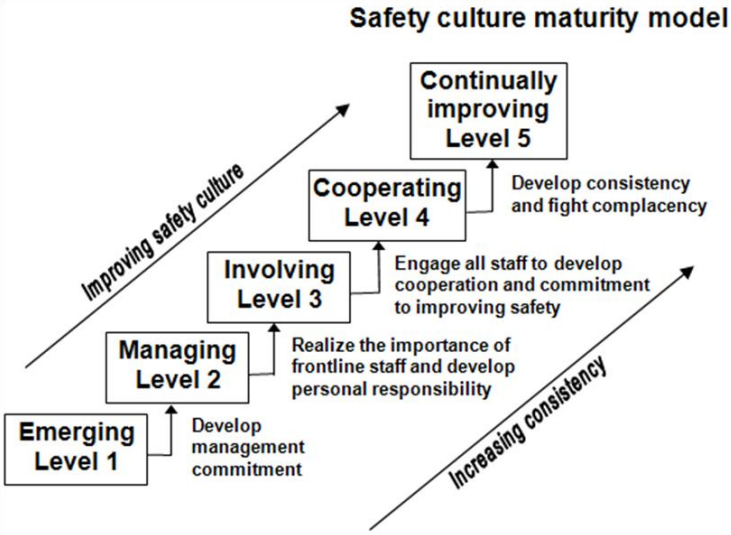


Figure 8. Safety culture maturity levels (from Fleming, 2001).

The second area in the proposed model is working environment.

3.6.2 Working environment

People are both products and producers of their environment (Cooper, 2000).The World Health Organization (WHO) defines working environment as a summarized term for biological, medical, physical, psychological, social and technical factors that affects an individual in or adjacent to their work (Hälsa och utveckling i småföretag, 2008). The design of the work environment affects safety directly through its inherent dangers and indirectly by its affect on the employee performance. Noise and light are two examples of factors in the working environment that affect employees (Akselsson, 2007, pp 13-21).

Working environment aspects used in the evaluation methodology

The working environment area in the methodology is composed of eight aspects. The aspects are largely based on the parameters and questions identified in IVF's WEST (Work Environment Screening Tool) method (Karling and Brohammer, 2002; Bengtsson et al, 1995). A short description of each aspect follows bellow.

Psychosocial environment

The psychosocial environment aspect is a combination between some of the working situation issues found in Ek (2006) namely stress, appreciation of work, support from co-workers and managers as well as issues regarding conditions for social work found in Karling and Brohammar (2002).

Accidents

Accidents or the risk of accidents can be a product of a poor working environment. The model includes accidents stated by the Swedish Social Insurance Agency as possible work-related accidents (Försäkringskassan, 2008).

Noise

Noise can cause harm in different ways. Ear damage is an obvious risk associated with noise. It can, however, cause problems already at much lower exposure levels. These problems include distraction, effects on orientating and focus ability, masking of sound, mental exhaust and defensive reactions (Edling et al., 2000, p 226).

Physical work load

The most frequent cause of work-related accidents is physical work load (Karling and Brohammer, 2002, p 17). Factors promoting work-load accidents are heavy lifts, monotone work positions, cold and vibrations (Karling and Brohammer, 2002, p 17).

General physical environment

The general physical environment represents physical aspects of the working environment including lightning, thermal climate, order, personal protection equipment (PPE), workspace size and interface between man and machine. Poorly designed working environment promotes risk for ill health as well as lowered productivity (Karling and Brohammer, 2002, p 21).

Vibrations

Vibrations can be caused by for example drills, chainsaws and vehicles and result in occurrence of numbness, reduced ability to feel vibrations and heat and cold (Karling and Brohammer, 2002, p 32; Edling et al., 2000, p 238). Moreover it can result in muscle, joint and tendon damage and back problems.

Freedom to act

The degree of freedom to act includes issues such as for how long the workplace can be left without supervision and to what extent the workers control the work pace (Bengtsson et al, 1995, p 15).

Chemical health risk

Chemicals can cause a wide range of adverse effects and about 800 accidents related to chemical exposures at work are reported in Sweden every year (Karling and Brohammer, 2002, p 37)

The third area of the proposed model is safety activities.

3.6.3 Safety activities

Safety activities are activities concerned with lowering the risk of accidents (OECD, 2003, p 27). Safety activities can be for example safety training, working with a safety management system and maintenance work. Extensive and thorough safety activities indicate a high safety performance. By evaluating which activities that are made and the quality with which they are carried out, information about the safety performance can be revealed.

Safety activity aspects used in the evaluation methodology

The aspects covered in the safety activity area are largely based of the organization for economic co-operation and development's (OECD) document "*Guidance for Industry, Public Authorities and Communities for developing SPI Programs related to Chemical Accident Prevention, Preparedness and Response"*. OECD's document gives guidance on how enterprises, authorities and communities can develop safety performance indicators (OECD, 2003, p 27). Although the guideline is intended for the chemical industry the different safety activity aspects are the common base for all kinds of industries.

Policies and general management of safety

Safety should be an integral part of the total business activities of an enterprise and be addressed as part of the overall corporate Safety, Health and Environment policies (OECD, 2003, p 29). This should be reflected in the overall management instruments for the enterprise and for individual sites.

Safety policy

A safety policy should provide standards and strategies designed to protect the health and safety of workers and the public as well as the environment (OECD, 2003, p 30). The policy should not be affected by short-term changes in the enterprise's economic conditions. Through the policy the organization can communicate its view on safety to external stakeholders.

Safety management system (SMS)

An SMS should be based on the safety policy. The SMS provides a structured approach to manage arrangements needed for a good safety performance. The SMS should define an ambition level that the enterprise considers adequate for its business. The minimum ambition level, under all circumstancesm, is to follow regulations (OECD, 2003, p 36).

Personnel

To ensure appropriate levels and competence/fitness of the staff, all employees should have a clear understanding of their job tasks (OECD, 2003, p 38). The staffing should be adequate on all levels and with the right competence, during normal and abnormal workload without overstressing the employees. Moreover, the employees should be given feed-back on safety-related aspects of their jobs.

Working Environment

There should be a regular monitoring of different aspects of the working environment in order to ensure a good workplace. The working environment should be designed to provide good working conditions and facilitate a safe way of acting, taking into account physical, physiological and mental capabilities and constraints of employees (OECD, 2003, p 43).

Administrative procedures

Administrative aspects play an important role in supporting and enforcing the commitment to safety through formal procedures and systems (OECD, 2003, p 49). Many of these procedures are included in the SMS.

Hazard identification and risk assessment

All safety management starts with the identification and assessment of hazards (OECD, 2003, p 50). Hazard identification and risk assessment are the basis for understanding risks and for implementing standards and goals for managing those risks (OECD, 2003, p 49). There should be systematic, written procedures that reflect the need to involve specialists, concerned personnel and responsible managers in order to guarantee objectivity (OECD, 2003, p 50).

Routines

Enterprises should develop and document safety-related procedures that are agreed upon, trained and followed (OECD, 2003, p 54). The procedures should be based on assessment of the risks in the operation and be an important part in the knowledge transfer within the organization. The procedures should include instructions for safe operations of equipment, process, storage facilities and other activities.

Management of Change

Historical evidence shows that inadequate reviews of changes in enterprises have resulted in accidents (OECD, 2003, p 56). There should be a system to help ensure that changes do not increase,

or create risks. The definition of what constitutes a change includes modification in equipment, technology, software, personnel and administrative/managerial adjustments.

Contractor safety

Many enterprises use contractors to carry out different kinds of work. There should be a system to ensure that contractors follow the safety requirements, policies and procedures of the enterprise. Contractors should receive proper training and work under the same conditions as other employees, applying normal safety policy and procedures (OECD, 2003, p 58).

Product stewardship

Product stewardship involves responsibility to promote a safe management of substances/products produced in the organization (OECD, 2003, p 60). Special efforts should be made to help prevent incidents and accidents during handling, transport and use by downstream users as well as during disposal.

Technical aspects

Good design, engineering and construction of technical systems are prerequisites for a safe installation (OECD, 2003, p 63). The design should try to make the process as inherently safe as possible and consider the safety hierarchy concept discussed in section 3.1.2.

Research and development

To help ensure the possibility to continually improve products, processes and procedures/methods there is a need for research. The research is often carried out jointly within the industry (OECD, 2003, p 64). In terms of safety it is important to have good safety management in the research and development (R&D) stages. Results from risk analysis should be considered when researching for new solutions.

Design

The safety of an installation is founded in its design and engineering (OECD, 2003, p 66) (also see section 3.1.2). There should be a harmony between the hardware, the equipment, the control systems, the computer software system and the human interaction by the people operating the facility (OECD, 2003, p 63). The system should be robust in its design and be able to accept both human errors and individual component failures without creating unsafe conditions.

Hazardous substances

Storage of hazardous substances presents special risks and concerns. Releases of products can lead to accidents with major consequences (OECD, 2003, p 74). Often large quantities of hazardous substances are stored in ware-houses. Therefore, special precautions should be taken to ensure safe storage and to avoid loss of containment.

Maintenance

The integrity of an installation should be kept at the intent of the original design (OECD, 2003, p 76). The focus should be on preventive maintenance including all important equipment with regular test and overhauls.

External Co-operation

Modern installations are often very complex and all parties involved have a responsibility to ensure high safety. Therefore, parties depend on each other for information on how to best handle for example chemicals and assistance in case of emergency etc (OECD, 2003, p 79). The co-operation involves co-operation with public authorities, with stakeholders and the public.

Emergency preparedness and response

Despite all the efforts put into avoiding accidents there must be a preparedness to deal with them in order to mitigate the impact if they occur (OECD, 2003, p 87). This is a responsibility for both the enterprise and the public, although the enterprise has a key role to facilitate co-operation between the parties. A key point in emergency planning is regular training of people in the implementation of the plans.

Accident/Near-miss reporting and investigation

A fundamental aspect in improving the safety is an organization's ability to learn from accidents. Therefore, there should be a functioning system for reporting incident and accidents and for follow-up based on experience (OECD, 2003, p 87).

4 Development of evaluation methodology

Section 4.1 presents the overall work process of the thesis. Section 4.2 describes the methodology developed to evaluate the safety model's components. In the following section, 4.3, the pilot study is described.

4.1 Thesis process

An illustration of the work process of the thesis is presented in Figure 9 below. The thesis process included; literature studies; interviews with experts; development of a safety model, methodology to evaluate the model's components and a computer-based tool to present the results; a pilot test of the developed concept; and an analysis of the results from the pilot test.

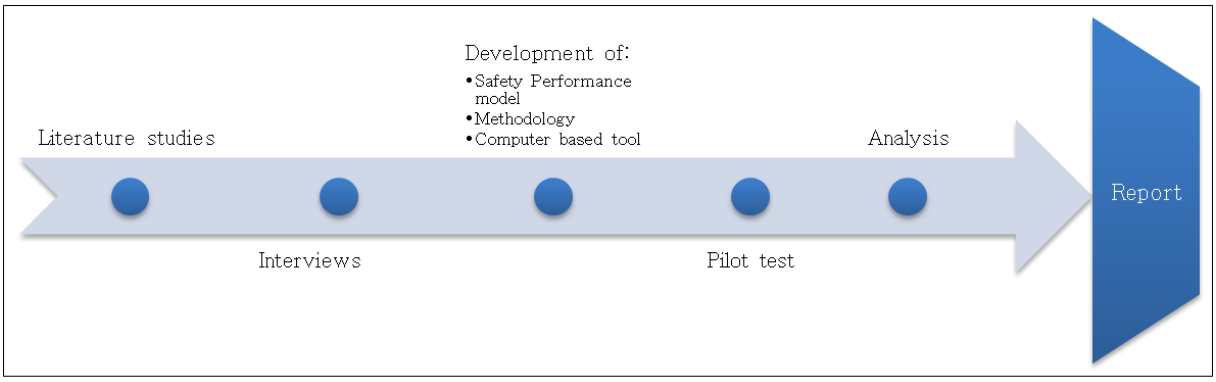


Figure 9. Illustration of the work process of the thesis.

4.1.1 Interviews

In the process of developing the proposed model and the methodology discussions with a number of people, with relevant experiences in the field, were carried out. These people, in no special order, were:

Anders Jacobsson, Expert from the process industry and guest teacher, Faculty of Engineering, Lund University

Per Kling, Swedish Work Environment Authority, Malmö

Mikael Engström, Swedish Work Environment Authority, Malmö

An environmental engineer at the pilot study company

Hans Lindgren, tutor, Det Norske Veritas (DNV), Malmö

Åsa Ek, tutor, Faculty of Engineering, Lund University

4.2 Evaluation methodology

The model, as discussed above, consists of the three areas or head categories *safety culture*, *working environment* and *safety activity*. Each one of these categories is evaluated through a questionnaire package (Questionnaires are presented in Appendix chapter, I, II and III).

The methodology consists of a total of 246 questions divided into the following categories;

Safety culture: Consists of 81 questions that are to be answered by a representative selection of employees. As stated above, safety culture should represent the total values, attitudes and beliefs in an organization. Therefore, ideally all employees should answer these questions. However, often the only practicable solution is to choose a sample group that represents the organization.

Working Environment: Consists of 39 questions. The results should illustrate the quality of the working environment in an industrial setting. Therefore, these questions should be answered mainly by employees exposed to this environment. Similar to the safety culture category above, all the employees exposed to this environment should, ideally, answer these questions.

Safety Activities: Consists of 114 questions. These questions should be answered by personnel with adequate knowledge in this area, such as employees actively working with safety management issues in the organization. This includes people participating in safety committees, safety engineers, designers/constructors etc. These questions are not supposed to represent people's total values, attitudes and beliefs as in the case of the safety culture and the working environment areas. The questions are constructed to measure what activities are preformed and the quality of those activities (leading indicator) rather than their outcomes (lagging indicator) (see section 3.5). Therefore, results from two or three people should be enough to receive adequate information regarding safety activities.

Additionally, a questionnaire designed for the top management was constructed which consists of 12 questions. These questions represent the top management's safety performance ambition and view on safety culture.

4.3 The pilot study

A pilot study was carried out as a part of the methodology development process with the aim to test the questionnaires.

4.3.1 Description of the object for the pilot study

The site for the study was a medium-sized factory with about 300 employees. The production at the site is largely carried out as an assembly line that is operating in three shifts. Several accidents have previously occurred at the site.

4.3.2 Method for the pilot study

The questionnaire packages concerning safety culture and working environment were combined to one questionnaire, a total of 120 questions. The questionnaire was distributed to one work group. 20 questionnaires were distributed and 18 were answered, resulting in a reply frequency of 90% (18/20). The estimated time it took to fill in this questionnaire was about one hour. The questionnaire package regarding safety activities was distributed to two employees involved in safety management. Two questionnaires were distributed and two were answered, resulting in a reply frequency of 100% (2/2). The questions regarding *Contractor safety*, *Design* and *Research and Development* could not be answered. The estimated time it took to fill in this questionnaire was also about one hour. The site manager answered the short questionnaire designed for the top management and this questionnaire was estimated to take about 15 minutes to fill in.

Recommendations for a high reply frequency

The aim of the safety culture and the working environment questionnaires is to yield results that represent the total values, attitudes and beliefs of a site/company/enterprise etc. Therefore, it is important to obtain a high reply frequency in the sample group. In order to achieve this, the management must show commitment to the evaluation. Ways to show commitment are to reserve time for the employees to fill in the questionnaires, inform about the evaluation and its importance. A thorough follow-up on the results of an evaluation, showing that improvements can be made and

that employees are involved in the process can have positive effects on the reply frequency of future evaluations.

4.3.3 Cronbach's coefficient alpha test

The Cronbach's coefficient alpha test was performed in order to determine the reliability and the internal consistencies, of the nine aspects of safety culture and five chosen aspects of working environment. The coefficient in the Cronbach's alpha test ranges from zero to one. A low value of alpha indicates that the instrument has little internal consistency which implies that the items (in this case; the questions) do not all refer to the same underlying aspect. On the other hand, a high alpha value indicates good internal consistency (Nunnally, 1978). An alpha value which exceeds 0.70, indicates that the instrument has sufficiently good reliability or internal consistency (Hair et al., 1998).

Internal consistencies for safety culture aspects

The Cronbach's coefficient alpha values for safety culture aspects are presented in Table 1. Five aspects; *Working situation, Reporting, Attitudes towards safety, Safety-related behaviours* and *Risk perception* all received coefficient alpha values above 0.7, which indicates good reliability. Three aspects; *Communication*, *Learning* and *Justness* received values below 0.7 but above 0.6. For *Flexibility*, the coefficient alpha value was negative. This might indicate poor internal consistencies and that the items measure different dimensions, leading to negative inter-item correlations.

Table 1. Cronbach's coefficient alpha for the nine safety culture aspects in the pilot study.

Safety culture aspects	n of items*	Cronbach's alpha coefficient
Working situation	9	.80
Communication	6	.66
Learning	7	.67
Reporting	10	.75
Justness	9	.66
Flexibility	5	Negative value
Attitudes towards safety	12	.88
Safety-related behaviours	12	.74
Risk perception	5	.87

Internal consistencies working environment

The Cronbach's coefficient alpha values for working environment aspects are presented in Table 2. Four aspects; *Psychosocial environment, Accidents, General physical environment* and *Freedom to act* all received coefficient alpha values above 0.7, indicating good reliability. One aspects; *Physical work load*, received a value below 0.7 but above 0.6. For the remaining aspects of working environment (not shown in Table 2) the Cronbach's coefficient alpha test could not be carried out, since these aspects only consist of a single question each.

Table 2. Cronbach's coefficient alpha for five working environment aspects in the pilot study.

Working environment aspects	n of items*	Cronbach's alpha coefficient
Psychosocial environment	8	.78
Accidents	15	.88
Psychical work load	3	.62
General psychical environment	6	.71
Freedom to act	2	.79

5 Development of the computer-based tool

A tool, based on the methodology, was constructed in order to compile, analyze and illustrate the data. The ambition was that the tool should be able to present results both on a holistic and a detailed level. The tool was constructed in Microsoft Excel®. In section 5.1 the developed computer-based tool will be described using some of the results obtained in the pilot study. The focus is on describing the tool rather than the results from the pilot study. However, some results from the pilot study will be presented to illustrate the tool's abilities. In section 5.2 relations between a number of chosen activities (safety activities) and attitudes (safety culture and working environment) are discussed.

5.1 The tool and the pilot study

The tool is, as argued before, constructed to illustrate and identify strengths and weaknesses in the safety performance in order to enable continuous improvements in safety. Therefore, the constructed tool presents results divided into three differently detailed levels, as can be seen in Figure 10. The first level consists of the three head categories. In the second level the head categories are divided into subcategories and the bottom level is made up directly by the results from the questions in the questionnaires (The questionnaires can be found in the Appendix). The questions are considered as equally important and therefore weighted equally in the tool.

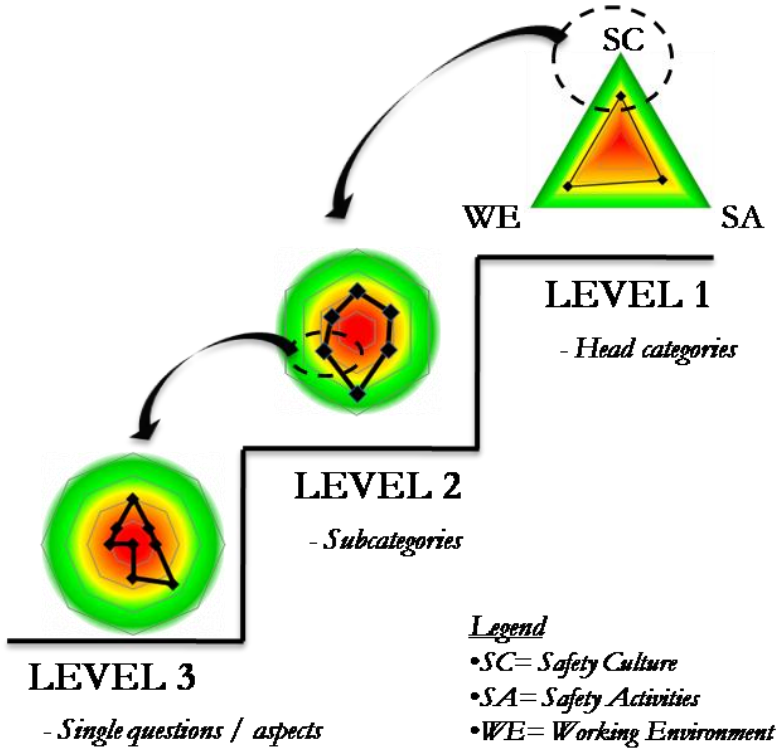


Figure 10. Illustration of the different levels in the tool.

5.1.1 Presenting results

The results on the three different levels have been presented in a similar way to avoid confusion. On all levels "spider-diagrams" are used as the main method to illustrate results. This type of diagram provides an easy way to understand results as it shows relations between results as well as presents them on a defined scale. The diagram also shows a picture of the total safety performance status, where a larger area indicates a higher "status" compared to a smaller area. Some results have been complemented or replaced by other visualization methods when needed, commonly bars or stacked bars diagrams.

The scale and how it should be interpreted

All diagrams are presented on a common scale, see Figure 11. The scale ranges from one to five in accordance with the scale used in the questionnaires. The scale is constructed with three buoyant main ranking levels. How these should be interpreted is described for *LEVEL 1.* However, the interpretation of the scale is similar for *LEVEL 2* and *3*. For *LEVEL 1,* an evaluation score close to one is considered an unacceptable status. It indicates the existence of numerous gaps in barriers resulting in a high level of latent conditions. Such a level presents a potentially high risk of accidents. Actions should therefore be taken to reach an acceptable safety performance status. A score adjacent to three is considered an acceptable status. Although there still exist various gaps in barriers at this status level and accidents may occur regularly they are at a level that can be regarded as acceptable. However, there is a high potential for improvements and actions should be carefully considered. Finally, a score close to five indicates an exemplary safety performance level where the potential risk of accidents is low and accidents are rare. However, the safety performance status may change rapidly. Therefore, it is especially important to identify and preserve strengths in the organization in order to maintain and enforce a high safety performance status. Additionally, the scale is coloured to further ease how it should be interpreted. A colour scheme commonly used in activities related to safety, in for example risk matrixes, was used. The colouring is easy to interpret where red represents a high risk, yellow a medium risk and green a low risk.

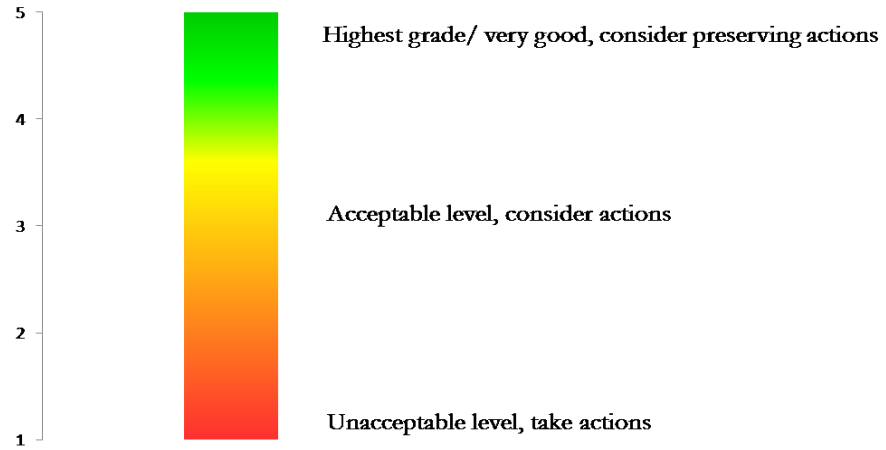


Figure 11. Illustration of the five-point scale.

LEVEL 1

The top level, *LEVEL 1*, shows a holistic view of the safety performance. At this level the status of the head categories *safety culture, safety activities and working environment* is given, see Figure 12. The diagram displays the results as the total means of both the manager's and the worker's opinions. As can be seen in the figure all three head categories have mean values around three, which indicates that there is a high potential for improvements in all three categories. In this thesis, the total safety performance is thought to be represented by the mean score of the head categories. In the pilot study, the safety performance index for the company was approximately three. To identify a given head category's most critical aspects, which also have the greatest improvement potential, a closer look at the subcategories is required. The subcategories are shown in the next level, *LEVEL 2*.

Figure 12. Illustration of LEVEL 1, safety performance.

LEVEL 2

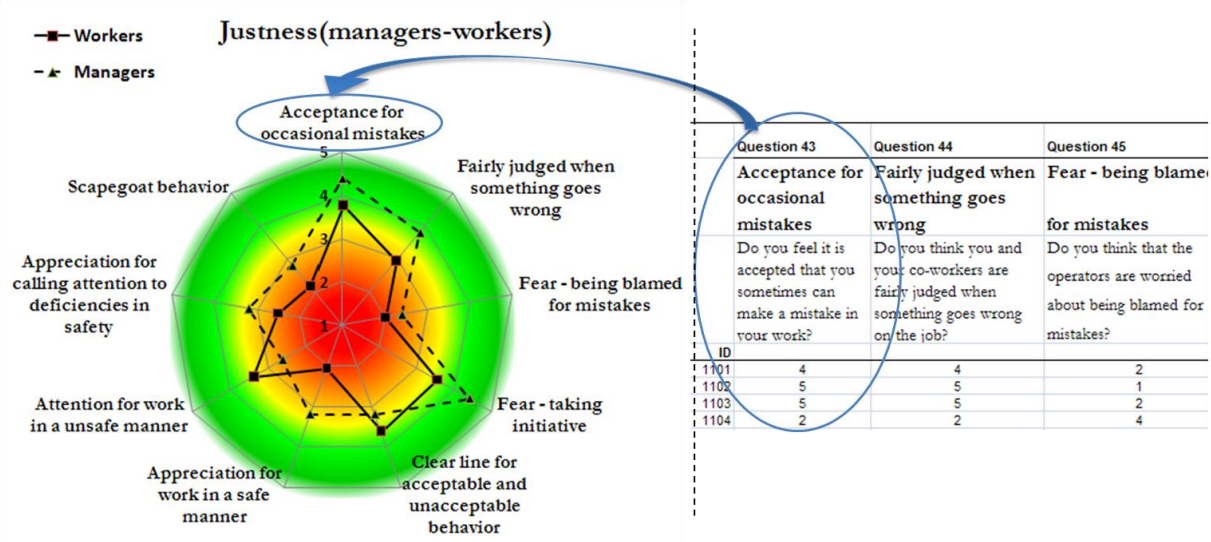
The second level shows the status of the subcategories. In Figure 13 the status of *safety culture's* subcategories can be seen. In the diagram the results are presented as the total mean of both managers' and the workers' opinions. However, at this level the status may also be viewed divided up into managers' and workers' opinions. Figure 12 shows, similar to Figure 13, that there is a high potential for improvements in all subcategories. The results from the pilot study shows that the subcategories *Learning, Justness* and *Safety-related behaviours* received somewhat lower scores than the other subcategories. In order to identify a given subcategory's most critical aspects, which need to be improved, a closer look on this subcategory is required. This can be viewed in the last level, *LEVEL 3*.

Figure 13. Illustration of LEVEL 2, safety culture.

LEVEL 3

In the third level, *LEVEL 3*, each question that constitutes a subcategory is presented. In the left part of Figure 14, the mean values of the questions in the subcategory *Justness* are presented. Figure 14 also illustrates how raw data from the questionnaire are compiled in the computer based tool. The figure shows the opinions for managers and workers separately to reflect the different opinions in

the organization. However, the results can also be viewed as a total mean. As seen in Figure 14, managers tend to give a somewhat higher score compared to workers. This is the case for almost all aspects in the pilot study. A reason for this might be that the managers are unaware of or have little knowledge of some of the safety-related issues that the workers experience. Another explanation can be that the managers are less exposed to the risks and therefore experience them as less severe. However, the results from the manager and the workers are quite similar. Figure 14 shows that some aspects are in the red field and close to score one, which indicates an unacceptable status. Actions should be taken to reach an acceptable status for these aspects and prevent the latent conditions they produce. This will result in a higher status of the subcategory *Justness* which in turn improves the main category *Safety culture* and hence leads to an improvement in the organization's safety performance.



	Question 43	Question 44	Question 45
	Acceptance for occasional mistakes	Fairly judged when something goes wrong	Fear - being blame for mistakes
	Do you feel it is accepted that you sometimes can make a mistake in your work?	Do you think you and your co-workers are fairly judged when something goes wrong on the job?	Do you think that the operators are worried about being blamed for mistakes?
ID			
1101	4	4	2
1102	5	5	1
1103	5	5	2
1104	2	2	4

Figure 14. Illustration of LEVEL 3, justness.

For some aspects, a potential of underlying factors for the questions are presented. An example of this is presented in Figure 15, where reasons for not reporting are presented. This can help to identify actions to improve this aspect.

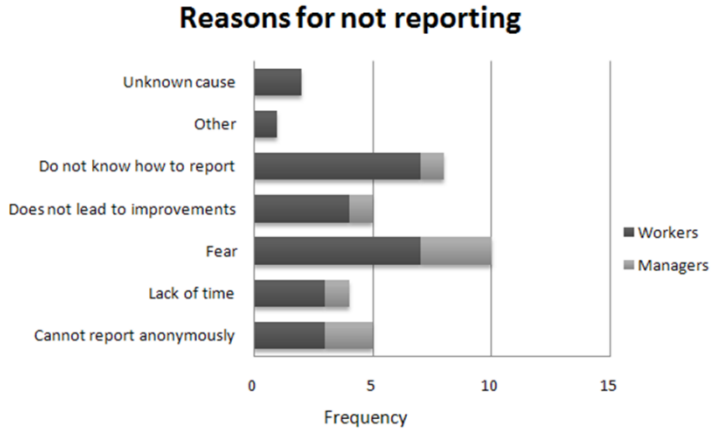


Figure 15. Example of underlying factors. Reasons for not reporting.

Maturity - awareness level

In addition to the results previously shown, the head manager was asked to give his views on the safety activity aspects, ambition and resources. He was also asked to answer questions which were

picked to represent the different subcategories of safety culture. The manager states his estimates of the current status, the organization's ambition and the lowest acceptable level for these aspects. These estimations from the manager should then be compared to the actual current status of these aspects, which is presented in Figure 16. The actual current status is the result received from the employee questionnaires. Figure 16 shows that, for all aspects, the actual status is lower than both the acceptable status and the ambition level. The management's estimations of the current status were generally higher than the actual status (seven of twelve aspects were higher). This could indicate that the management is unaware of or under-estimates safety issues concerning the workers. The fact that the actual status is below the stated acceptable status shows that more efforts have to be put down into safety. An organization where the management estimates the current status in line with the actual status, and where the actual status is above or equal to the accepted status, is thought to have a good maturity or awareness level.

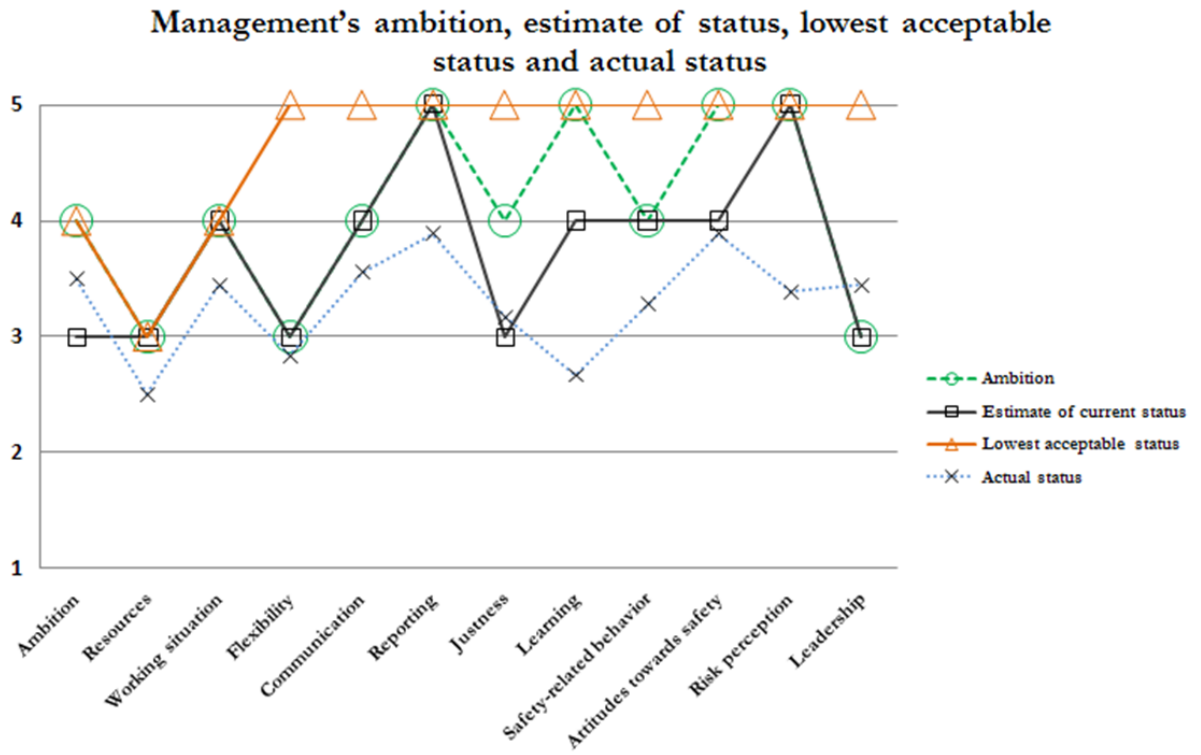


Figure 16. Management's ambition, estimate of status, lowest acceptable status and actual status concerning safety activities and safety culture.

5.2 Relations between attitudes and activities

Results from the safety culture and working environment survey are, in the thesis, considered as the general *attitudes* that exist in the organization. Safety activities, on the other hand, are considered to be the actual safety-related *activities* that are carried out in the organization. It can be argued that a change in activities will affect attitudes, and at the same time attitudes might affect which activities will be carried out. A high score for activities can be expected to result in a high score for attitudes. To briefly examine this relation, the outcomes for some questions concerning similar aspects were gathered for attitudes and activities, respectively. The mean for the clustered questions was then compared between activities and attitudes. In Figure 17 a plot of the means for the examined aspects is presented for attitudes and activities, respectively. The three first aspects; education/training, hazardous substances and reporting indicate that a higher score for attitudes yields a higher score for activities. However, the last aspect, maintenance, indicates the opposite while the second last

aspect, working environment gives a similar score for both activities and attitudes. One reason for why maintenance differs from the other aspects might be that the questions for the *activity* area, concerning maintenance, were only answered by one person, who might not have adequate knowledge of maintenance activities. In order to further explain the relation more data and more aspects need to be analyzed.

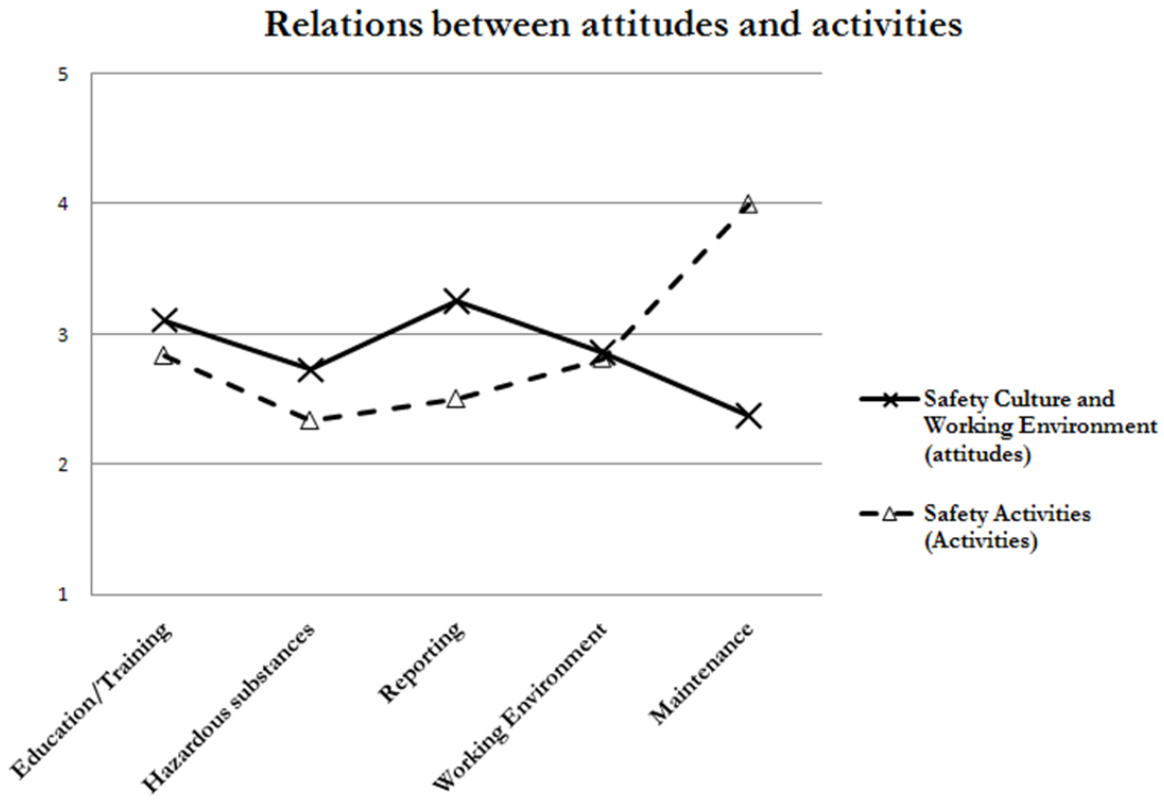


Figure 17. Relations between attitudes and activities.

6 Results from interviews

To receive feedback on the developed model, methodology and tool, interviews with an environmental engineer and a working environment inspector were conducted. The environmental engineer, who participated in the pilot study, gave feedback on the safety activity questionnaire package. She thought that the five-graded scale was adequate. Five grades were thought to be sufficient, fewer grades would make it too rough and more grades would make it hard to differentiate the grades. Furthermore, the questions were thought to be relevant, but some of them were difficult to answer. This indicates that the safety activity questionnaire package might be better answered by a group of safety professionals with varied competence that covers all issues included in the safety activity questionnaire package. The questions in the safety activity questionnaire took about an hour to answer.

Per Kling, a working environment inspector at the Swedish Work Environment Authority in Malmö, gave his view of the working environment and safety culture questionnaire packages. His opinion was that the questions covered a broad and a relevant spectrum. However, some questions needed to be rewritten in order to make them easier to comprehend and interpret. This was done accordingly before the pilot study was conducted.

7 Discussion

The general aim of the thesis was to develop a concept built on a safety model, methodology and tool that can be used to evaluate safety performance in an organization. In the thesis, safety performance was defined as the quality of safety-related work and evaluated through leading indicators. Safety performance is evaluated using a total of 246 questions divided into the three areas of the safety model; safety culture, working environment and safety activities.

7.1 The developed safety model

The aim of the model is to illustrate important components that affect the overall safety performance in an organization. Safety culture, working environment and safety activities were found, in the literature, to be important contributors to safety. Therefore, these three areas were chosen as the components which the proposed safety model is built upon. The safety model evaluates safety performance, defined as the quality of safety-related work. Safety-related work is regarded as the efforts made to achieve safety. Safety performance is thought to greatly affect the safety of an organization but other factors such as location, type of branch, workforce size etc. also affect safety. Therefore, the model cannot be thought to assess the total safety or the total risk of accident. However, many latent conditions in an organization's safety work can be found in the three areas of the model. The presence of latent conditions, as stated in section 3.2.1, increases the likelihood of an accident but the consequence of an accident is largely affected by factors not incorporated in the model, such as type of branch and location. However, safety performance will also affect the consequence. A good safety performance with, for instance, well functioning emergency routines may lower the consequence of an accident. Factors such as location, type of branch and technology may, as stated in section 3.1.2, be difficult to change and further improve in an organization. The three components in the proposed model include factors that might be more practicable, and less expensive, to change in order to improve safety and lower the risk of accidents.

7.2 The methodology

Questionnaires were chosen as a method to evaluate safety performance since it is a fairly quick way to gather information from a large group of people. As mentioned earlier in section 3.6.1, safety culture is represented by the product of individual and group values, attitudes, competencies, and patterns of behaviour. Therefore, a questionnaire is an appropriate method to evaluate this area. Further, questionnaires can be argued to be an appropriate method to evaluate working environment as well. Employees affected by the working environment, on a regular basis, should have the appropriate knowledge to assess the quality of aspects affecting the working environment. Similar, the personnel involved with safety-related work should be able to assess the quality of the aspects included in the safety activity area. However, questionnaires are sometimes criticized as a tool to gather information (Hammond, 1995). The criticism refers to the problem with untruthful answers. There could be many reasons why people would not answer truthfully, including for example, that the employee answers strategically or does not understand the question. Similar to the discussion in the safety culture study found in Ek (2006), the authors of this thesis believe that the participants generally answered truthfully. However, an independent expert's assessment of the three areas could be argued to be more objective since it is less likely to be biased. On the other hand, an independent expert's assessment of the safety performance, taking into account the same aspects as the proposed model, is likely to be more time-consuming than the methodology proposed in this thesis. Moreover, even in the case of an expert assessment, involvement of employees will most likely be necessary. The authors believe that a totally independent expert, who has no personal gain, does not exist and therefore an assessment by an expert will also be biased.

Questionnaires were designed to evaluate the performance in each area. In line with the discussion held in section 3.5.1, the questionnaires were designed primarily to evaluate leading indicators.

Leading indicators were chosen since they can illustrate the status of the safety work in an organization and identify insufficiencies or latent conditions. This is a proactive approach, which in contrast to lagging indicators, such as LTI, does not rely on statistics on actual accidents to assess the safety performance. A proactive approach has the ability to prevent accidents before they occur. Catastrophic accidents that occur in complex technologies are relatively rare and the underlying set of causes that produce them may be unique. Therefore, the only appropriate and sustainable approach is to prevent them proactively. Furthermore, also more common and less severe accidents can result in too serious consequences to be prevented in a reactive manner.

The questions in the evaluation methodology were chosen to be applicable in most industrial organizations. However, some of the aspects in the questionnaires may not be relevant for all organizations. For the company in the pilot study, some aspects in the safety activity questionnaire could not be answered by the assigned employees because of lack of knowledge. This highlights the need to involve enough people to cover all the aspects included in the safety activity area. There were also some questions that were not answered since the participants thought that the questions were not relevant for the site. Since the site did not have an R&D department questions regarding research and development (R&D) were not answered. Nevertheless, the authors' opinion is that more activities and a higher quality of these activities generally result in a better total safety performance. For an organization, type of branch and size should determine which and how many activities that are relevant.

The participants were able to answer all the questions in the safety culture and working environment questionnaire packages. One reason why the participants were able to answer all questions can be that they only refer to believes, values and attitudes regarding safety and the working environment. Therefore, the questions are easy to fill in and no special competence is required.

The results from the top management questionnaire indicate that some questions were not interpreted as they were intended to. The ambition level was for some aspects stated below what was considered as an acceptable level. The authors believe that this was not the manager's intention. An explanation could be that the scale for these questions was confusing and needs to be reconstructed.

Some questions, in particular the questions regarding accidents in the working environment questionnaire, could be rewritten in order to it easier to identify the latent conditions. These questions are now constructed in a way that conceals much information. The questions indicate latent conditions as the probability of accidents, but they do not reveal the source of the latent conditions. For instance, the probability of a truck accident may be affected by various latent conditions but these are not revealed in the questions used.

7.3 The computer based tool

The aim of the computer-based tool is to identify and pedagogically illustrate the strengths and weaknesses in an organization's safety performance. From a risk management perspective the tool can be of use in the risk identification phase, see section 3.4, since it highlights latent conditions. Furthermore, the tool can be a part of an organization's SMS since it can provide assistance to monitor and revision safety work. The tool consists of the different questionnaires compiled in specially designed spreadsheets in Microsoft Excel®. The spreadsheets are designed to enable the organization to visually examine the safety performance status. This enables the organization to evaluate if improvements are necessary and/or whether improvements have been made since a previous evaluation. To validate improvements is, as argued in section 3.4.1, a natural part in the work towards continuous improvements and is therefore a cornerstone in an SMS. By highlighting insufficiencies in an organization's safety work, the tool might also help the organization to follow safety regulations. The authors' believe that the tool can ease safety-related strategic planning and

decision-making and thereby facilitate continuous improvements and enable more sustainable and enlightened decisions.

Mean values can be argued to represent the general beliefs of a group. Since safety culture and working environment are represented by beliefs of a group, mean values are used in the tool to present results. If the questionnaire regarding safety activities is answered individually and not together in a group of safety professionals, mean values should be used. However, the authors suggest that the safety activity area should be evaluated in a group. By only illustrating mean values some information, such as extreme values and the spread of the values, are consequently left out. The left-out information can be important since it might reveal further information about latent conditions. An example of this could be that an employee states that he/she does not have the adequate training for the job. Even though the mean value for the group regarding training is sufficient, the fact that one employee lacks competence might create a situation where an accident could happen.

As mentioned previously, in section 5.1.1, the tool presents results both on a holistic and a detailed level since different professionals might have different aims with a safety performance evaluation. For instance, the top management often wants an overview and might therefore only be interested in the total safety performance status, displayed at *LEVEL 1*. Safety professionals, on the other hand, might want to identify areas that need to be improved and will therefore be interested in the results displayed at *LEVEL 2* and *LEVEL 3* as well. Furthermore, raw data from the questionnaires are presented at *LEVEL 3* to enable more detailed evaluations, if needed. In order to get an accurate opinion about the safety performance it is important to not only focus on the mean results from *LEVEL 1* but also consider the results from *LEVEL 2* and *LEVEL 3*. All the three areas in the safety model were considered equally important for the safety performance. Therefore, in order to improve the safety performance one strategy could be to first consider improving the weakest links, found at *LEVEL 3*.

As previously stated, the proposed safety model does not include all aspects that affect safety in an organization. Therefore, to only compare the results from the safety performance evaluations between different organizations is not equal to a comparison in total safety. As mentioned before, the tool is mainly intended as a self-evaluating tool to be used in the organization's own safety work. Nevertheless, to compare results from a safety performance evaluation between organizations or within an organization can be a useful way to gain knowledge of successful strategies and actions that lead to improved safety performance.

7.4 Reliability

Results from the Cronbach's coefficient alpha test showed that for most of the aspects, in the safety culture and working environment questionnaires, the internal consistencies were high. This indicates that the questions within one aspect refer to the same aspect. However, for one aspect of safety culture, *Flexibility*, a Cronbach's coefficient alpha value was negative. This could indicate that the questions in this aspect do not all refer to *Flexibility*. However, the same questions were used for *Flexibility* in Ek (2006), where a Cronbach's coefficient alpha test was conducted and received values that ranged from 0.61 to 0.69. Cronbach's coefficient alpha test was not generated for the safety activity questionnaire since only answers from two participants were received.

7.5 Validity

More studies are required in order to validate the safety model since the pilot study only included one site and 20 participants. Even though the number of questions is large they do not include all aspects that refer to the safety performance. However, the questions are thought to highlight or identify some of the major safety aspects found in the literature. In this thesis, safety culture,

working environment and safety activities were assumed to be equally important for the total safety performance. This assumption might not be accurate. It is likely that the three areas affect each other and in order to get a more valid safety model it is important to evaluate these relationships. An attempt was made to illustrate the relationship between attitudes (safety culture and working environment) and activities (safety activities) but no conclusion could be drawn from this.

8 Conclusions

The proposed concept, including a safety model, methodology and tool, presents a relatively fast and easy way to evaluate an organization's safety performance. Moreover, the concept can be used as a tool for risk identification and be a part of an SMS by providing assistance in the monitoring and revision of safety work. Thereby, it could ease safety-related strategic planning and decision-making and thus facilitate continuous improvements and enable more sustainable and enlightened decisions.

8.1 Further research

Further research could include

- Further interviews to asses if questions are answered as intended.
- Rewrite some questions to further identify latent conditions.
- A usability study of the computer-based tool to evaluate if results are presented in an appropriate way, if there are requests not included in the tool, and if the interface is feasible.
- Examine how and to what extent the three areas of the safety model; safety culture, working environment and safety activities affect each other.
- Examine the relationship between outcome indicators (e.g. accident rates) and the results from an evaluation using the tool.
- Examine the relationship between the results from a safety performance evaluation using the proposed concept and the total funds spent on safety activities.
- Life cycle perspective

  The original aim of the thesis was to develop a concept that could assess a product's impact on safety in a life cycle perspective. Even though the concept was not developed with the life cycle perspective in mind it is still possible to perform such an analysis using the developed concept. The main difference is that the perspective has to be wider and include all the organizations involved in a product's life cycle ("from the cradle to the grave"). However, how to allocate a product's safety impact has not been examined in the thesis. Furthermore, the developed concept presents no solution on how to assess the impact on safety for the consumer phase of a product. Neither is the concept optimally designed to assess issues in the disposal phase. A safety performance evaluation in a life cycle perspective could be a part of an analysis that aims at choosing the safest life cycle options for a product.

- Implement additional aspects in pursue of a concept that can evaluate total safety, such as the hazard potential, location and technical design etc.

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Appendix

I. Questionnaire package: Safety culture and Working environment

Nedan följer ett antal frågor rörande säkerhet och arbetsmiljö på din arbetsplats.

Svaret kommer att behandlas helt konfidentiellt och det kommer inte att framgå hur enskilda personer har svarat. Svara så ärligt som möjligt och kryssa i en ruta per fråga om inget annat anges!

För att resultatet från denna undersökning ska bli så bra som möjligt ber vi er att inte diskutera undersökningen med varandra innan samtliga har svarat.

I.I. Utvärdering säkerhetskultur

Arbetssituation

1. *Tycker du att du har fått tillräcklig utbildning/träning för att kunna utföra ditt arbete på ett säkert sätt?*
2. *Har du tillgång till den utrustning som behövs för att utföra ditt arbete på ett säkert sätt?*
3. *Tycker du att du har fått tillräcklig träning i att använda maskiner i arbetet?*
4. *Hur tycker du generellt att statusen är på de maskiner du använder i arbetet?*
5. *Känner du att du kan påverka din egen arbetssituation?*
6. *Har det klargjorts vem som ska göra vad på arbetet?*
7. *Uppstår det osäkerheter på arbetet på grund av att olika språk används?*
8. *Hur ofta hamnar du i en situation då det är oklart vad du ska göra?*
9. *Anser du att bemanningen är tillräcklig för att utföra arbetet på ett säkert sätt?*

Flexibilitet

10. *När det uppstår problem är det den person med lämpligast kunskap som får lösa det?*
11. *Är det accepterat att komma med förslag på förändringar inom någon annans ansvarsområde?*
12. *Om en uppgift i nära anknytning till din egen inte har blivit utförd, berättar du det för den personen som skulle ha gjort den?*
13. *Om en uppgift i nära anknytning till din egen inte har blivit utförd, gör du den själv?*
14. *Anser du att anställda uppmuntras till att komma med förslag för förbättringar rörande arbetet?*

Kommunikation i arbetet

15. *Får du tillräcklig information för att utföra ditt arbete på ett säkert sätt?*
16. *Får du den information du behöver i arbetet i rätt tid?*
17. *Får du tydliga instruktioner från din närmaste chef?*
18. *Anser du att du har fått tillräcklig träning i hur kommunikation ska fungera i ett nödläge?*

19. *Hur anser du att kommunikationen mellan olika grupper på arbetet fungerar? (Är det enkelt att prata med andra gruppmedlemmar rörande arbetet?)*

20. *Hur fungerar kommunikationsfunktioner vid skiftbyte? (t.ex. informationsutbyte vid överlämning)*

Rapportering

21. *Är du nöjd med hur du blir informerad om säkerhetsaspekter som rör dig?*

22. *Hur mycket information får du rörande tillbud och olyckor som händer på arbetsplatsen?*

23. *Anser du att tillräcklig information inhämtas för att avgöra om maskiner och teknisk utrustning fungerar?*

24. *Anser du att tillräcklig information inhämtas för att avgöra om arbetsrutiner fungerar?*

25. *Anser du att tillräcklig information inhämtas för att avgöra om säkerhets- och brandbekämpningsutrustning fungerar?*

26. *Upplever du att du kan utrycka dig fritt rörande säkerheten på arbetsplatsen?*

27. *Om du råkar skada utrustning som används i arbetet, anmäler du det då?*

28. *Vilken reaktion får du om du rapporterar något rörande utrustningen som används i arbetet?*

(Välj alla lämpliga alternativ)

☐ tas på allvar ☐ får ett bra gensvar ☐ blir belönad

☐ avslås ☐ får ett dåligt gensvar ☐ blir tackad

☐ de struntar i det ☐ blir straffad

☐ annat (skriv vad här under)

29. *Vilken reaktion får du ifall du skulle rapportera någonting negativt om säkerheten på arbetsplatsen?*

(Välj alla lämpliga alternativ)

☐ tas på allvar ☐ får ett bra gensvar ☐ blir belönad

☐ avslås ☐ får ett dåligt gensvar ☐ blir tackad

☐ de struntar i det ☐ blir straffad

☐ annat (skriv vad här under)

30. *Av vilken anledning tror du att anställda skulle dra sig för att rapportera skador på utrustning som används i arbetet?*

(Välj alla lämpliga alternativ)

☐ kan inte rapportera anonymt ☐ rädsla ☐ osäker på hur man rapporterar

☐ tidsbrist ☐ det leder inte till förbättringar

☐ annat (skriv vad här bredvid)

☐ okänd anledning

31. Finns det rutiner för att rapportera säkerhetsaspekter anonymt?

☐ ja ☐ nej ☐ vet ej

32. Om du är med om en händelse som kunnat leda till en olycka, rapporterar du detta?

33. Tycker du att ledningen lyssnar till anställdas åsikter rörande säkerhet?

34. Om du råkar skada dig på arbetet, rapporterar du det då?

Rättvisa

35. Tycker du att det är accepterat att ibland göra misstag på jobbet?

36. Upplever du att du och dina medarbetare blir rättvist behandlade när något fel uppstår i arbetet?

37. Upplever du att anställda är oroliga för att anklagas för misstag?

38. Avstår du från att ta initiativ i ditt arbete på grund av rädslan för vad som ska hända om det misslyckas?

39. Tycker du att det har tydliggjorts var gränsen går för acceptabelt och oacceptabelt beteende på arbetet?

40. Får de som utför sitt arbete på säkert sätt uppskattning för detta?

41. Får de som inte utför sitt arbete på ett säkert sätt tillsägningar angående detta?

42. Upplever du att du och dina kollegor får uppskattning för uppmärksammande av brister i säkerhet?

43. Upplever du att det eftersöks en syndabock då någonting går fel?

Lärande

44. Upplever du att operatörer/medarbetare själva aktivt söker efter brister i säkerheten?

45. Upplever du att du uppmuntras att påpeka säkerhetsbrister i ditt dagliga arbete?

46. Diskuterar du händelser som skulle kunna ha lett till att olyckor skett?

47. Om du upptäcker brister i ditt arbete som skulle påverka säkerheten, tror du att förbättringar kommer att ske?

48. Om du rapporterar något säkerhetsrelaterat, upplever du att åtgärder sker inom rimlig tid?

49. Upplever du att ansvariga chefer agerar utifrån information om säkerhetsbrister?

50. Om åtgärder sker, upplever du att uppföljning sker i syfte att fastställa om förbättringar verkligen skett?

51. När sker, i regel, förbättringar i arbete och säkerhet?

☐ Alltid innan något negativt sker

☐ Oftast innan något negativ sker

☐ Före och efter att något negativt sker

☐ Oftast efter att något negativt skett

☐ Alltid efter att något negativt har skett

Säkerhetsrelaterade beteenden

52. Upplever du att det generellt diskuteras hur arbetet kan förbättras för att ge en ökad säkerhet?

53. Uppmuntrar dina chefer till att man följer regler och rutiner?

54. Upplever du att dina arbetskamrater uppmuntrar varandra till att jobba säkert?

55. Händer det att onödiga risker tas på er arbetsplats?

56. Upplever du att säkerhetsföreskrifter och rutiner fungerar i verkligheten?

57. Anser du att ditt arbete skulle kunna utföras på ett säkrare sätt om vissa föreskrifter eller regler togs bort?

58. Förekommer det att dina medarbetare pressar dig till att ta genvägar i ditt arbete?

59. Förekommer det att dina chefer pressar dig till att ta genvägar i ditt arbete?

60. Anser du att säkerhetsövningarna är tillräckliga?

61. Anser du att det finns tillräckligt med säkerhetsutrustning?

62. Händer det att du tar genvägar i ditt arbete som kan medföra risker?

63. Hur ofta händer det, på din arbetsplats, att det råder förhållanden som gör att du inte kan följa gällande säkerhetsregler?

Om detta händer, vilken är orsaken?

☐ tidspress

☐ arbetsbelastning

☐ arbetsschema

☐ utrustning

☐ annan avdelning

☐ säkerhetsutrustning

☐ väder

☐ personalbrist

☐ annan orsak

Säkerhetsattityder

64. *Anser du att ledningen verkar för en hög säkerhet på din arbetsplats?*
65. *Anser du att dina chefer verkar för en hög säkerhet på din arbetsplats?*
66. *Anser du att operatörer/tekniker/maskinister arbetar för en hög säkerhet?*
67. *Hur mycket personligt ansvar känner du för säkerhetsarbetet?*
68. *Hur ofta har du varit delaktig i säkerhetsplanering? (ex möten, diskussioner)*
69. *Anser du att det är viktigt att prata om tillbud (en händelse som skulle kunna ha lett till en olycka) i syfte att ta lärdom av dem?*
70. *Anser du att säkerhetsövningar är nödvändiga/viktiga?*
71. *Upplever du att arbeta på ett säkert sätt uppskattas på din arbetsplats?*
72. *Anser du att ledningen intresserar sig för de anställdas välbefinnande?*
73. *Anser du att ledningen uppmuntrar till att arbetet sker på ett säkert sätt?*
74. *Upplever du att ledningen tycker att det är viktigt med utbildning och träning?*
75. *Anser du att dina närmaste chefer tycker säkerhet är en del av det dagliga arbetet?*

Riskperception

76. *Anser du att arbetet på din arbetsplats sker på ett säkert sätt?*
77. *Finns det en risk att du skadar dig på ditt jobb?*
78. *Hur stort förtroende har du till dina chefer rörande säkerhet i arbetet?*
79. *Känner du att du kan påverka säkerheten på din arbetsplats?*
80. *Känner du att det är stora säkerhetsmarginaler i ditt arbete?*

I.II. Utvärdering arbetsmiljö

Psykosocial miljö

1. *Trivs du med ditt jobb?*
2. *Kommer du bra överens med dina arbetskamrater?*
3. *Hur ofta känner du dig stressad under en normal arbetsvecka?*
4. *Upplever du att du får det stöd som du behöver i ditt arbete från din närmaste chef?*
5. *Upplever du att du får det stöd som du behöver i ditt arbete från dina medarbetare?*
6. *Känner du att ditt arbete är uppskattat?*
7. *Hur arbetar du?*

Treskift ☐

Tvåskift ☐

Normal arbetstid ☐

24-timmar-pass ☐

8. Arbetar du natt?

Ja, enbart ☐ Ja, ibland ☐ Nej ☐

9. Hur ofta arbetar du helt isolerat från dina arbetskamrater?

10. Hur ofta är du trött på jobbet?

Olyckor

11. Hur stor bedömer du att sannolikheten är att skada sig av maskindelar/arbetsstycken/föremål i farlig rörelse?

12. Hur stor bedömer du att sannolikheten är att skada sig av sprut, splitter eller flygande föremål?

13. Hur stor bedömer du att sannolikheten är att träffas av fallande föremål?

14. Hur stor bedömer du att sannolikheten är att du överbelastar någon kroppsdel genom häftiga och ansträngande rörelser?

15. Hur stor bedömer du att sannolikheten är att skada sig på verktyg, redskap, arbetsmaterial mm?

16. Hur stor bedömer du att sannolikheten är att skada sig genom dålig ordning, att det är trångt eller mycket material eller verktyg etc. i vägen?

17. Hur stor bedömer du att sannolikheten är att någon skadas genom truckkörning, bilkörning på arbetsplatsen eller i arbetet?

18. Hur stor bedömer du att sannolikheten är att falla omkull och skadas, ex halka eller att underlaget glider undan?

19. Hur stor bedömer du att sannolikheten är att någon skadas genom arbete på hög höjd?

20. Hur stor bedömer du att sannolikheten är att skada uppstår genom att någon utsätts för kemiska ämnen?

21. Hur stor bedömer du att sannolikheten är för bränn- och frysningsskador?

22. Hur stor bedömer du att sannolikheten är för direktkontakt med farlig elström?

23. Hur stor bedömer du att sannolikheten är för brand eller explosion?

24. Hur stor bedömer du att sannolikheten är för att skadas av våldsamma människor?

25. Hur stor bedömer du att sannolikheten är för att skadas av farliga djur?

Buller

26. Hur upplever du bullernivån på din arbetsplats?

Fysisk arbetsbelastning

27. Hur upplever du din normala arbetsställning?

28. I vilken utsträckning sker det tunga lyft utan maskinhjälp?

29. *Hur varierande är dina arbetsuppgifter?*

Övrig fysisk miljö

30. *Hur upplever du belysningen på arbetsplatsen generellt?*

31. *Hur upplever du det fysiska klimatet på arbetet generellt?*

32. *Hur upplever du den allmänna ordningen på arbetsplatsen?*

33. *Anser du att det finns tillräckligt med personlig skyddsutrustning?*

34. *Hur bedömer du arbetsutrymmenas storlek?*

35. *Anser du att gränssnitten i maskiner, datorer och annan utrustning är användarvänligt?*

Vibrationer

36. *Hur upplever du exponeringen av vibrationer?*

Handlingsfrihet

37. *Till vilken grad bestämmer maskinerna/processen din arbetstakt?*

38. *Hur lång tid kan arbetsplatsen lämnas utan avbytare?*

Kemiska hälsorisker

39. *I vilken utsträckning hanterar du farliga ämnen? (hudgenomträngande ämnen, allergiframkallande ämnen, cancerframkallande, mutagen eller reproduktionsstörande ämnen, bakterier, virus)*

Övriga kommentarer:

II. Questionnaire package: Safety activity

II.I. Utvärdering säkerhetshantering

Om någon fråga inte är relevant för er verksamhet, avstå då från att svara på den. (Exempelvis ska ni inte svara på detaljerade frågor om säkerhetsledningssystem om ni inte har ett sådant utan hoppa då över dessa frågor)

Policy och generell säkerhetsledning

Säkerhetspolicy

Vilken ambitionsnivå återges i säkerhetspolicyn

3= Leva upp till ställda lagkrav ☐

4= Ligga över ställda lagkrav ☐

5= Vara ledande/föredöme inom branschen ☐

1. *Hur ofta sker information till anställda angående säkerhetspolicyn?*

2. *Hur ofta uppdateras säkerhetspolicyn?*

3. *Hur mycket resurser finns tillgängliga för att uppnå en hög nivå av säkerhet*

Säkerhetsledningssystem

Till vilken grad stämmer följande påstående in på ert **säkerhetsledningssystem** (gäller även ett informellt säkerhetsledningssystem)?

Skala:

1= Stämmer inte alls

2= Stämmer lite

3= Stämmer måttligt

4= Stämmer väl

5= Stämmer helt

4. *Det fungerar mycket väl i praktiken*
5. *Det resulterar i ständiga förbättringar av säkerhetsarbetet*
6. *Det är väl koordinerat med andra ledningssystem, t.ex. kvalitet och miljö*
7. *Det är väl i linje med företagets säkerhetspolicy*
8. *Det sker väl genomförda kontinuerliga revisioner och förbättringar av säkerhetsledningssystemet*

Personal

Till vilken grad stämmer följande påstående in på företagets **personalhantering**

9. *Det sker välfungerande och regelbundna tester/kontroller av personalens kapacitet och lämplighet (ex drogtest)*
10. *Personal kan alltid kopplas bort (frivilligt eller ofrivilligt) från sitt arbete om de är tillfälligt olämpliga för ett arbete, utan att det blir negativa påföljder för dem*
11. *Det finns mycket god expertis inom säkerhetsområdet*
12. *Det sker mycket väl fungerande säkerhetskontroller av nyanställda*
13. *Det sker en mycket väl fungerande oberoende kontroll av att anställda har rätt utbildning och träning? (innefattar såväl yrkesskicklighet som säkerhetskunnande)*

Arbetsmiljö

Till vilken grad stämmer följande påstående in på **mätningar/kontroll av exponeringar/status** på arbetsplatsen

Det sker tillräckligt regelbundna mätningar av mycket god kvalitet rörande:

14. *Buller*
15. *Kemiska/Biologiska ämnen*
16. *Vibrationer*
17. *Tunga lyft*

18. *Belysning/ljusförhållande*
19. *Arbetsställningar*
20. *Klimatet (temperatur, ventilation etc.)*
21. *Psykosociala miljön (personalens välbefinnande)*
22. *Det sker tillräckligt regelbundna och mycket väl genomförda säkerhetsronder*
23. *Det sker tillräckligt regelbundna och mycket väl genomförda kontroller av att personlig skyddsutrustning (PPE) fungerar och finns lättåtkomlig?*

Administrativa rutiner

Riskidentifiering och riskbedömning

Till vilken grad stämmer följande påstående in på ert arbete med **riskanalyser**

24. *Det finns mycket tydliga kriterier för när riskanalyser ska genomföras*
25. *Det finns mycket tydliga krav på utformning av riskanalyserna*
26. *Erfarenheter från tidigare incidenter/tillbud tas med, i mycket noga beaktande, i analyserna*
27. *Det finns mycket klara roller och ansvarsfördelning för involverade i utförandet av analyserna*
28. *Det finns fastställda och mycket väl fungerande krav på dokumentation*
29. *Åtgärdsförslag baseras alltid på resultat utifrån analyserna*
30. *Det finns mycket väl fungerande verktyg för att beräkna konsekvenser för valda scenarion*
31. *Det finns mycket väl fungerande verktyg för att beräkna sannolikheter*
32. *Det finns en mycket väldefinierad fastställd gräns för acceptabel risk*
33. *Det finns tillräcklig kompetens för att genomföra riskanalyser och riskbedömningar*
34. *Det finns tillräckliga ekonomiska resurser för att genomföra riskanalyser och riskbedömningar*
35. *Det sker kontinuerlig och en mycket väl fungerande uppdatering av riskanalyserna*
36. *Det sker en mycket väl fungerande återkoppling av analyserna*

I vilken omfattning innefattas följande områden i riskanalyserna

Skala:

1= Ingen omfattning

2= Liten omfattning

3= Måttlig omfattning

4= Stor omfattning

5=Mycket stor omfattning

37. *Säkerhet*
38. *Hälsa*
39. *Miljö*
40. *Egendom*
41. *Ekonomi*
42. *Mänskliga faktorer*
43. *Tekniska faktorer*
44. *Organisatoriska faktorer (ledarskap, arbetets fördelning i tid och rum, ensamarbete, utvecklingsmöjligheter)*
45. *Särskilda driftförhållanden (uppstart och ökad produktion etc.)*
46. *Dominoeffekter (orsaksförlopp; liten händelse leder till en större)*

Allmänna rutiner

Till vilken grad stämmer följande påstående in på **rutiner i företaget**

Skala:

1= Stämmer inte alls

2= Stämmer lite

3= Stämmer måttligt

4= Stämmer väl

5= Stämmer helt

47. *Det finns mycket väl fungerande rutiner som säkerställer att samtliga har nödvändiga arbetstillstånd (ex hett arbete, arbete i trånga/slutna utrymmen och andra farliga arbeten)*
48. *Vilka av följande delar innefattas i era rutiner (kryssa i alla relevanta)*

Uppstart ☐

Normal drift ☐

Nedstängning ☐

Nödsituationer ☐

Säkerhet (rörande tillträdesförbud) ☐

Transport ☐

Allmän ordning ☐

49. Rutiner är väldigt lättillgängliga för alla berörda anställda.

Hantering av förändring

Till vilken grad stämmer följande påstående in när det gäller **hantering av förändringar**

Skala:

1= Stämmer inte alls

2= Stämmer lite

3= Stämmer måttligt

4= Stämmer väl

5= Stämmer helt

50. Det finns en mycket tydlig definition av vad som menas med förändringar i verksamheten och hur dessa ska hanteras

51. Definitionen innefattar:

(kryssa i alla relevanta)

Förändringar i utrustning ☐

Förändringar i teknologi eller mjukvara ☐

Förändringar i bemanningsstyrka (downsizing etc.) ☐

Administrativa förändringar ☐

Arbetsorganisatoriska förändringar ☐

52. Det sker alltid ett godkännande av ansvarig person

53. Riskanalyser genomförs alltid väl

54. Klara uppdelningar av nya roller och ansvar sker alltid

55. Temporära förändringar innefattas alltid

56. Det sker alltid dokumentation av information (teknik, instruktioner och rutiner) före en förändring genomförs

57. Det sker alltid en omfattande utbildning/information av anställda före en förändring

Inhyrd arbetskraft

Till vilken grad stämmer följande påstående in när det gäller **inhyrd personal/entreprenörer**

Skala:

1= Stämmer inte alls

2= Stämmer lite

3= Stämmer måttligt

4= Stämmer väl

5= Stämmer helt

58. *Det sker mycket väl genomförda kontroller av yrkeskompetens*
59. *Det sker mycket väl genomförda kontroller av utrustning*
60. *Det sker mycket väl genomförda kontroller av tidigare säkerhetsprestationer*
61. *Säkerhetsaspekter innefattas alltid i kontrakten*
62. *Inhyrd personal/ entreprenörer följer alltid uppsatta säkerhetsregler/säkerhetsnormer*
63. *Inhyrd personal/ entreprenörer som gravt missköter sig blir alltid avstängda från arbetsplasten*
64. *Det sker mycket väl genomförda återkommande inspektioner i syfte att utvärdera inhyrd personal/entreprenör*
65. *Inhyrd personal/entreprenör behandlas alltid på samma sätt som anställd personal vad beträffande säkerhet*
66. *Det finns ett mycket väl fungerande system för att delge inhyrd personal/entreprenörer nödvändig information*

Produktsäkerhet

Till vilken grad stämmer följande påstående in rörande **produkthantering i företaget?**

Skala:

1= Stämmer inte alls

2= Stämmer lite

3= Stämmer måttligt

4= Stämmer väl

5= Stämmer helt

67. *Det finns mycket väl utarbetade rutiner för identifiering av relevanta risker förknippade med företagets produkter*
68. *Relevant information om riskerna kommuniceras alltid till:*
69. *Distributörer*
70. *Kunder*
71. *Slutanvändare (Konsumenter)*
72. *Transportörer*

73. *De som handhar återvinning*

74. *Det finns mycket utförliga Säkerhetsdatablad (MSDS) innefattande hantering (även transport) samt användning för samtliga farliga ämnen/produkter*

Tekniska aspekter

Farliga ämnen

Till vilken grad stämmer följande påstående in på ert företags **hantering av farliga ämnen?**

Skala:

1= Stämmer inte alls

2= Stämmer lite

3= Stämmer måttligt

4= Stämmer väl

5= Stämmer helt

75. *Det finns mycket väl fungerande förvaringsplatser för farliga ämnen (ex tillräckligt dimensionerade, rätt material, etc.)*

76. *Ämnen som inte är kompatibla med varandra hålls alltid separerade i förvaringsplatserna*

77. *En minimering av mängden farliga ämnen per area och per volym eftersträvas och efterlevs alltid*

78. *Det finns mycket väl fungerande kärl som tar hand om eventuellt spill*

79. *Det vidtas alltid nödvändiga brandförebyggande åtgärder där farliga ämnen förvaras*

80. *Det är alltid endast behörig personal som har tillgång till farliga ämnen*

81. *Det finns alltid acceptabla etiketter på samtliga behållare, tankar, burkar etc.*

82. *Förvaringsplasterna är alltid placerade så att om ett eventuellt läckage sker kan det inte ske ett okontrollerat olycksförlopp*

Underhåll

Till vilken grad stämmer följande påstående in på ert företags **underhållsarbete**

Skala:

1= Stämmer inte alls

2= Stämmer lite

3= Stämmer måttligt

4= Stämmer väl

5= Stämmer helt

83. *Det finns ett mycket välfungerande förebyggande underhållsarbete med regelbundna mätningar av status på utrustning*
84. *Endast välrenommerade leverantörer av utrustning används*
85. *Endast välrenommerade montörer/entreprenörer används vid installation*
86. *Det finns ett mycket väl fungerande system för att testa funktionaliteten av befintliga säkerhetssystem (kritiska alarm, överfyllnadsskydd, vatten och elförsörjning vid nödsituationer etc.)*
87. *Det finns mycket väl fungerande rutiner för dokumentation och uppföljning av underhåll*

Extern samverkan

Till vilken grad stämmer följande påstående in på ert företags **samverkan med externa parter**

Skala:

1= Stämmer inte alls

2= Stämmer lite

3= Stämmer måttligt

4= Stämmer väl

5= Stämmer helt

88. *Det finns mycket väl etablerade rutiner för samarbete och kommunikation med myndigheter vid normal drift*
89. *Det finns mycket väl etablerade rutiner för samarbete och kommunikation med myndigheter i händelse av olycka*
90. *Det finns mycket väl etablerade rutiner för samarbete och kommunikation med allmänheten vid normal drift*

91. *Det finns mycket väl etablerade rutiner för samarbete och kommunikation med allmänheten i händelse av olycka*

92. *Det finns mycket väl etablerade rutiner för samarbete och kommunikation med media vid normal drift*

93. *Det finns mycket väl etablerade rutiner för samarbete och kommunikation med media i händelse av olycka*

94. *Det finns väl etablerade rutiner för att dela information rörande säkerhet med andra företag (ex, olyckor och tillbud)*

Krisberedskap

Till vilken grad stämmer följande påstående in på ert företags **krisberedskap**

Skala:

1= Stämmer inte alls

2= Stämmer lite

3= Stämmer måttligt

4= Stämmer väl

5= Stämmer helt

95. *Det finns en mycket väl fungerande krisberedskapsplan som ständigt uppdateras (innefattande både små och sannolika olyckor samt stora och osannolika olyckor)*

96. *Det finns ett mycket välfungerande krisledningscentral i händelse av en kris*

97. *Det finns alltid funktionsduglig kommunikationsutrustning (även i händelse av olycka)*

98. *Det finns alltid tillgång till nödvändiga planer och ritningar över fabriken (även i händelse av olycka)*

99. *Det finns mycket kompletta telefonlistor och personallistor att tillgå (även i händelse av olycka)*

Olycks- och tillbudsrapportering och utredningar

Till vilken grad stämmer följande påstående in på ert företags **olycks- och tillbudsrapporteringssystem**

Skala

1= Stämmer inte alls

2= Stämmer lite

3= Stämmer måttligt

4= Stämmer väl

5= Stämmer helt

100. Det finns mycket klara definitioner av olyckor, tillbud och nära missar.

101. Det dokumenteras mycket väl

102. Det finns mycket klara ansvarsfördelningar för koordinering och underhåll av olycks- och tillbudsrapporteringssystemet

103. Entreprenörer och transporter inkluderas väl i systemet

104. Det finns mycket väl fungerande rutiner för hur rapporteringen ska gå till

105. Det finns mycket väl fungerande rutiner för återkoppling och uppföljning av rapporteringen

Till vilken grad stämmer följande påstående in på ert företags arbete med **säkerhetsutredningar** (inkluderar även uppföljning av olycks- och tillbudsrapportering)
Skala:

1= Stämmer inte alls

2= Stämmer lite

3= Stämmer måttligt

4= Stämmer väl

5= Stämmer helt

106. Det finns väldigt klara roller och ansvarsområden för de som deltar i utredningar (lämpliga experter och anställda involveras)

107. Det finns väldigt klara kriterier för vilka incidenter som ska utredas

108. Det finns väldigt klara direktiv för när en utredningsgrupp ska tillsättas

109. Det finns mycket väl definierade kriterier för när utomstående resurser ska kallas in

110. Det finns mycket väl fungerande rutiner för hur utredningar ska ske (insamling av bevismaterial från vittnen, dokumentation, tekniska utredningar etc.)

111. Det finns mycket väl fungerande rutiner för hur analys av bevis ska ske

112. Det finns mycket väl fungerande rutiner för identifiering av bakomliggande olycksorsaker

113. Det finns mycket väl fungerande rutiner för att ta fram åtgärdsförslag

114. Det finns mycket väl fungerande rutiner för återkoppling och uppföljning av olycksutredningar

Forskning och utveckling

Till vilken grad stämmer följande påstående in beträffande forskning och utveckling

Skala:

1= Stämmer inte alls

2= Stämmer lite

3= Stämmer måttligt

4= Stämmer väl

5= Stämmer helt

115. Riskanalyser utgör alltid en viktig del av utvecklingsarbetet

116. Det görs alltid mycket väl genomförda riskanalyser för samtliga laboratorieexperiment

117. Det finns mycket väl fungerande rutiner för att säkerhetsställa övergången från laboratoriestadium, pilotstadium och fullskalle stadium.

118. Lärdomar från tidigare incidenter tas alltid med i utveckling och forskning.

119. Det genomförs mycket utförliga jämförelser med företag i branschen med syfte att öka säkerheten (benchmarking)

Design

Till vilken grad stämmer följande påstående in när det gäller **design eller utformning av verksamheten**

Skala:

1= Stämmer inte alls

2= Stämmer lite

3= Stämmer måttligt

4= Stämmer väl

5= Stämmer helt

120. Det finns mycket väl fungerande rutiner med syfte att välja så säker teknologi som möjligt

121. System designas alltid för att minimera konsekvenserna av mänskligt felhavande (förlåtande system)

122. System designas alltid för att kunna stå väl emot värsta tänkbara olycka

123. System designas alltid för att kunna ta väl hand om eventuella oavsiktliga utsläpp

124. Systemen designas alltid med väl tilltagna säkerhetsavstånd (för att skydda anställda och tredje part från konsekvenser)

125. System designas alltid med så användarvänliga gränssnitt som möjligt

126. Anställdas åsikter tas alltid i stort beaktande i design- och utvecklingsfasen

127. Farliga kemikalier undviks alltid eller ersätts med mindre farliga kemikalier

128. Mängden farliga ämnen, både i processer och i lager, minimeras alltid

129. Process betingelser/förhållanden görs alltid så milda/ofarliga som möjligt (ex lägre tryck och temp)

130. Beslut i designstadiet tar alltid hänsyn till påverkan på miljö/hälsa/säkerhet sett ur ett livscykelperspektiv (från ”vaggan” till ”graven”)

III. Questionnaire package; manager

Allmän säkerhetshantering

1.

a) Vilken säkerhetsambitionsnivå har företaget?

3= Leva upp till ställda lagkrav

4= Ligga över ställda lagkrav

5= Vara ledande/föredöme inom branschen

b) Vad tror du att de anställda, i genomsnitt, svarade på denna fråga?

3= Leva upp till ställda lagkrav

4= Ligga över ställda lagkrav

5= Vara ledande/föredöme inom branschen

c) Vad tycker du är en acceptabel nivå?

3= Leva upp till ställda lagkrav

4= Ligga över ställda lagkrav

5= Vara ledande/föredöme inom branschen

2.

a) Hur mycket resurser finns tillgängliga för att uppnå en hög nivå av säkerhet

b) Vad tror du att de anställda, i genomsnitt, svarade på denna fråga?

c) Vad tycker du är en acceptabel nivå?

Säkerhetskultur

Arbetssituation
3

a) Tycker du att anställda har fått tillräcklig utbildning/träning för att kunna utföra sitt arbete på ett säkert sätt?

b) Vad tror du att de anställda, i genomsnitt, svarade på denna fråga?

c) Vad tycker du är en acceptabel nivå?

Flexibilitet
4

a) Anser du att anställda uppmuntras till att komma med förslag för förbättringar rörande arbetet?

b) Vad tror du att de anställda, i genomsnitt, svarade på denna fråga?

c) Vad tycker du är en acceptabel nivå?

Kommunikation
5

a) Anser du att anställda får tillräcklig information för att utföra sitt arbete på ett säkert sätt?

b) Vad tror du att de anställda, i genomsnitt, svarade på denna fråga?

c) Vad tycker du är en acceptabel nivå?

Rapportering
6

a) Upplever du att anställda kan utrycka dig fritt rörande säkerheten på arbetsplatsen?

b) Vad tror du att de anställda, i genomsnitt, svarade på denna fråga?

c) Vad tycker du är en acceptabel nivå?

Rättvisa
7

a) Upplever du att anställda blir rättvist behandlade när något fel uppstår i arbetet?

b) Vad tror du att de anställda, i genomsnitt, svarade på denna fråga?

c) Vad tycker du är en acceptabel nivå?

Lärande
8

a) Upplever du att anställda uppmuntras att påpeka säkerhetsbrister i sitt dagliga arbete?

b) Vad tror du att de anställda, i genomsnitt, svarade på denna fråga?

c) Vad tycker du är en acceptabel nivå?

Säkerhetsrelaterande beteenden

9

a) Hur ofta händer det, på er arbetsplats, att det råder förhållanden som gör att anställda inte kan följa gällande säkerhetsregler?

b) Vad tror du att de anställda, i genomsnitt, svarade på denna fråga?

c) Vad tycker du är en acceptabel nivå?

Säkerhetsattityder

10

a) Upplever du att arbeta på ett säkert sätt uppskattas på din arbetsplats?

b) Vad tror du att de anställda, i genomsnitt, svarade på denna fråga?

c) Vad tycker du är en acceptabel nivå?

Riskperception

11

a) Känner du att det är stora säkerhetsmarginaler i ert arbete?

b) Vad tror du att de anställda, i genomsnitt, svarade på denna fråga?

c) Vad tycker du är en acceptabel nivå?

Ledarskap

12

a) Hur stort förtroende tror du att anställda har till sina chefer rörande säkerhet i arbetet?

b) Vad tror du att de anställda, i genomsnitt, svarade på denna fråga?

c) Vad tycker du är en acceptabel nivå?

Egna kommentarer

Tack för medverkan!

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