TNO Work And Employment

TNO-report

15747/018.17488/ste/stm

A report on developing a checklist to assess company plans focused on improving safety awareness, safe behaviour and safety culture Final report

Date   24 December 2003

Authors   N. Steijger
                A. Starren
                M. Keus
                J. Gort
                M. Vervoort

Samenvatting

Dit rapport beschrijft de ontwikkeling van een checklist om verbeterplannen te kunnen beoordelen die ingediend worden bij het Ministerie van Sociale Zaken en Werkgelegenheid. Het indienen van verbeterplannen door bedrijven is een onderdeel van het programma Versterking Arbeidsveiligheid van het Ministerie dat tot doel heeft een reductie in het aantal arbeidsongevallen te bewerkstelligen door maatregelen te nemen op het gebied van veiligheidsbewustzijn, veilig gedrag en verbetering van de veiligheidscultuur. Deze samenvatting geeft een korte beschrijving van de opbouw van het rapport en van de manier waarop het rapport te gebruiken is. Tot slot wordt de totstandkoming van de checklisten toegelicht en de daarbij gemaakte keuzes.

De opbouw van het rapport en de checklist

Binnen het programma Versterking Arbeidsveiligheid heeft het Ministerie van Sociale Zaken en Werkgelegenheid de doelstelling geformuleerd het aantal arbeidsongevallen in Nederland te reduceren met 15 tot 20 procent. In dit programma is gekozen voor de strategie van de aanpak van de mensgebonden aspecten van veiligheid door de bedrijven. Om deel te nemen aan het programma worden bedrijven uitgenodigd met behulp van een verbeterplan aan te geven hoe zij denken het aantal ongevallen te kunnen reduceren met maatregelen die zich richten op deze mensgebonden van veiligheid. Om deze plannen op uniforme wijze te kunnen beoordelen was het nodig een beoordelingskader te creëren. Het Ministerie van Sociale Zaken en Werkgelegenheid heeft daartoe TNO Arbeid gevraagd een checklist te ontwikkelen om plannen te kunnen beoordelen die door bedrijven ingediend worden ter versterking van veiligheidsbewustzijn, -gedrag en -cultuur. Dit rapport bevat deze checklist plus de toelichtende informatie in de bijlagen. In de bijlagen wordt een overzicht gegeven van actuele inzichten, theorieën en praktijkervaringen die betrekking hebben op veiligheidsbewustzijn, veilig gedrag en veiligheidscultuur.

De checklist bestaat uit twee delen. Het eerste deel heeft betrekking op een beoordeling van de aanvangssituatie bij bedrijven. Aangezien de aanvangssituatie per bedrijf verschilt, en de plannen betrekking dienen te hebben op de verbetering ervan, is het voor het Ministerie noodzakelijk hierin inzicht te verkrijgen. Checklist Deel 1 is daarom ontworpen om te kunnen gebruiken in de 'pre-assessment' die door de werkgever wordt gedaan. Aan de hand van deze informatie over de startsituatie kan het Ministerie beoordelen of de begincondities (voldoende) optimaal zijn en welke maatregelen oa. deel uitmaken van het definitief op te stellen verbeterplan.
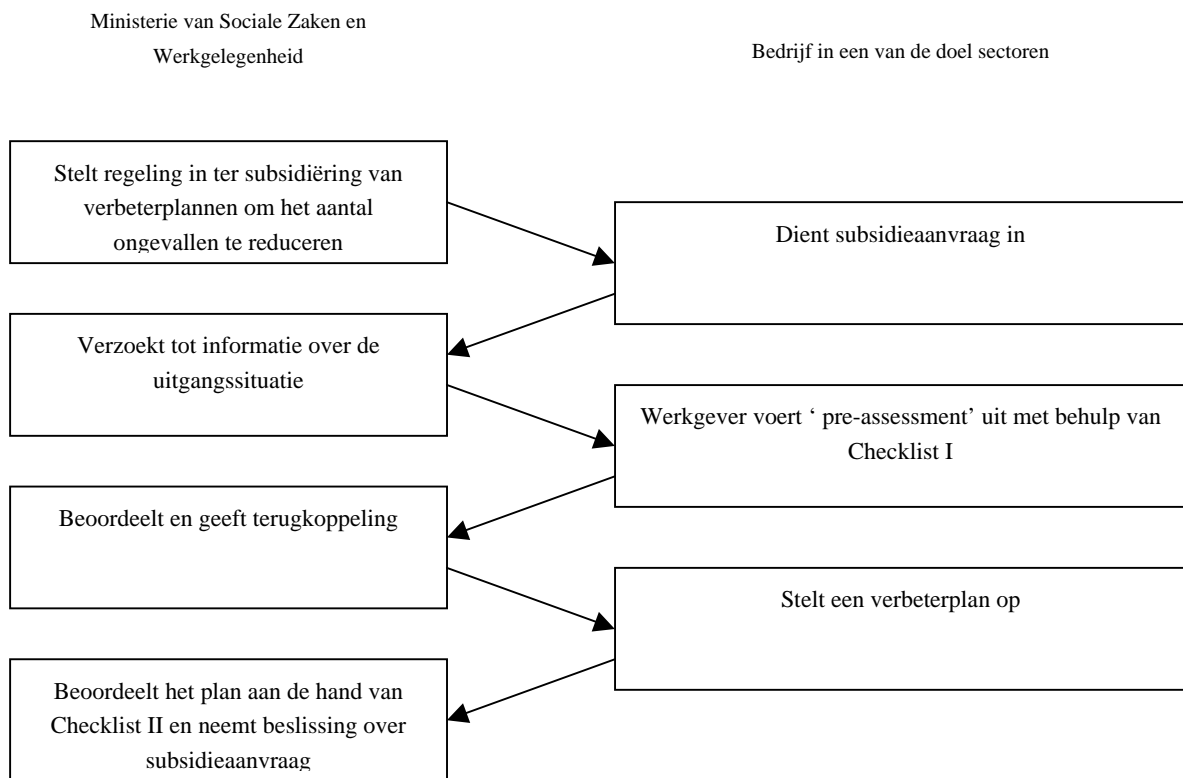
Deel 2 van de checklist is bedoeld om de plannen op uniforme wijze te kunnen laten beoordelen door de medewerkers van het ministerie van Sociale Zaken en Werkgelegenheid. De kern van de checklist bestaat uit de succes- en faalfactoren van in Nederland veel gebruikte veiligheidsmaatregelen (totaal negen) die gericht zijn op de mensgebonden aspecten van veiligheid. In de checklist staat bij elke maatregel een rijtje van aandachtspunten die men in het oog moet houden en juist wel moet doen (do's) en juist niet moet doen (don'ts) teneinde de kans op succes te vergroten bij implementatie van de voorgestelde maatregelen.

Procesverloop

Om het uitvoeren van verbeterplannen te stimuleren, heeft het Ministerie een subsidieregeling ingevoerd. Het subsidietraject begint met de aanvraag van de werkgever. Naar aanleiding van deze subsidieaanvraag zal het bedrijf worden uitgenodigd meer informatie te verstrekken over de omstandigheden en de ambities van het bedrijf. De werkgever dient hiertoe een 'pre-assessment' uit te voeren met checklijst 1. Naar aanleiding van de terugrapportage zal het Ministerie van Sociale Zaken en Werkgelegenheid een oordeel geven en dit met het bedrijf bespreken. Daarna kan door het bedrijf een verbeterplan worden opgesteld waarin maatregelen worden voorgesteld om de beoogde ongevallenreductie te bereiken middels versterking van veiligheidsbewustzijn, -gedrag en -cultuur.

De veiligheidsmaatregelen uit dit verbeterplan worden beoordeeld door de medewerkers van het Ministerie met behulp van checklijst 2. Met dit oordeel wordt het vertrouwen uitgesproken dat de doelstelling op de voorgestelde wijze kan worden gehaald en op basis daarvan het plan subsidiabel is. De figuur hieronder geeft een schematisch overzicht van het procesverloop (zie figuur).

Een schematisch overzicht van het procesverloop.

Ministerie van Sociale Zaken en Werkgelegenheid

Bedrijf in een van de doel sectoren

Stelt regeling in ter subsidiëring van verbeterplannen om het aantal ongevallen te reduceren

Dient subsidieaanvraag in

Verzoekt tot informatie over de uitgangssituatie

Werkgever voert ' pre-assessment' uit met behulp van Checklijst I

Beoordeelt en geeft terugkoppeling

Stelt een verbeterplan op

Beoordeelt het plan aan de hand van Checklist II en neemt beslissing over subsidieaanvraag

Totstandkoming van de checklisten en toelichting op keuzes

TNO Arbeid is het ontwikkelingstraject van de checklist, begonnen met een inventarisatie van veel toegepaste mensgebonden veiligheidsmaatregelen. Dat heeft geleid tot een lijst van negen veel gebruikte maatregelen binnen de adviespraktijk van TNO Arbeid. Van deze maatregelen is beschreven hoe ze werken en wat, op basis van

praktijkervaring, de succes- en faalfactoren zijn. Daarnaast is aanvullend relevante literatuur geïnventariseerd.

De succes- en faalfactoren zijn beschreven in de vorm van aandachtspunten waarmee rekening moet worden gehouden (do's) and zaken die moeten worden vermeden (don'ts). Dit vormde de basis voor de checklist om de succesvolle toepassing van de door bedrijven voorgestelde maatregelen te kunnen beoordelen. In tweede instantie is door de begeleidingscommissie besloten om ook een checklist voor het uitvoeren van een 'pre-assessment' te ontwikkelen. Op die wijze wordt inzicht verkregen in de uitgangssituatie waarop het verbeterplan gebaseerd is en maakt het mogelijk te beoordelen of de meest adequate verbetermaatregelen worden voorgesteld door het bedrijf. De checklist was het primaire doel van dit project en is als zodanig in het hoofdrapport beschreven.

De genoemde veiligheidsmaatregelen uit de checklist zijn voorzien van aanvullende informatie, theoretische achtergronden en praktijkervaringen, en beschreven in de bijlagen. De basisindeling van de bijlagen in hoofdstukken is afgeleid van de drie schaalniveaus die onderscheiden kunnen worden binnen de mensgebonden veiligheidsmaatregelen: individueel-, groeps- en organisatie (-cultureel) niveau. Deze toelichtende bijlagen zijn beschreven in een vorm die te gebruiken is als achtergrondinformatie. In eerste instantie, bedoeld voor medewerkers van het Ministerie van Sociale Zaken en Werkgelegenheid als ondersteuning bij het gebruik van de checklist. Aangezien het Ministerie overweegt deze informatie tevens voor educatieve doeleinden te gebruiken, is rekening gehouden met de mogelijkheid dat deze informatie ook ter beschikking wordt gesteld aan de bedrijven zelf.

Summary

This report describes the process of developing a checklist to asses company plans focused on improving safety awareness, safe behaviour and safety culture. These plans are part of a programme initiated by the Ministry of Social Affairs and Employment aiming at improving the safety performance of companies in target sectors. This improvement should be visible in a reduction of incidents and accidents and has to be established by acting on safety awareness, safe behaviour and safety culture.
A tool for the assessment of the plans had to be developed. This has been the starting point for the development of a checklist by TNO Work and Employment. This summary gives an overview of the development process, the choices which have been made and the way the report and the checklists can be used.

The report and the checklists
In its programme "Versterking Arbeidsveiligheid" the Ministry of Social Affairs and Employment aims at 15 to 20 percent reduction in occupational accidents in the Netherlands. Within the programme the focus is on reaching this target by improving safety awareness, safe behaviour and safety culture. Companies can participate in the programme by proposing plans to reduce accidents in their own situation by acting on the human aspects of safety. Because plans and strategies adopted can differentiate, a uniform method of assessing these plans had to be created. The result is a checklist to assess plans for improvement of safety awareness, safe behaviour and safety culture. The main report contains this checklist. In the appendices a lot of background information - recent insights, theories and best practices - is given about these subjects.

The checklist has been divided into two parts: the pre-assessment and the actual assessment. Different companies will have different starting points depending on their own specific circumstances. For that reason the pre-assessment is designed to get insight in the starting position. This is essential for the measurement of progress in improvement later on. Part I has to be filled in by a company's representative, preferable the employer or chief executive, and provides information for the Ministry about the company's starting position and enabling the Ministry to establish if the necessary conditions are present for the project to be successful. Part I also provides a context to asses measures which will be proposed in the actual plans to improve safety.

Part II has been designed to create a uniform method for the assessment by the officials of the Ministry of Social Affairs and Employment. Nine most commonly used safety measures and intervention techniques, aiming at human aspects of safety, have been described. From experiences with these measures and techniques, and their success or failure in practice, dos and don't s for their implementation are derived. Keeping these in mind during projects for the improvement of safety will increase the chance of being successful.
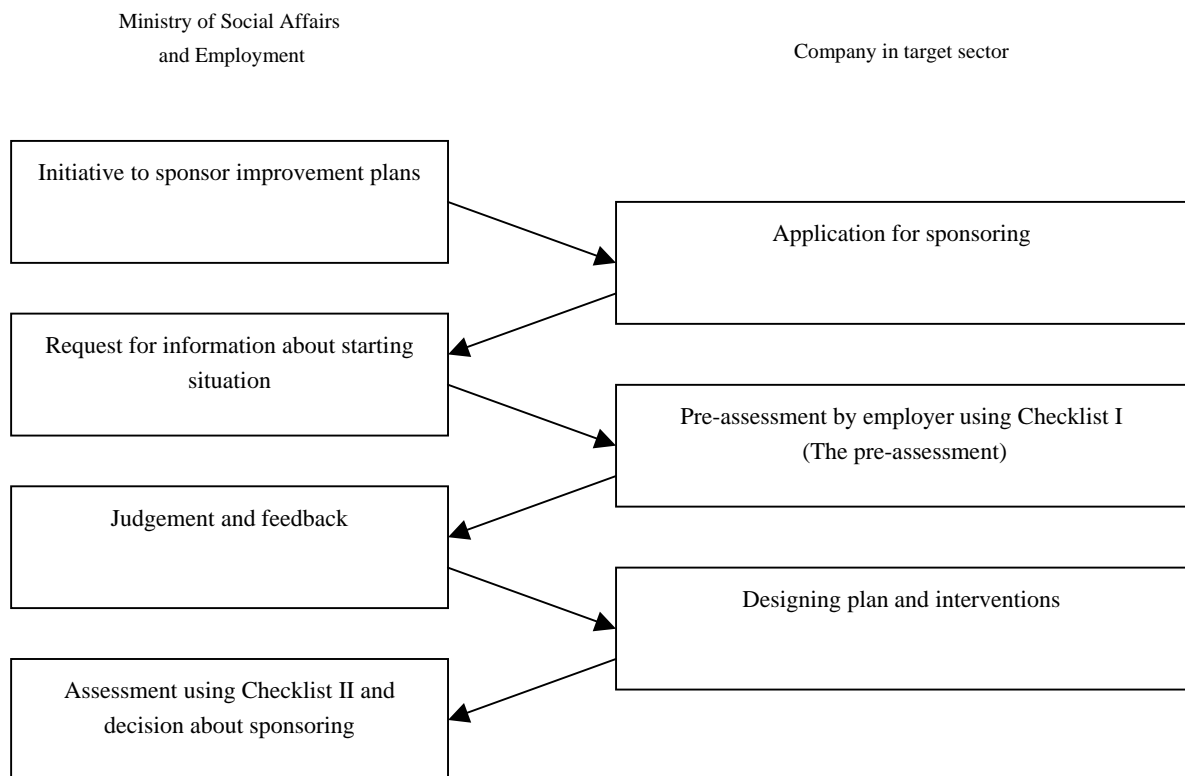
The Process
The improvement of safety by acting on the human factor will be sponsored by the Ministry of Social Affairs and Employment. The sponsoring trajectory starts with the application for sponsoring by companies. After the initial request companies will be

invited to hand over information about the present state of safety, specific company conditions and the ambitions towards the improvement of safety. By filling in the Pre-Assessment questionnaire (checklist I) necessary information will be provided. The Ministry of Social Affairs and Employment will discuss this information with the company and after that the actual improvement plan can be made. In this plan concrete measures and interventions have to be proposed to improve on safety by acting on safety awareness, safe behaviour and the safety culture.

This plan will be assessed by the Ministry using Checklist II. With this assessment the Ministry judges if there is enough confidence that targets can be reached and if the plan should be sponsored or not. The figure underneath gives a schematic representation of the process.

A schematic overview of the process

Ministry of Social Affairs
and Employment

Company in target sector

Initiative to sponsor improvement plans

Application for sponsoring

Request for information about starting situation

Pre-assessment by employer using Checklist I (The pre-assessment)

Judgement and feedback

Designing plan and interventions

Assessment using Checklist II and decision about sponsoring

Development process and choices made

In the process of developing the checklist TNO Work and Employment initially has made an inventory of the most commonly used intervention techniques regarding human safety. From this overview nine interventions have been selected. These nine interventions have been described and, based upon experiences from the consultancy practice of TNO Work and Employment, success and failure for implementation have been worked out. Furthermore additional literature has been studied.

Success and failure have been elaborated in the form of points of interest (dos) and points of avoidance (don'ts) to take into account by the implementation. These formed

the basis for the Checklist for Assessing safety plans. The Steering Committee has decided to add a Pre-Assessment questionnaire. Using this Pre-Assessment insight can be obtained in the starting position of companies. This makes a more adequate and balanced judgement of the chances on success of measures possible. The development of this checklist was the primary goal of this project and for that reason the main report is about the checklist.

In the Appendices the overview of most common used safety measures and interventions, as well as the additional literature and experiences from the consultancy practice, can be found. The Appendices are organized around the three main levels which can be distinguished in acting on human safety: the individual, group and organisational (cultural) level.

The appendices can be used as a source for background information for the assessors of the Ministry of Social Affairs and Employment. As the Ministry intends to use this information for educational purposes too, the information could provide a useful source of information for participating companies as well.

Contents

1 Introduction

How can companies act on safety by means of influencing safety awareness, stimulating safe behaviour and creating and maintaining a good safety culture, in order to improve the safety performance and reduce incidents and accidents?

This question underlies the request from the Ministry of Social Affairs and Employment to develop a checklist to asses improvement on safety culture. The Ministry of Social Affairs and Employment has a programme that sponsors companies that improve on safety. In order to participate in this programme a plan has to be submitted and approved by the Ministry of Social Affairs and Employment. A tool for a fair judgement of the plans had to be developed. This has been the starting point for the development process of a checklist by TNO Work and Employment which is the subject of this report. During the development process a steering committee had the role of sounding board in the development process.

In this report the tool, consisting of two checklists, to asses safety plans on improving safety awareness, safe behaviour and safety culture of companies in target sectors will be presented. In these plans companies have to make an improvement plan to reduce occupational accidents in the workplace by 15-20%. One of the possibilities to achieve this is by enhancement of safety awareness, behaviour and culture.

In order to do so, the company has to assess the existing situation. One of the items must be some statistics about the accident rate. In an ideal situation this consists of an analysis of the root causes of accidents/incidents in the categories of human, organizational and technical factors. The next step should be a plan describing how to deal with problems relating to these factors.

The plan to improve the human and organizational factors has to be submitted to the Ministry of Social Affairs and Employment who will then decide about sponsoring the plan. In order to do so the Ministry of Social Affairs and Employment wants to assess whether the improvements of these factors are properly addressed. The main question will be: Is this a sound therapy to a correct diagnosis?

In this chapter we will present a brief description of the process of checklist development as well as some considerations of justification.

1.1   Brief description of the development process

In order to develop a checklist to assess company plans focused on improving safety awareness, safe behaviour and safety culture, the following research questions were leading:

1. What are successful intervention techniques on safety awareness, safe behaviour and safety culture which companies can deal with in order to choose their own measures ?
2. How does a conceptual framework look like in order to illustrate how these intervention techniques have influence on safety awareness, safe behaviour and safety culture ?
3. How does a checklist look like in order to assess company plans focused on improvement of safety awareness, safe behaviour and safety culture ?

An overview of the most relevant concepts and intervention techniques dealing with safety awareness, safe behaviour and safety culture was gained by starting with a limited review of literature of safety science and safety practitioners. Because its purpose was not an attempt to present an in depth pure scientific psychological review of these behavioural and organizational issues, a more pragmatic approach was chosen. The overview was needed both for the foundations of the checklist and for giving some background information for the assessors of the Ministry of Social Affairs and Employment as a framework for applying the checklist. Later on this background information may also be delivered to the companies as support in developing their plans or for educational purposes. Together with a review of the research and consultancy practice of TNO Work and Employment, an overview of relevant safety concepts, intervention techniques and examples of experiences in successes and failures of these interventions was established. This overview of theory and practice provided an underlying framework for the subsequent operationalisation in the checklist and was discussed with the steering committee.

The steering committee decided that there was a need for a proper diagnosis by the company as a sound basis for the actual improvement plan, so two phases in the planning process were distinguished. By that, we had to develop the checklist in two parts. Phase 1 consists of some considerations before the actual plan will be made in phase 2. To provide a diagnosis-tool in the preparation phase of the plan, a pre-assessment checklist was developed. This pre-assessment should be filled in by the employer or the chief executive and has to be submitted to the Ministry of Social Affairs and Employment in order to assess that significant aspects on strategic and tactical level or essential conditions are identified and fulfilled by the company. This

must precede the making of the actual plan on improving safety awareness, safe behaviour and safety culture in order to reach a high probability of success. This step may also be an opportunity for the Ministry of Social Affairs and Employment and the company to have a fruitful dialogue on improving some essential prerequisites in the preparation phase of the plan. Figure 1.1 outlines this process.
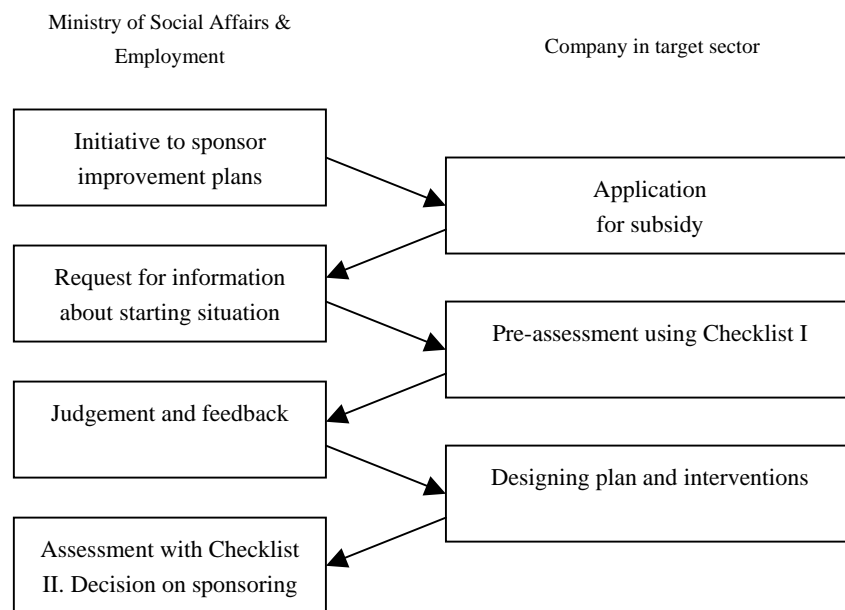

Figure 1.1 The planning process

So, according to the phases of the planning process the assessment tool consists of checklist part I and checklist part II. Checklist part I (presented in chapter 3) is designed to help a company to create a background for their plans and to generate motives and can be considered as a sort of shopping list for the actual plan. Checklist part I has two perspectives; on the one hand answers at four leading questions (§ 2.3) can be generated and on the other hand a brief assessment of the present state of the safety culture and the prerequisites for cultural change can be made.
The outcomes of checklist part I have to be discussed with the Ministry of Social Affairs and Employment. After that, in a dialogue between the Ministry of Social Affairs and Employment and the company, the actual plan can be developed using checklist part II of the assessment tool (as presented in chapter 4). In this way the company can make a plan which may consist of the most relevant safety measures or intervention techniques which are presented and questioned in the pre-assessment tool. As presented in the appendices, the underlying framework of the checklist consists of a lot of

examples of experiences in successes and failures. In the appendices these are summarized in boxes with dos and don'ts. These dos and don'ts have also been used in the checklist. Thus they can be used as points of verification to assess the company plans. They can also be used in selecting, designing and implementing the right safety interventions by the company on enhancement of safety awareness, safe behaviour and safety culture.

In chapter 2, we present some considerations on the design of the checklist. In chapter 3, the pre-assessment tool, checklist part I is presented. Checklist part II for assessing the safety plans, is described in chapter 4.

In the appendices the underlying safety concepts used for the development of the checklist are described. As stated earlier, its main purpose is to be used as background information for the assessors of the Ministry. It is also possible to deliver this background information to the companies for educational purposes.

2 Design for an assessment tool

2.1 Introduction

In this chapter we present some considerations on the design of the assessment tool based on four leading questions. We also give some background information on the concept of safety culture in a brief way for the companies as users of the checklist part I, in order to give some insight in our motivation to add some detailed questions to the pre-assessment tool, checklist, part I.

2.2 Four leading questions

For the Ministry of Social Affairs and Employment the changes in safety performance should be shown by reducing accidents and improving safety awareness, safe behaviour and safety culture. So for measuring the successes, the existing position on these aspects should be established.

Before a detailed plan can be made, some preparations have to be made and some questions have to be answered. In this pre-assessment four questions are leading and answering them will provide a good foundation for plans to be made. The four leading questions are:
1. What is the present state of safety performance ?
2. What changes are to be made ?
3. How can these be achieved ?
4. How can (afterwards) be determined if the goal has been realised ?

According to these leading questions, checklist part I is divided in four parts in which these leading questions are operationalised in detailed ones: part A, B, C and D. The Ministry of Social Affairs and Employment will, after receiving the answers resulting from the initial checklist, advise in order to use the gathered information for developing the final plan.

As stated previously, the key part of the plan should be aimed at reducing accidents and improving safety awareness, safe behaviour and safety culture. From a safety science point of view, human behavioural issues are closely linked with accidents. It is well known and accepted that incidents or near misses are signals or precursors for accidents to come. Furthermore the same can be said of unsafe behaviour, unsafe conditions or bad housekeeping. These are also useful signals of a sub-optimal safety

situation. There is much consensus on the use of safety indicators like employees' and managers' attitudes towards safety or a company's safety culture.

Together with other safety measures, procedures and safe hardware must be in place according to the regulations of the Working Conditions Act. In the context of this project, the Ministry of Social Affairs and Employment thinks, as stated before, that further improvement of safety and reduction of accidents should be achieved by enhancing issues like safety attitudes, awareness, behaviour and the company's safety culture. This focus on safety culture is based on the assumption that, not only structural elements of safety management have to be in place, but that additional improvement in safety performance can be sought in improvement on culture and cultural related issues. In order to do so in the checklist questions are posed concerning safety culture or safety culture related topics. These questions deal with the most important parts or characteristics of a positive safety culture. Getting these characteristics, which can be seen as conditions which have to be fulfilled at a satisfactory level, helps a company in realising a good safety performance.

The checklist helps to get insight in the present position. This position serves as a starting point to formulate ambitions. Before coming to the checklist a short introduction on safety culture must be given specifying what is meant by safety culture and which beneficial effects can be expected by acting upon it.

2.3 A brief introduction to safety culture

Every company has an organizational culture. Safety culture is a part, or an aspect, of that culture, Guldenmund (2000). The organizational culture is the result of a long collective and at least commercially successful learning process of all members of a company in coping with the big bad world: 'we are not out of business yet'. The way all members of the company do things, is taken for granted and an important guide for behaviour. Other behaviour is inconceivable. So predictability is very important. Deep rooted basic assumptions are the essential guides for perceiving, thinking, feeling and behaviour, after Schein (1992) in Guldenmund (2000). They are shaped for instance by the values of the founding fathers, or the owner of an SME, which were important values for doing successful business and thus became deep rooted assumptions. The most important question is then: what is paramount for all members of the company to guide behaviour? Is that:
- maximum production;
- customers' satisfaction;
- to exceed your own and customers' quality standards;
- reliable reputation;

- quick profit;
- safety and continuity;
- predictable and so reliable production;
- other……………..?

It is important to gain insight in these assumptions, because they can compete or conflict with safety, but they can also guide behaviour to other goals. It is a mechanism in setting priorities by all members of the company and is mostly very strong and almost subconscious: members are mentally programmed that way through the years. Or in popular words: 'That is the way we do things around here'.

For instance in a production company a high production is usually considered to be the greatest value. It should be, otherwise the company will soon be bankrupt. The whole organization is generally percolated with this fact. Therefore, individuals might break certain safety rules because of the greatest value, which is production, Guldenmund (2000).

This apparent conflict between safety and production can only be solved, if the assumption is that there is no conflict between these two issues of production and safety, and that synthesis is possible. These should become basic assumptions which guide behaviour to integration of good safety and business practices. The commercially successful company DuPont de Nemours is convinced of the possibility to integrate business and safety. To show that they use statements like "We earn money with safety", so they see putting money in safety as an investment, not as a cost. With the statement "the goal is zero", they show their confidence in doing business accompanied with the possibility to prevent all accidents by good safety management. In cultural terms we call that statements espoused values, very much propagated by management. To make it a deep rooted basic assumption with all members of the company a long process is needed, putting this in practice and by that achieving business results.

This development must be accompanied by a long process of trust and support by everyone in the company that this is the only successful way to do it: actions speak louder than words. In short, if you can combine, and convince everyone of the business principles that safe operations support a predictable and reliable production which guarantees delivery on time which satisfies customers, conflict between production and safety is minimized. If these principles become basic assumptions, you have achieved a mechanism of setting priorities by everyone in favour of reliable operations and not on quick fixes. So by that it supports desired e.g. safe behaviour with focus on carefulness and competence and discourages unsafe behaviour and sloppiness with short cuts and a high probability on failure.

In order to assess safety aspects of an organizational culture some characteristics are given, so companies can compare these with their own organization. We use for that

purpose a definition according to the principles of a functional safety culture, see page 89 in the appendix 6.

In that way safety culture can be characterized by:

1. *safety commitment, participation and leadership*: the way management propagates a safety philosophy, makes sure employees are involved and is taking actions based upon it (management commitment);

2. *learning and trust*: the way an organization is willing to learn from deviations, errors, near misses and accidents and creates the right environment for the reporting of deviations;

3. *informedness*: insight in safety performance and the willingness to improve unsafety in a structural way.

Ad 1. Involvement of management, and all other levels of the organization, both bottom-up and top-down. So commitment and participation of employees, supervisors and management in all aspects of the safety management process are visible.

Ad 2. A learning organization (the error culture or the 'learning' culture). This is an organization with an open culture in which hazards, accidents and near misses are discussed and in which in the long and short term the company and its employees learn from their mistakes (for example, with flexible and dynamic procedures (if not functional, skip it or improve it), function-related education and training, and group discussions). An atmosphere of trust exists and employees are motivated, even rewarded for providing essential safety-related information. The distinction between accepted e.g. safe behaviour and not accepted behaviour is very well known by everyone and actions are taken upon it. The creation of such a culture is a prerequisite for making risks transparent within an organization and to be able to act on them in an adequate way.

Ad 3. Insight into hazards (the 'reporting' culture). People must have insight in the safety-critical activities in which people play a role. In order to be able to measure safe or unsafe behaviour, the establishment of a safety system is a good resource. Registering and analysing accidents and near misses give insight into the probability that a certain accident will occur. If the number of accidents is small, the reliability and predictability decrease. In such a situation, in order to be able to measure the 'safety performance' of a company, a good approach is to examine other safety risk factors instead of accidents. This can be done by reporting and analysing: errors, deviations or near misses, unsafe acts, unsafe conditions like bad housekeeping, attitudes of employees, supervisors and managers towards safety. This can even go as far as safety auditing of latent failures in management processes such as lack of adequate communication, conflicts in deci-

sion making between economy and safety, lack of introduction training of new personnel, etc.

This definition of safety culture with three characteristics or cornerstones makes it possible to operationalise safety culture in a way that the measures which are proposed by a company can be assessed whether they reflect these cultural characteristics. For example, a company with plans to organise a training for all employees including supervisors, will only be successful in terms of safety culture if it is embedded in a system where the safety performance is known and understood, lessons are drawn from that information and management is committed to act upon that information. When these three add-ons are not in place a training (and most other safety measures) will have no effect on safety culture whatsoever.

Checklist part I, contains many questions, which we think are necessary to create a clear picture of the company's situation for the assessors of the Ministry of Social Affairs and Employment. A company and its issues like safety awareness, behaviour and culture is a multi-facetted reality, which is very hard to assess by an assessor of the Ministry of Social Affairs and Employment who is a relative outsider, solely on the basis of a written plan. That is why we think that a company should make the investment of taking some time to fill in these questions in order to execute a sound diagnosis which can be properly assessed. For instance, the improvement plan will be submitted to the Ministry of Social Affairs and Employment with the purpose of having it sponsored, in the same way as having a business plan being assessed by its bank. A proper plan needs a proper preparation. It is our view that any improvement trajectory towards a safety culture is incompatible with a quick fix. So investing in a proper and sound diagnosis reflects management commitment towards a professional culture e.g. a safety culture.

After this introduction, checklist part I will be presented in the next chapter.

3 Pre-assessment tool ; Checklist Part I

3.1 Introduction

The checklist starts with questions which enable companies to identify briefly how to characterize the safety culture. After that there are some questions to review the safety performance up till now.

On the basis of the issues which are not yet satisfactory, ambitions to improve can be formulated. That will be the foundation of the final plan which can be made after this pre-assessment and will be assessed with checklist part II.

3.2 The Checklist Part I

To be filled in by the employer or chief executive

A. What is the present state of safety performance?

2.1	Safety and business
2.1.1	Can you give a short description of the working processes?
2.1.2	What is your motivation for working safely?
2.1.3	Is safety important for your business?
2.1.4	Is your license to operate in danger because of unsafe practices? Or for your customers of suppliers? Does that have an impact on your business?
2.1.5	What is paramount for all members of your company to guide their behaviour? ❑ maximum production ❑ customers satisfaction ❑ to exceed your own and customers quality standards ❑ reliable reputation ❑ quick profit ❑ safety and continuity ❑ predictable and thus reliable production

	❑ other ....
2.1.6	Can these paramount issues compete or be in conflict with safety?
2.1.7	If so, how can this problem be solved and what are your role and actions in that?

2.2	**Safety and the organization**
2.2.1	**Safety commitment, participation and leadership**
2.2.1.1	How is management commitment or genuine leadership towards safety visible?
2.2.1.2	Is there a training or some sort of safety education for employer, management or supervisors?
2.2.1.3	Are employer, management, supervisor good role models for safe practices?
2.2.1.4	What is the participation of employees in: ❑ safety plans: .... ❑ safety objectives, targets: .... ❑ proposing, amending, improving or maintaining parts of a safety management system: .... ❑ selecting safety means, equipment, tools, personal protective equipment: .... ❑ selecting safety training: ....
2.2.1.5	What is the evidence for that?
2.2.2	**Learning and trust**
2.2.2.1	Are deviations, errors, near misses, accidents reported?
2.2.2.2	Is there trust amongst every member of the company to talk about errors, deviations and to contribute to this reporting?

2.2.2.3	Is there trust that this reporting leads to analysing root causes in order to improve safety and business and not to blaming people?
2.2.2.4	Do you have confidence that information about every deviation, near miss, incident, accident is being reported?
2.2.2.5	Are you satisfied about the quality and quantity of reporting?
2.2.2.6	Do you have evidence of improvements based on these reports? *Examples:*
2.2.2.7	Is that know by all employees?
2.2.2.8	Is management spontaneously addressed by employees or supervisors with deviations or suggestions?
2.2.3	**Informedness**
2.2.3.1	How are plans, actions or results pervaded from the organization to the shop floor?
2.2.3.2	What are the communication channels and how is feedback organized?
2.2.3.3	What is your check that information is properly delivered, understood, and results in adequate actions?
2.2.3.4	What is the '*walk and talk ratio*' from employers, managers, supervisors?
2.2.3.5	Do you know what the hardest part of the job is for employees?
2.2.3.6	Do you know what the hardest things on safety are and how to overcome these for employees in an optimal and effective mode? Both for safety and business?
2.2.3.7	Is that satisfactory for you and do you show that?

2.2.3.8	What is the evidence of positive feedback/reinforcement?

2.2.3.9	Do employees show that they are content with positive feedback and how?

2.2.3.10	How is appraisal from management, supervisors to employees on work, on safety?

2.2.3.11	And the other way around? Is the manager, supervisor appraised by employees? What is your evidence?

2.3	Safety performance
2.3.1	What have you done up till now? The measures or activities to create safe working conditions. Please, give examples. ❑ make clear safety roles and responsibilities ❑ safety training, education ❑ safe and ergonomic job design ❑ ergonomic workplace design ❑ ergonomic tools ❑ functional procedures ❑ adequate planning and preparation for safe execution ❑ other ....
2.3.2	Are safety systems/system elements in place? ❑ Initial Status Review and Risk Assessment ❑ Safety Policy ❑ Organizing ❑ Planning ❑ Implementation ❑ Measuring Performance ❑ Audit ❑ Review ❑ Checking and Corrective Action
2.3.3	Outcomes of risk analysis; have/can safety risks been/be identified?

2.3.4	Top three (major) hazards? 1. .... 2. .... 3. ....
2.3.5	Describe your safety history in short. Like the accidents rates in past years, major historic events, initiatives in the past, prices won, certificates, VCA, etc.
2.3.6	What are the signals for unsafety? (accidents/incidents/near misses, signals for a dysfunctional safety culture, etc.). What examples do you have?
2.3.7	Are accidents or near misses being investigated?
2.3.8	What are the main causes? How many in the following categories? ❑ technical, hardware ❑ organizations, procedures ❑ behavioural, supervisors and employees
2.3.9	What are your results in reducing accidents up till now and are you satisfied?
2.3.10	We are not satisfied with (please, give examples): ❑ management commitment, attitudes, actions .... ❑ supervisor commitment, attitudes, actions .... ❑ employee commitment, attitudes, actions .... ❑ staff (QSHE, planning, maintenance, purchase) commitment, attitudes, actions ....
2.3.11	We are not satisfied with (please, give examples): ❑ accident or near miss rate .... ❑ safety skills of the following target groups .... ❑ job safety analysis before starting work .... ❑ proper planning and preparation before starting work (time, competent people, tools, equipment) .... ❑ safety performance measured by the following .... ❑ behaviour on projects or workplace .... ❑ use of PPE .... ❑ other ....

B. What changes are to be made?

2.4	Change and ambition
2.4.1	What changes are wanted, and by whom?
2.4.2	Is there a clearly defined objective for the final plan?
2.4.3	Have specific targets been formulated (more rule-compliance, greater awareness of risks, reduction in losses, in absenteeism, etc.)?
2.4.4	At what time should change be realized? (determine milestones)
2.4.5	We want to improve management commitment which must be shown by: ❑ improved attitudes (initial attitudes measured with questionnaire) and the following actions or behaviour: ❑ always present on safety training ❑ safety as regular item on management meetings ❑ regular reports on safety performance ❑ regular presence on shop floor ❑ supervisor commitment, attitudes, actions ❑ employee commitment, attitudes, actions ❑ staff (QSHE, planning, maintenance, purchase) commitment, attitudes, actions ❑ other ....

C. How do we get there?

2.5	Conditions for change
2.5.1	Will the plan be company wide or department specific?
2.5.2	Are specific groups of employees identified?
2.5.3	Do we need to temporise and start wit a try-out or pilot?
2.5.4	Is the workforce cooperative? How is that ensured?
2.5.5	Is management informed and supportive?
2.5.6	Who is responsible for meeting the targets?
2.5.7	Is there a coordinator assigned?
2.5.8	Are regular audits being planned?
2.5.9	How is feedback on progression/performance being measured?
2.5.10	Have resources been allocated?
2.5.11	Have budgets been allocated and have expenses been calculated?

2.6	Interventions
2.6.1	Interventions are aimed at:

❑ management commitment, attitudes, actions
❑ supervisor commitment, attitudes, actions
❑ employee commitment, attitudes, actions
❑ staff (QSHE, planning, maintenance, purchase) commitment, attitudes, actions
❑ other ....

2.6.2	The following interventions are being planned:
	❑ observation of behaviour
	❑ discussion of safety behaviour in meetings, safety workshops
	❑ training of employees
	❑ selection and training at the gate of contractors
	❑ poster campaigns
	❑ safety skills of the following target groups ....
	❑ job safety analysis before starting work
	❑ agreement with planning department on proper planning and preparation before starting work (time, competent people, tools, equipment)
	❑ safety performance measured by the following ....
	❑ behaviour on projects or workplace ....
	❑ use of PPE
	❑ agreement with contractors about materials, equipment, tools
	❑ other ....

2.7	**Scope of the plan (to be detailed after this pre-assessment in the final plan)**
2.7.1	Planned interventions will be specified and described in detail according to:
	❑ target groups
	❑ objectives
	❑ activities
	❑ methods (of training, measurements or monitoring)
	❑ planning
	❑ who is responsible for results and testing or measuring
	❑ who or which parties are also involved in the activity, project or training
	❑ how will the end results be measured
	❑ links with other plans/actions/policies

D. How can be determined if the goal is realised?

2.8	Evaluation
2.8.1	Indicators (attitudes measured with questionnaire): ❑ management commitment, attitudes, actions ❑ supervisor commitment, attitudes, actions ❑ employee commitment, attitudes, actions ❑ staff (QSHE, planning, maintenance, purchase) commitment, attitudes, actions ❑ other ....
2.8.2	When must we have achieved our goals? Please, fill in targets and time schedule: ❑ the following accident rate .... ❑ observed safe behaviour according to the following written standards .... ❑ the following evaluations of meetings on safety .... ❑ the following evaluations on safety trainings and resulting behaviour on the workplace .... ❑ the following evaluations on the performance of contractors .... ❑ the following evaluations on poster campaign .... ❑ the following evaluations on safety skills of the following target groups .. .. ❑ the following evaluations on job safety analysis .... ❑ the following evaluations on planning and preparations of work (time, competent people, tools, equipment) .... ❑ other safety performance measured by the following .... ❑ the following evaluations on use of PPE ....
2.8.3	Which method(s) will be used to assess whether the goals are achieved?
2.8.4	Will learning experience and performance information regularly be fed back into the planning system?
2.8.5	Will audits be performed? On what topics, by whom (internally/externally)?

4 Tool for Assessing Safety Plans; Checklist Part II

4.1 Introduction

The checklist, part I as presented in chapter 3, is meant to gather information before the actual plan is made. The checklist part II, presented in this section, can be used by the assessor of the Ministry for evaluating the final company plan with its specific safety measures. In the first column of the table (see table 4.2) possible measures are summed up. In the checklist nine possible measures or interventions are displayed which can be helpful in reducing accidents by means of behavioural and cultural related actions. These nine measures are the most common intervention techniques derived from the consultancy practice of TNO Work and Employment and of the safety concepts which are presented in the appendices of this report. In the experience of TNO Work and Employment a lot of companies especially SMEs do not have a formal safety management system. So, not all of the mentioned safety measures are common practise in SMEs, althought there are no fundamental objections. In the case a safety measure may be also applicable in a SME in a practical way, it is marked with *).

The nine safety measures are:

1. Behaviour Based Safety programmes; formal system of observation and feedback of safe behaviour on the workplace;
2. specific group discussions or safety workshops on issues like safety awareness and behaviour and action planning (*);
3. participation of employees by mandating/maintaining parts of the Safety Management System to groups or initiating special safety projects, for instance reviewing safety procedures and (training) manuals;
4. installing a safety committee with representatives of employees with special tasks or assignments;
5. structured safety meetings with employees and supervisor on safety performance and improvement (*);
6. safety trainings (*);
7. enhancing risk perception and safe behaviour by implementing a system of job safety analyses, safety leadership (*);
8. safety campaigns, poster campaigns (*);
9. participation of employees in accident or near miss reporting, investigation and analyses and initiating improvement projects.

In the second column of table 4.2 the dos and don'ts are summed up. They are based on many examples of experiences in successes and failures. In the appendices these are summarized in boxes with dos and don'ts. They can be used as points of verification to assess the company plans. They can also be used in selecting, designing and implementing the specific safety intervention by the company. The dos can serve as suggestions to use in operationalising the specific measure because there is evidence for success. The don'ts are advises to leave some issues out because they can serve as a condition for failure. Whether all these aspects are visible for the assessor depends on the level of detail to which the company has operationalised its plan. Because of that we have formulated some generic questions in table 4.1. With these questions the most important issues are addressed as behavioural, organizational or cultural conditions for success. They can serve as a guidance throughout the assessment of the measures and interventions of table 4.2. Have the right elements been taken into account in the conceiving of the measures?

Table 4.1 Generic questions to assess the interventions

Expectations and norms
• Is there a written norm specifying the expected change?
• Does everyone have access to it?
• Is it known by everyone?
• Is there evidence for that?

Employee involvement
• Are employees involved?
• Which responsibilities have been assigned/shared in this process?
• Is there a sense of ownership/involvement?
• Is there evidence for that?

Training
• Are needs for training analysed?
• Which skills are essential for success of the programme?
• Is there a suitable training present or developed?
• Is there evidence for that?

Management commitment
• Is management informed?
• Is management involved?
• Who's accountable/responsible for success of the programme?
• Is there a sense of ownership/involvement?
• Is there evidence for that?

Information and learning
• Is it clear which information is necessary to measure progress and success?
• How is information provision ensured?
• Is the information gathered:
- available when needed;
- adequate and precise;
- complete?
• Are unwanted outcomes and learning experiences fed back?
• Is there evidence for that?

Trust
• Do employees and management trust each other?
• Is there a tolerant/blame-free environment?
• Is there evidence for that?

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Table 4.2 The assessment tool

intervention/keywords	do/don't
1. Behaviours Based Safety, observation and feedback of behaviour on workplace	*do* • use a written norm of standard behaviour; relevant and easy to observe • deploy a training for target groups in advance, on the skills of observation and giving feedback • organise active involvement of employees in the system; create ownership by employees or teams • show management commitment and active support • give quick and undelayed management response on the basis of gathered information • gather information only by observation not by interpretation • stress the importance of the observation on direct behaviour, not on negative consequences • use positive feedback and positive reinforcement in order to improve • give feedback on observed behaviour as soon as possible by colleague or supervisor • conduct quick simple interventions, functional and integrated with the company safety policy • integrate this technique in organization and systems, with closed feedback and learning loops
	don't • do not stress the output (e.g. Accident statistics) and by that forget that the observed behaviour itself needs the focus in letting this system function • do not give or tolerate negative feedback, blame and punishment • do not conduct modifications without commitment, you will loose ownership by employees • do not show lack of management commitment, you will loose motivation and trust in putting effort in the system by employees • do not manipulate outcomes and reports (fake reports), by that you will loose trust and ownership by employees

intervention/keywords	do/don't
2. group discussions or safety workshops, action planning	*do* • use role playing exercises in groups of workers during a safety training to alter safety attitudes • organize directed group discussions with workers in analysing safety problems, generating solutions and making action plans • execute safety trainings or workshops with complete teams including supervisors • discuss in this training daily safety practices, dilemmas and solutions which are relevant for the group
	don't • do not forget the scope of the sessions by discussing issues beyond responsibilities of employees which they are not able to manage
3. mandating of parts of SMS to employees	*do* • create ownership by participation of employees, shifts, teams or departments within implementing elements of SMS. For instance review and maintenance of safety rules, procedures, training manuals • involve employees in designing and implementing special safety projects
4. install safety committee	*do* • install a safety committee as a committee of the Work Council in order to contribute to the company's safety policy with special tasks or assignments on behalf of the employees • install a safety committee as a advisory committee of management or department in order to contribute to the company's safety policy with special tasks or assignments
5. structured safety meetings with employees and supervisor (shift, team, department)	*do* • organise structured safety meetings on a regular basis with employees and a supervisor as chairman to discuss safety performance and the planning of improvement projects; creating ownership motivates • discuss daily safety practices, dilemmas and solutions which are relevant for the team • facilitate in proper preparation, use a fixed agenda and a written list of actions • show genuine safety leadership as a manager or supervisor; be a good role model for safe behaviour • stimulate safe behaviour by positive feedback and positive reinforcement through appraisal by walking and talking or appraisal after doing a good job safely

intervention/keywords	do/don't
6. safety training	*do* • make it a rule that the company's safety policy is an integrated part of all safety training • make it a rule within the company that management opens every training with discussion on safety policy • conduct a job analysis and an analysis of training needs before designing a training plan • make all trainings part of a company training plan as a coherent framework: different training objectives and different target groups • make a link with training objectives and safety awareness, safe behaviour or safety culture on the workplace • establish the degree of actual knowledge, skills and attitudes, link them with training objectives and desired training issues, exercises, group work and other training tools • design active participation of employer (SME), management or supervisor in training • incorporate other elements or results of SMS in training: for instance information on incidents, accidents, analysis, actions; special safety devices for developing skills to work with them • incorporate other elements of experience or collective company learning • continuously state the relevance of the training issues with the working practice • identify the limits of a training: what you can not achieve with training, or needs supportive or complimentary actions • evaluate the training on performance and improvement in work practices • management/supervisors give positive feedback/reinforcement on training outcomes • assess whether it is necessary to adjust parts of SMS as an output of discussions in the training
	don't • do not train employees with irrelevant or already mastered knowledge or skills • never postpone management attendance on safety trainings because of other priorities • never start a safety meeting or a training too late • do not allow absence without good reason

intervention/keywords	do/don't
7. enhancing risk perception and safe behaviour, job safety analysis	*do* • use a system of job safety analysis as a standard preparation of professional job execution • organise a training for every team on hazard recognition and risk evaluation, specially designed for jobs which are relevant for the team • develop, on that basis, standards of safe work practices with the team • show management commitment to safety by actions, it enhances individual perceived possibilities and responsibilities to control safety • present safety information or education as tangible as possible. Hazard is a more tangible concept than a rather vague concept of safety • formulate and implement a 'visible' safety policy. It arouses safety awareness amongst employees and perceived influence and commitment to behave safely • enhance group relationships between employees and between supervisor and employees by collective trainings, meetings or workgroups • provide by training a 'safe' setting in which new skills can be practiced. More specialised training can improve the feeling of self- efficacy and enhance safe behaviour
	don't • tolerate improper job planning and preparation, quick fixes and shortcuts
8. safety campaigns, poster campaigns	*do* • use clear objectives in a poster campaign leading to a clear message • exposure in a visible spot relevant to the action required • designed to grab attention • use a simple comprehensible message • use a believable message from a reputable source • deliver a clear motivation to comply
9. participation in accident/ incident reporting, investigation and analysis and improvement projects	*do* • design a user friendly system • train employees in perceiving and acting on dangerous situations or near misses; they should be trained in proper classification skills in order to process and analyse the data in an adequate way • invest in feedback and communication about reports, analyses and actions

intervention/keywords	do/don't
	• create ownership by participation in the system, employee involvement in the steering committee • create trust, show top management commitment • make clear there are limits to deviations e.g. unacceptable situations/behaviour; make clear what's not tolerated • communicate standards of acceptability • involve employees in design and implementation of improvement projects based on preceding analyses of root causes of deviations
	don't • do not blame persons on reporting, or on their role in a deviation, except if it is beyond clear communicated standards of acceptability • do not change the system without involvement or participation of employees

Appendix 1 Reader's guide to the Appendices

A1.1   Introduction

In the main report the checklists were presented. In the appendices we give an overview of the safety concepts and underlying theories we have used for the development of the checklists.

In paragraph A1.2, we present the view of TNO Work and Employment which guided our research in selecting and reviewing the different safety concepts with potential use as building blocks in the needed framework for the checklist. In that trajectory we use the 'Human, Organization, Technique'-model (see figure A1.1) as a conceptual starting point and as way of looking at safety related issues in the organizational context together with our motto:

Safety as an integrated part of work through professionalism and competence.

In the next appendices, appendix 2 up till appendix 8, we present the essence of the separate safety concepts and building blocks.

As a summary, we present in the last appendix, 9, a conceptual model or framework, just to visualise the separate safety concepts we presented in the previous appendices in one picture. This is not an attempt to present a theoretical or an empirical model.

A1.2   Safety as a HOT issue

TNO Work and Employment consequentially considers the improvement of safety to be connected with human, organizational and technological components, the HOT-model (see figure A1.1).
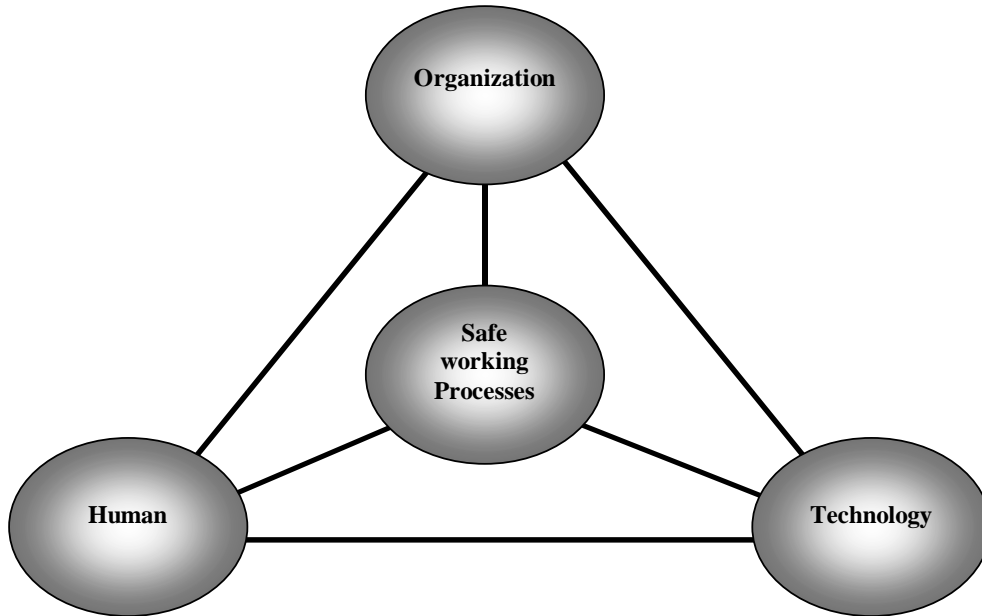
Figure A1.1 The HOT-model

In our view human activity plays a key role in the optimisation of working processes in the working environment. This is very important in for instance the complex and high-risk environment of the process industry. To ensure process safety and continuity the optimal balance and adjustment between human resources, technical installations and the organization are of vital importance. These notions are equally applicable in high risk industries as in other industrial sectors with less prominent risks and hazards.

Working processes are central to the model. These can be observed and assessed on their outcomes. The outcomes can be considered as indicators of organizational per-formance. Most safety related problems and initiatives are a result of (perceived) in-adequacies in this performance. For instance, observations can point towards unsafe situations, due to negligence (human), flaws in the design (technological) or conflicting interests of safety versus productivity (organizational). For a solution, these examples each point toward one of the corners of the model. Seen this way the model can be in-terpreted as a 'display' and a set of 'buttons' which can be pressed in order to influence the values on the display. The working processes are the outcomes which can be ob-served in the display and by reading the level of realizing the desired outcomes, the human button, the technology or the organizational button should be pressed (or per-haps a combination) to control the working processes.

In this report the working processes will be considered as a source of information. Working processes can, in our opinion, be influenced indirectly by taking measures towards human, organization or technology.

The information presented in the following appendices can be ordered and placed in the HOT-model. Some issues related to the building blocks itself will be discussed, relationships between the blocks will be presented and possible measures to intervene in the working processes (pushing the buttons) will be proposed. Some relations will be mentioned but not be elaborated upon because of the limitations following the objective of this project.

1   Starting point for TNO Work and Employment are competent and professional employees. Attention will be given to individual attitudes and motives for behaviour, specifically professional attitudes and behaviour in respect to occupational risk management. This will be covered in Appendix 2 'Personal motives and perception'.

2   The fit between employees and job requirements in the working processes also is an important one. Do employees have sufficient and adequate skills to perform their tasks ? Are they motivated to do their job and how can feedback on performance most effectively be given? Training will be discussed as one of the most frequently used and relied upon intervention techniques. Appendix 3 (learning and training) and Appendix 4 (Behaviour Based Safety) deal with the relationship between human and working processes.

3   Human influence is present in all the life-cycles of technology; not only employees working with equipment, but also engineers, designers and maintenance personal. Running a process installation means human involvement critical for the proper functioning throughout the life-cycle. Ergonomics and Man-machine-interactions are placed in the model between 'human' and 'technology'. Because of the focus of this project on human, organizational and cultural aspects, this relationship will not be worked out in this report.

4   In the interaction between human and organization, individual and collective learning processes, processes of development of social and organizational norms and organizational culture will be discussed. People work together in a company-specific structure and culture. Successful management of this relationship will determine the success of both organization and (groups of) individual('s) performances in the working processes. Appendix 5 describes the psycho-social processes in groups and can be seen as an illustration of the relationship between human and organization in relation to the working processes. Appendix 6 is about safety culture and cultural interventions and safety cam-

paigns as a possible intervention in the collective attitude towards the working processes.

5   Setting up an adequate organization to regulate the primary processes and setting up an adequate Safety Management System (SMS) to ensure safety in these processes is an important point. A lot of risk management theories and practices traditionally direct their attention towards the organization of technological safety, design and maintenance. Also the organizational requirements which are needed, and answers to the question 'how can be ensured that information about risks and unwanted events (accidents/incidents) will be fed back in the management system in order to improve performance?' are important. Appendix 7 is about the organization of safety and the relation with working processes. Appendix 8 describes what can go wrong (Human Error).

6   With respect to the technological component of the model, consideration about the inherent safety of installations can be discussed. However, this is a subject which falls beyond the scope of this report. Improvement of safety by using technological solutions and engineering safety will not be discussed.

Finally, figure A1.3 gives an overview of issues and interventions placed in the HOT-model.
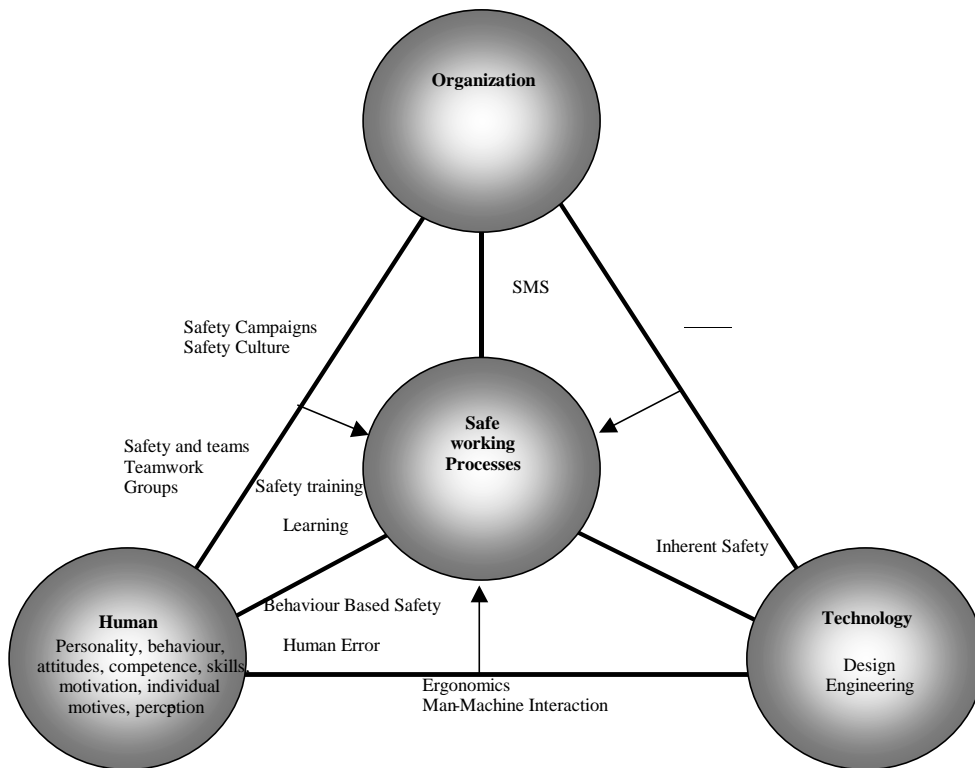
Figure A1.3 An overview

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Appendix 2 Personal Motives and Perception

A2.1   Introduction

This chapter deals with the motives that guide people in their behaviour. What makes people behave the way they do, and which aspects of personal response to dangerous situations or risks should be taken into account to exert influence on this behaviour? In this appendix some considerations about the 'human-building-block' of the model will be discussed. The following appendices (appendix 3 and 4) about Learning and Training and Behaviour Based Safety will help to get some insight in the possibilities to exert influence on the working processes from the human starting point.

The subsections of this appendix deal with motivation, personality, cognitive processes, values and beliefs as part of the individual context and decision making process. No attempt is made to present an in-depth psychological review of individual behaviour. In our opinion, the importance of these concepts is that being aware of how people make their 'behavioural' choices helps designing programmes which can intervene in unwanted behaviour and helps understanding the aggregation of individual values, beliefs and motivation in the form of organizational values, beliefs and culture. In section A2.7 and further, attitudes and their role in safe behaviour and a model for considering this relationship will be presented.

A2.2   Motivation

Motivation is the basis for nearly all human behaviour. Glendon et al. (1995) use a general definition of motivation: 'Motivation is what makes people tick'. Motivation is considered a central concept in psychology. It underlies personal values, attitudes, personality and behaviour and therefore is connected to the different layers of culture distinguished by Schein (1992). Because of the link with behavioural aspects, motivation is of interest for the field of safety management. Motivation however is being used in different meanings:

1. motivation is connected with personal needs which need to be met and can be considered as the force or energy which is directed at satisfying those needs. For instance people who are hungry need to eat. This is more a physiological state than an state of mind and can be labelled as 'pre-conscious needs' (Wentholt cited in Munning, 1986, p.111);

2. motivation is seen as a state of mind meaning enthusiasm to do something or the lack of it. It is of importance for the field of safety because of the credits that are attributed to a workforce motivated to behave in a safe way;
3. motivation can also be seen as the process in which behavioural alternatives are weighed. Here motivation can be seen as a cognitive process. It is about the motives - or reasons - behind acting one way or the other. This can be important in the decision making process in high-risk environments;
4. motivation as exhortation. Management effort is directed toward employees to motivate them to show behaviour consistent with company guidelines, beliefs and directions. In this context motivation is not being used as an individual characteristic but rather as a means to impose motives of management on the individual.

Different management styles have been adopted to try to motivate people in their work, each connected with different notions of what actually motivates people at work, derived from Maslow's need hierarchy. The assumption is that by providing means to satisfy workers' needs (motivation under 1) management can motivate (as under 4) the workforce to perform as desired.

From a economical motivation point of view rewards (and penalties) for performance helps motivate people satisfying the physiological needs with financial means: the Scientific Management School.

The Human Relation School addresses the social motivation satisfying the affiliation needs. Paternalistic Management aims at meeting safety and security needs (safe in the Maslowian sense), addressing the security motivation. From a Participative point of view, needs for self-esteem are met as being motivated from a sense of ownership.

A2.3   Intrinsic and extrinsic motivation

Two basic categories with regard to motivation can be distinguished: intrinsic and extrinsic motivation. Intrinsic motivation for a task means that the task itself is perceived as interesting or worth working for. Extrinsic motivation comes forth out of the fulfilment of other needs (financial: e.g. salary, rewards) which make the task worth doing. The work is a means to get to an end which is perceived as interesting.

Intrinsic motivation combined with actual involvement is considered more durable than extrinsic motivation: once the extrinsic motivator is no longer present, behavioural changes which have been established will be reversed.

Intrinsic motivation is in a sense the only way of motivation. Before motivation was defined as 'what makes people tick'. It is an internal process and people can therefore not 'being made tick'. Can motivation and subsequent behaviour not be changed? In

our opinion there are ways to influence the motivation of people by discussing the motivations of behaviour. Insights of Appelo and Hoogduin (2002) published in the field of psycho-education may help to overcome the confusion about the motivation concept. They start with the question how to prevent people from actions which we think harmful or disapprove of. And how can we persuade people into doing something which is considered to be right, but which they do not do at the moment? Those questions cannot be answered in terms of motivation because they are about conversion and not about motivation. The most difficult aspect of motivation is not motivating people but avoiding to impose one's own vision onto the other's. Conversion to another believe is difficult because this means old beliefs and principles have to be set aside and replaced by beliefs or principles of others.

An alternative to trying to change motivation directly is an open discussion of arguments, in search for solutions and agreement. Non-motivated people do not exist because there are always motives, but sometimes they are not always known to the other. Discussion of motivation is not about targets and goals. Employees and management share the same goals: for instance meaningful relations and physical and psychological well-being. Stated otherwise: no one goes to his/her work to violate rules or to be involved in accidents. Agreement should thus be sought on for both parties acceptable ways to achieve shared goals.

Based on previous experiences and projects, a participative style of leadership in promoting safe behaviour, based on intrinsic motivation, will be more desirable for its long-term effect. Safe behaviour from intrinsic motivation helps forming a positive attitude towards safe behaviour possibly being incorporated in cultural layers. 'Safe is the way we do things around here'. Fear and punitive based strategies tend to lead to circumvention, violation and 'hidden' unsafe behaviour. Hale (1987) concludes about motivation and Safety: 'A continuing theme throughout this chapter has been the insistence that most motivational measures are ones which have a temporary effect. Only if motivation is combined with new facts or teaching of new skills will it be turned into a more permanent gain which we have called learning (...). The more successful use of motivation is often therefore to use the rather less extreme motivators of praise, feedback of results or challenge. This can often be done through manipulation of work procedures or of organizational factors, or through social groups'. In strategies to influence behaviour open discussion of the arguments and reasoning which lead people in their current behaviour (motivation) will help to lead to mutual understanding and the seeking of alternatives.

A2.4 Personality

Personality theories suppose links between personal characteristics and job perform-ance. Under the assumption that there are stable types[1] of personality with their own typical behaviour and reactions to stressful events (risk situations), a selection can be made of people suitable to a job or not. Typical reactions can be foreseen and unwanted reactions in hazardous situations (risk taking) can be avoided.

It may seem attractive to recruit safe behaving employees, well equipped for their jobs, personality theories however cannot serve to this end.

Several problems prevent selection on personality types. Although there is some con-sensus about how personality traits may have their influence on safety, traits which show a direct link to safe behaviour cannot be distinguished. In cases that 'accident prone' groups can be distinguished, it is not to say that these groups consist of the same people over time. Some leave a group and others join.

In the selection process type indicators can however help to exclude certain combina-tions of personality traits in candidates. Furthermore, being aware of personality traits can help in giving useful feedback on performance and preferred behaviour.

A2.5 Values and beliefs

'Attitudes may be considered as being located somewhere between deep seated values and beliefs - which may well remain unchanged over a lifetime - and relatively superfi-cial views and opinions - which may change frequently depending upon what informa-tion we have most frequently been exposed to.' (Glendon et al., 1995).

Glendon et al. (1995) argue that attitudes have the potential to influence behaviour and can be seen as a cognitive force which has positive or negative potential in the process of considerations preceding actual behaviour.

Because we are looking at behaviour and at possibilities to influence behaviour, values and beliefs are of importance for their effect on attitudes. The other way around values and beliefs are important for their link with the shared values and beliefs as important elements of organizational culture (being discussed in appendix 6). Individual values and beliefs are relatively stable but may be changed over time. Socialisation processes in which group norms are internalised can have influence on individual values and be-liefs. This makes values and beliefs of the individual less interesting than the shared

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[1] For instance five categories of personal characteristics are frequently distinguished and are being referred to as 'The big five', being: 1) Extraversion/Introversion, 2) Neuroticism/Emotional stabil-ity, 3) Tender-minded/Tough-minded, 4) Autonomy/agreeability, 5) Consciousness/impulsive.

values and beliefs. Even more so because of the effectiveness of interventions. It is not efficient to aim at differentiating in strategies to change individual values and beliefs. Instead cultural interventions aiming at coming to collective values and beliefs and sharing and (in the end) shaping them towards the desired Safety Culture are undertaken. Values and beliefs can also have the role of a selection criterion (implicit); people with fundamentally different values and beliefs will either not be selected for a job or may not be willing to join a company with radically different values and beliefs.

A positive safety culture within an organization may have the potential to change individual beliefs and norms (as can a negative safety culture). Consequentially attitudes on specific topics can be influenced. Hale (1987) states: 'Groups are thus features which promote conservatism in any organization or society. If their norms favour safe behaviour they are a good thing for health and safety, if the opposite then they are a major barricade to its propagation (...) the more central the attitudes and beliefs are to the purpose of the group, the greater the pressure to will be to conform'.

A2.6 Safety attitude and behaviour

Safety professionals are becoming increasingly aware that there are occasions when people's attitudes and behaviour towards risk and hazards need to be changed, (Glendon et al., 1995). Like many other groups, safety and risk professionals seek to 'win hearts and minds' in order to be able to carry out their tasks and functions effectively. Therefore it is vital to have a basic understanding of the nature of attitude and attitude change and how these concepts are related to behaviour. It is necessary to appreciate something of the complexity of the relationship between attitudes and behaviour.

A2.7 The relationship between Risk Perception and Behavioural Response to risk

Many activities by safety professionals are aimed at changing the behaviour of employees towards safety-at-the-workspot. The core question is therefore 'What precisely are the factors that promote people to behave safely?'.
According to Güttinger's research along welders in a plant (1985) a lot of effort is given to safety training, safety promotion and safety communication, while the precise determinants of safe behaviour were not always known. It was often too easily presumed that by offering training, information and promotion of safety, the risk perception of employees enhances and therewith their safety behaviour.

Apparently the relationship between risk perception and risk behaviour was not as clear as thought. Apparently people respond to risk differently and training alone has limited effect. People are influenced by more factors than risk perception when 'intending to behave safely or not'.

Risk Perception has several determinants, like:

- the familiarity of certain risks;
- the habituation of risks;
- the perception of own controllability of risks;
- the level of perceived measures against risks;
- the free choice in dealing with risks;
- the possible consequences of risks;
- the probability of risks;
- tangible versus more abstract risks (e.g. tangible risks like accidents are earlier perceived than e.g. occupational diseases like RSI because of the time scale).

Risky behaviour can be defined as 'all behaviour that contains a condition to an accident'. All behaviour can be risky behaviour depending on the situation. For example: walking through an assembly hall can be safe. But it is not when you close your eyes. In some cases risky behaviour is defined in relationship with accidents. Andriessen (1974) defined 'safe behaviour' in terms of 'carefulness' and 'safety initiatives' in his research on safety in the working environment. These terms seem to be strongly related to the 'social environment' (appreciation by colleagues, management, etc.).

The theory of reasoned behaviour of Fishbein and Ajzen (1975) provides a framework in which the relationship between risk perception and risk behaviour can be explained. This model is used in many contexts and has been proven valid for more than 25 years. In this model the relationship is described between attitudes and actual behaviour. According to Otway (1980) risk perception can be considered as equal to attitudes towards risks (Otway, 1980), and risk behaviour as equal to overt behaviour (Güttinger, 1985). Then this model can be used to determine the underlying factors of safe behaviour. Otway cites (1980, p6): *'The Fishbein attitude model was especially attractive to us because, given the risk perception attitude analogy, it allows the measurement of "risk perception" as a function of its salient determinants (beliefs) and the values assigned to their attributes (...) further it can be called a model and written as an equation'.*

A2.8   Attitude as a predictor for (safe) behaviour

The following scheme represents the relationship between attitude, intention and be-
haviour according to the extended version of the Fishbein and Ajzen model (Ajzen,
1987; De Vries et al., 1987).
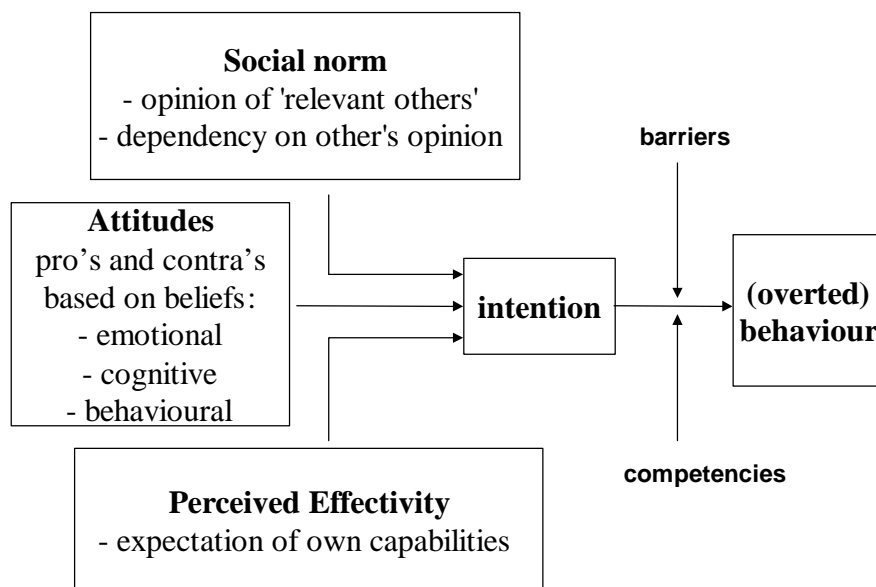
Figure A2.1 Model for explanation of behaviour (after Meertens & Von Grumbkow,
        1988)

This model describes what factors influence (human) behaviour and how. The intention
to perform the desired behaviour is determined by the factors 'attitude', 'social norm'
and 'perceived efficacy'. Next to an individual's intention behaviour is also determined
by barriers and competencies. The model and its underlying concepts will be explained
more in detail.

A2.9   Attitude

Attitude is no behaviour in itself, but it is one of the precursors for behaviour. Actually,
it is a theoretical construct that makes a link between the *feelings* of a person and
his/her (consequential) *behaviour*. According to Fishbein and Ajzen (1975, p. 301 et

seq) an attitude can be conceived as the tendency to act in a specific way in response to the attitude object. An attitude consists of 3 components:

- affective responses;
- cognitive responses;
- behavioural responses.

People develop attitudes toward an object by *balancing pros and contras* against each other. These pros and contras are not objective or 'true': they are the result of a person's *beliefs*. A belief is a consequence that a person relates to certain behaviour. These 'beliefs' vary depending on his or her knowledge and experience. All pros and contras together are the structure of an attitude.

Translated to the safe working environment this means that the attitude to risk, i.e. risk perception, influences someone's beliefs regarding risks. These beliefs are based on emotions, knowledge or 'tendency to act' (Glendon et al., 1995). In other words: earlier knowledge and experience with risks and his/her own response to risks determines what an employee believes what the consequences are.

By now we would expect that attitudes are indeed the most dominant factor that explain risky behaviour, (see also Hale, Rundmo, 2003), but this doesn't always hold true. For example, some employees are conscious of the risks, but still do not follow all the safety rules. Apparently someone's attitude is not the only factor that predicts future behaviour. More factors increase or reduce the chance that certain desired behaviour will occur. Another example is the subject of 'smoking': most people who smoke cigarettes like to live a healthy life. Nevertheless they continue smoking cigarettes. This confirms that there must be more factors than attitudes that predict behaviour. A very important factor that also determines the intention to behave in a certain way is 'the social norm'.

A2.10   Social norms (relevant others or institutions)

The role of the social norm, '*subjective norm*' or '*normative factor*', in influencing behaviour is considered as the role of the 'social environment'. In organizations and also outside organizations people are influenced by other people, e.g. their peers, people they admire, their parents, their team of co-workers etcetera (see also the chapter about teams and groups). Especially people or groups that are important for an individual can have influence on behaviour.

Theoretically the social norm consists of two aspects:

- the opinion of the referent group, i.e. 'relevant others' (the *normative belief*);

- the motivation to comply, i.e. the dependency on another's opinion.

The latter is directly related to personality. Since people differ in personality, e.g. high self-monitoring people are more sensitive to social norms and interpersonal influence than low-monitoring people (Meertens, 1988), the social norm always has a variable aspect. Together with an individual's attitude and perceived affectivity, the subjective norm determines someone's intention to behave in a certain way.

A2.11 Perceived effectivity

It is not uncommon that someone who's attitude towards safety is very positive, whose friends and co-workers share this, still has the intention to do a job in an unsafe way. The factor that causes this unwanted intention is called '*perceived effectivity*'. Perceived effectivity says something about how a person expects himself to be able to show the desired behaviour (Bandura, 1986). If you are convinced that you are not able to perform conform the desired behaviour, you will still feel resistant to it, no matter how much you would like to do it or how important it is. Take for example a team leader very involved in safety, who thinks that he is not assertive enough to discuss safety issues with his team members.

A2.12 Intention or behavioural intention

'Behavioural intention' is a psychological construct that is most close to the actual 'overt' behaviour, the benefit being that it can be measured without observing the actual behaviour (by questionnaires). As a consequence this measurement of 'intentions' is the most effective way to predict future behaviour, as long as the measurement actual behaviour is not possible.

A2.13 Barriers and competencies

Measuring people's intentions is the best way to predict future behaviour, but there still is a gap between intentions and actual behaviour. This can be accounted for by:
- barriers:
  - task design/job design, e.g. working hours/schedules, repetitiveness of tasks, variety and complexity of tasks, limited responsibilities of the job;
  - physical conditions of the working environment, e.g. light, noise, working with heavy materials or chemicals, ergonomics;

- social aspects of the task environment, e.g. colleagues, teams, supervision, organizational climate (Zohar, 1980) and culture.
- competencies:
  - seniority/education;
  - ability and skills;
  - personal condition (alertness, fatigue);
  - personality factors traits.

Well known is the fact that young people and less experienced people are more inclined to be involved in accidents. Attention needs to be given to these competencies and barriers in the working environment. A lot of research has been done in relation to the mentioned barriers and competences. These will be presented in the next chapters. It is important to remember that next to training these organizational and personal factors need to be considered.

A2.14 Behaviour

There is only one way to measure behaviour and that is by observing behaviour. Unfortunately in most research aimed at predicting behaviour, the measured behaviour is no overt behaviour (by observation), but intentional behaviour (by questionnaires). Due to the above mentioned barriers and competencies, an employee that has the right intentions, will not behave safe after all.

The model gives us insight in the factors that influence safe behaviour. A risk professional keeping all these factors in mind must be able to change not only the attitudes towards safety in his organization, but also actual behaviour.

The next challenge is to maintain the desired behaviour. Unfortunately changing behaviour doesn't imply the behaviour will be maintained. The chances that behaviour will be maintained will be enhanced when someone receives positive feedback to his new behaviour and secondly when he openly commits himself to the new behaviour.

A2.15 What can be done about it?

- A positive attitude towards safe working is important in enhancing cautiousness and diminishing risky behaviour at the workplace. A positive attitude can be created by communicating the right information about existing risks and their consequences. Training, promotion and awareness campaigns are good methods to enhance a positive attitude to safety. Risk information should be described as tangible as possible to have a successful impact on behaviour. For example talking

about safety is rather vague. Also frequent but less severe risks have probably more impact than policy towards risks that are harmful on the long run. This will be further discussed in the training appendix.

- It is very important to pay attention to the social environment of the targeted employees (the social norm) and the perceived effectivity of the employees.
  - Regarding the social environment it is important to be aware of the enormous impact of reference groups (e.g. successful teams) or relevant others (e.g. team leader, the manager). A good relationship between employees, colleagues and management is an important condition for safety. Respectively team/groups and the role of management will be discussed more thoroughly later on.
  - Regarding the perceived effectivity, several kinds of training can be effective. Training provides a 'safe' setting in which new skills can be practiced. More specialised training can be oriented towards the feeling of perceived effectivity. We will discuss this further in the appendix about training.
- Organizational factors are mentioned as important factors related to safe behaviour. For example task characteristics, e.g. task diversity, complexity, durations of tasks are sometimes even more related to safe behaviour than attitudes. Especially knowledge of the process of the own task makes employees aware of their own behaviour. To enhance this awareness an observation tool for employees to observe colleagues with the same task is effective.

  Other organizational factors that influence safe behaviour are material design, working schedules, managerial capacities or organizational culture, etcetera. The influence of organizational barriers to safety will be discussed in the appendix dealing with the Tripod philosophy.
- There will always be situations in which an employee's competencies do not fit the task requirements, which can be of course a risk to safety. Either they don't have the right experience or background education or they just do not have the ability or the skills to do the job. Also personality factors can have a positive or negative impact on safe behaviour. Sometimes training can bridge the gap. In other cases the organization is advised to use appropriate selection methods when hiring new employees.
- Systematic observation of behaviour (employees - colleagues, team leader - team members) can be of great help to gain insight in good work practices and providing feedback. It is already mentioned that peer to peer observation is effective for employees to get insight in the process of the task. Moreover it is recommended that observations of behaviour should be a structural part of the activities of a risk professional. Systematic observations of behaviour are far more informative because they can give insight in stable behaviour patterns and its causes. It prevents

focussing on deviant behaviour that seldom occurs. With systematic observation the most appropriate preventive safety measures can be derived.

This way a good and active safety policy can have double impact: first it will have a direct effect on safety in the workplace, second it can have a positive contribution to the awareness of employees of the influence of their own behaviour towards safety and the intention to act upon that (Güttinger, 1985).

A2.16   Examples of mechanisms that contribute to intended risk behaviour

Risk Homeostasis: according to the Risk Homeostasis Theory (Wilde, 1981) people will always accept a certain (stable) amount of risk. If someone encounters a discrepancy between this accepted amount of risk and the actual perceived risk, he or she will compensate this by changing behaviour. This means for example that if an employee encounters a higher perceived risk than his accepted risk, he will act cautiously. On the other side he/she has a tendency to act recklessly in a situation with a lower perceived risk than his accepted risk level. This theory is very important because it can explain why some safety measures have no net impact on safety. These measures probably enhance the 'feeling' of safety in such a way that employees will become more reckless.

Cognitive dissonance: the essence of the Cognitive Dissonance Theory (Festinger, 1957) is that two contradictory implications cause an uncomfortable feeling, called cognitive dissonance. To remove this uncomfortable feeling of dissonance, people modify knowledge about the contrary implications.

A2.17   Summary, dos/don'ts

Motivation is an important basis for human behaviour. It guides the decisions and choices between various courses of action open to an individual at any given moment.

Posters, films and informational campaigns can have effect on safety awareness, motivation and can produce change in attitudes towards safety, but their effect is limited over a short period. In general these campaigns can motivate by delivering information which supports action to reduce risks. Information which arouses fear without real perspective on what kind of action can be adequate, is less effective. To motivate for a longer term of change continuous reinforcement through feedback of results and reinforcement for instance by supervisors is required.

1. Arousing safety awareness or motivating by posters campaigns

do	don't
• use clear objectives leading to a clear message • exposure in a visible spot relevant to the action required • design to grab attention • use a simple comprehensible message • use a believable message from a reputable source • deliver a clear motivation to comply	• arouse fear without real perspective on what kind of action can be adequate

2. Motivating by group discussions, training

An alternative way of trying to motivate directly is an open discussion of arguments, in search for solutions and agreement. In strategies to influence behaviour open discussion of the arguments and reasoning which guide people in their current behaviour will help in mutual understanding and the seeking of alternatives. Social groups like workers or colleagues can be very powerful in achieving change, for instance in directed group discussions to change attitudes towards acceptance of safety measures.

do
• use role playing exercises in groups of workers during a safety training to alter safety attitudes • organize directed group discussions with workers in analysing safety problems and generating solutions

3. Motivate by developing ownership in structured safety meetings with employees and supervisor

A participative style of leadership in promoting safe behaviour based on intrinsic motivation will be more desirable for the long-term effect. Safe behaviour from intrinsic motivation helps forming positive attitudes towards safe behaviour possibly being incorporated in cultural layers. 'Safe is the way we do things around here'. Fear and punitive based strategies tend to lead to circumvention, violation and 'hidden' unsafe behaviour. Motivation can be achieved by praise, feedback of results or challenge. To

convert motivational measures in a longer term of change it requires continuous rein-
forcement through feedback of results and reinforcement by supervisors.

do
• motivate by creating ownership through employees' review of safety rules and proce-dures
• stimulate safe behaviour by positive feedback and positive reinforcement through appraisal by walking and talking or appraisal after doing a good job safely

4. Enhancing risk perception and safe behaviour

Risk perception is the individual attitude towards risks. Risk perception deals with the
way risks are perceived and assessed by individuals A positive attitude towards safe
working is important in enhancing cautiousness and diminishing risky behaviour at the
workplace. A positive attitude can be created by communicating the right information
about existing risks and their consequences. Training, promotion and awareness cam-
paigns are good methods to enhance a positive attitude towards safety and so risk per-
ception. Job safety analysis can be a powerful tool to recognise hazards and evaluate
risks before executing a job.

do
• use a system of job safety analysis as a standard preparation of professional job execution
• organise a training for every team on hazard recognition and risk evaluation specially designed for jobs which are relevant for the team
• develop on that basis with the team standards of safe work practices
• show management commitment to safety by actions, it enhances individual perceived possibilities and responsibilities to control safety
• present safety information or education as tangible as possible. Hazard is a more tangible concept than a rather vague concept of safety
• formulate and implement a 'visible' safety policy. It arouses safety awareness amongst employees and perceived influence and commitment to behave safely
• enhance group relationships between employees and between supervisor and em-ployees by collective trainings, meetings or workgroups. It diminishes risky behav-iour
• provide by training a 'safe' setting in which new skills can be practiced. More spe-cialised training can improve the feeling of self-efficacy and enhance safe behaviour

Appendix 3 Competence, Learning and Training

A3.1   Introduction

The ability to learn is one of the most important assets of human beings. To stimulate learning is one of the most powerful possibilities for organizations to develop the strategic capacities of their employees and training is an intervention technique to influence learning (Bergenhenegouwen, 1998).

'Learning and training or in general human development processes are a key element in managing occupational safety risks which need a strategic approach.' (Glendon et al., 1995).

The objective of this chapter is to provide a framework for safety training principles and practices. The aim is to discuss evidence for effective safety training based on literature and practical experience. As mentioned before it is our assumption that training, including safety training, can contribute to strategic business goals and is therefore critical to optimal organizational functioning.

A3.2   The basis of safety training

Like any aspect of business, safety training should have a coherent basis. Safety training is a component of risk management which consists of elements like hazard identification, risk evaluation, development and implementation of controls, monitoring and feedback and learning loops. Safety training has relevance to all elements of this risk management process.

It is important to deal not only with the training of individuals or teams, but also to ensure that there is a match with their organizational environment. In other words, investing in training has to meet the needs of both individuals or teams and the needs of the organization. A strategic approach should ensure that training matches organization development. That is also the basis for the safety training programme, Glendon et al. (1995).

A3.3   The training sequence

Once strategic issues have been addressed, a training programme can be based on objectives which are set for both individuals and the organization. It is important to fol-

low a logical series of steps in carrying out the training Glendon et al. (1995). A job analysis followed by a training needs analysis is the best starting point.

It is important to consider that training has its limitations. Training can only be expected to achieve certain types of objectives. For instance relevant experience may be the only way of acquiring some types of abilities. For example, it is useful to make a distinction between declarative knowledge and experimental knowledge or procedural knowledge, Glendon et al. (1995). The latter knowledge relates to a person's ability to do things and is likely to be based upon long-term experience including training.

Training needs are used as a basis for determining training objectives, van den Berg et al (1996). Objectives are expressed as statements of what the trainee should be able to do afterwards. The training objectives and training issues are the terms of reference for the designing process of the training. The next step is to execute the training with the target group.

The following step of the training sequence is one which is most likely to be omitted, but crucial and that is to evaluate the training. The evaluation process has to assess the training for meeting the objectives, for example in respect of adding appropriately to the employee's skills and knowledge. If evaluation shows that the training has not fully met the objectives, then it may mean that training provision has not been linked with organizational objectives, and therefore that the organization is unable to make effective use of the new skill and knowledge resources. It will then be necessary to review not just training needs, but the whole training sequence, including objectives and training needs. In literature there are a lot of evaluation studies about training or more specific about a related intervention technique which is called Behaviour-Based Safety (BBS), see Appendix 4.

The last step is to monitor training effectiveness in carrying out the job. This means answering the question: 'In the long term, has the investment in training the employees made a detectable difference to the organizations safety performance?'.

This may be a very difficult question to answer. However it is useful to be able to do so, for example by setting appropriate criteria in advance against which performance can be measured, for example, an increase of safety audit scores by a certain amount within a given time period. Or a very ambitious one, a decrease in lost working hours by optimising safe work planning, preparation and executing jobs.

If this question is answered negatively, then a review of the way jobs are carried out by employees will be necessary, Glendon et al. (1995).

A3.4   The learning cycle of Kolb

Learning is a natural human function which involves both mental activity and behaviour, Bergenhenegouwen (1998). Because it is a complex process, it is helpful to have a coherent picture of what learning comprises. One of the best-known models for describing the learning process is that of Kolb (1984). The learning cycle of Kolb reflects that our experiences are the basis for learning, followed by reflections on the experiences and making generalizations from these reflections. After that they have to be tried out in new situations. Kolb's learning cycle is an example of a system which provides feedback to the individual which can result in modified behaviour and thought patterns. We will discuss the importance of feedback in appendix 4, Behaviour-Based Safety (BBS). Individuals have their own preferred style of learning and these preferences are related to different stages of the learning cycle (Glendon et al., 1995). Some people might have a preference for learning through active experience, others would prefer to spend a lot of time reflecting upon their experiences. The best learners have preferences for all components of the learning cycle.

A3.5   Incorporating learning principles in safety training

Although there are individual differences in preferred learning styles, there are some general characteristics of the training context which are likely to influence learning (Glendon et al., 1995).

1. The most important is motivation. Trainees need to be motivated in order to learn. Motivation may be intrinsic, that is generated internally by the trainee's desire to learn. Or it is extrinsic, derived from the training environment, for instance, the trainer's enthusiasm or a bonus afterwards. Training of itself can provide motivation, for example by demonstrating that the employee's organization is interested in developing an individual's skills and knowledge (extrinsic) or because the trainee finds the subject matter and its application fascinating (intrinsic).

2. Another important part of learning is incorporating feedback or knowledge of results within the training. To learn effectively, trainees need to be able to measure their own progress over time. They may also seek to compare their progress with that of their peers. To incorporate a test or exam in a training is an example of that principle. Trainees can adjust their subsequent practice towards a goal of performance optimisation.

3. A related learning principle for use in training is that of positive reinforcement, provided by some form of reward. Rewards for performance during training sessions, used in combination with feedback contributes to motivational effects. Rewards may take the form of verbal encouragement from a trainer or the satisfac-

tion of passing a test or exam and receiving a certificate. See VCA-practice in the Netherlands, where thousands of employees in industry or in the business of industrial services received their VVA-certificate as their first formal educational certificate. This occupational safety system, including safety training, which is compulsory for most of the businesses in industrial services, had a positive influence on the safety performance in general in those businesses.

Rewards are also necessary during training to sustain interest and motivation. Petersen (1989), following behaviourist reinforcement principles, argues the advantages of reinforcing safe behaviour over reprimanding unsafe behaviour, citing a number of studies that have used reinforcement principles to improve work practices and reduce occupational risks and reported injuries.

A3.6   Learning from experience

Another learning principle in occupational safety is learning appropriately from experience (Glendon et al., 1995). It is a challenge for safety training to maximize the utility of relevant experiences by incorporating them into the learning processes. Training for many skills, like driving a car, provides trainees with the basics and after that they have to learn by experience, by trial and error. However, young male drivers who are 'unsafe' tend to perceive driving a car as essentially a skill-based activity, Glendon et al., (1995). Such drivers then have to learn through experience, having near misses, that the time scale of decision-making in driving is longer than they first thought. There are other abilities involved such as planning and accurately perceiving risks in the environment. Training, for example using refresher courses, which involves the discussion of 'trial and error'-experience of the trainee or 'near miss' experiences, can be a valuable way of increasing awareness of risk and improving safe behaviour. For instance TNO Work and Employment uses exercises derived from real cases within a chemical company within trainings for supervisors to conduct accident analysis, with good results as improvement of the quality of the subsequent analyses.

Learning exclusively from your own experiences is both less comprehensive and less efficient than learning from a larger sample of incidents, most of which have happened to others. See the use of near miss management systems (Van der Schaaf, 1991).

It is evident that training can't be the sole influence on safe behaviour, nor a cure for all safety problems within an organization, nor a substitute for inadequate health and safety practices. Training for safety must be considered as one part of the system which also addresses organizational, design, ergonomics and other issues as part of a strategic safety programme.

A3.7 Models for safety training

For the safety training itself it is very important that the objectives, the content and the training process matches the requirements of those for whom it is designed. Hence it is necessary to applicate a systematic model of the processes involved (Glendon et al., 1995).

One way is using a model which is specifically concerned with an outcome of safety training, for example enhancing ability of an individual or group to address danger situations appropriately. One such model is that of Hale and Glendon (1987), who propose a model formulated as a series of questions about the nature of danger and a party's response to it.

LEVEL OF
FUNCTIONING

SYSTEM MODE

Input   Processing   Output

Knowledge

Rules

Skills

| | No | No | | |
| Tests for danger known and carried out? | Yes | Need for action recognized? (Labelled as danger?) | Yes | Responsibility accepted or allocated? | No |

Hazard seeking initiated   No

Obvious Warning?   No

Programmed or insistent danger signals?   No

Plan made and carried out?   No

Procedure known and chosen?   No

Response in program and carried out?   No

Yes

Yes

Yes

Yes

SYSTEM BOUNDARY

Danger unaffected

Danger brought (or stays) under control

(Increasing Static Decreasing)
OBJECTIVE DANGER

Figure A3.2 Individual behaviour in the face of danger model (after Hale and Glendon, 1987)

Stages of the model correspond with the skills, rules and knowledge levels of functioning and can be considered as a series of questions, each of which needs to be answered in the affirmative way for danger to be positively influenced by the humans in the system.

Another way is using a more generic model; SHE-competence management, which is based on the principle of employees being the managers of their own work processes

and associated hazards, on the operational level and as SHE-actors in the safety management system, on a tactical level (Van den Berg et al., 1996). The aim of the SHE-competence management is to develop the ability of the employees to manage these processes adequately, and to manage their SHE-role. So the design of the training is based on an analysis of work processes, tasks and jobs; analysis of associated hazards and the safety management system. It is followed by a training needs analysis to manage these processes and SHE-role on three levels of ability: knowledge, practical application or skills, attitudes towards risk management. TNO Work and Employment developed such a system in the Netherlands for a variety of vocational educations in the technical industries, for instance the education to process operator in chemical industry on four levels up till the level of supervisor (Van den Berg et al., 1996). The basis of a training or development trajectory for every function or job is called a document with terms of reference. It includes all training objectives which are operationalised with respect to needed levels of knowledge, skills and attitudes. TNO Work and Employment made such documents for functions and jobs in a variety of vocational educations in the technical industries in the Netherlands. A pilot study was conducted at a petrochemical company for developing such documents for different industrial jobs, for instance working in an explosive and toxic H_2S environment together with the monitoring instruments to measure the training effects, such as a 360° feedback monitoring system. This was a pilot study to develop a SHE competence management toolkit for this chemical company.

To secure long-term positive changes in safety practices it is necessary to change both behaviour and attitudes, see appendix 2. Changing attitudes is a necessary but not sufficient condition for changing behaviour. However compared with most approaches to safety training, for example more traditional trainings which are focused on cognitive or skill based objectives, a special technique of applied psychology called safe behaviour modification or Behaviour based Safety (BBS) is perhaps more readily appraised. The last 20 years a wide variety of evaluation studies was published. In these studies we see a strong link between learning and training through behaviour modification and motivation. These studies examined the effectiveness of positive reinforcement and feedback and found that that there was some success in improving safety or reducing accidents (See appendix 4).

A3.8 Objectives of safety training

As mentioned before a strategic context for overall objectives of safety training is needed, as well as a strategic direction to the shape, format and methods of safety

training. Once it has been established what role safety training will play within the organization's overall safety strategy, the components can be planned. A good safety policy should be the basis of the principles and objectives of a safety training. In Glendon et al. (1995) Warburton identifies a number of features of safety training which are associated with good safety (and other) performance:

1. identification of training needs and target groups;
2. feedback of accidents and inspection data into safety training programme design;
3. periodic monitoring of training for effects (evaluate);
4. provision for updating the training (improve);
5. assessment of the trainer's competence;
6. involvement of employees in development/evaluation;
7. management commitment to safety training in safety policy.

The importance given to, and the effectiveness of, safety training is among the key aspects of safety culture. The safety culture of an organization comprises the combination of employee attitudes, values and behaviours which reflect the commitment and actions of its management to safety. See Appendix 6.

An important component of safety culture is top management commitment to safety. One way of expressing management commitment to safety training is being involved, both as participants and as trainers (see case A3.1 in § A3.9).

A3.9 Summary, dos/don'ts

Development of competence, including, safety competence, and training must have a strategic, systematic a coherent basis. So it must be linked with company goals and especially with safety policy and safety management system.

Safety training is a component of risk management, so safety training can be linked with the elements of the risk management process like hazard identification, risk evaluation, development and implementation of controls, monitoring and feedback and learning loops. Trainees need to be motivated in order to learn. Training can of itself provide motivation, for example by demonstrating that the employee's organization is interested in developing an individual's skills and knowledge (extrinsic) or because the trainee finds the subject matter and its application fascinating (intrinsic).

Another important part of learning is incorporating feedback or knowledge of results, within the training. To learn effectively, trainees need to be able to measure their own progress over time. They may also seek to compare their progress with that of their peers. To incorporate a test or exam in a training is an example of that principle. Trainees can adjust their subsequent practice towards a goal of performance optimisation.

1. *Safety training*

Do	don't
• make it a rule that the company's safety policy is an integrated part of every safety training • make it a rule within the company that management opens every training with discussion on safety policy • conduct a job analysis and training needs analysis before designing a training plan • make all trainings part of a company training plan as a coherent framework: so different training objectives and different target groups • make a link between training objectives and safety awareness, safe behaviour or safety culture on the workplace or some sort of desired safety performance • establish the degree of actual knowledge, skills and attitudes, link them with training objectives and desired training issues, exercises, group works and other training tools • design active participation of employer (SME), management or supervisor in training • incorporate other elements or results of SMS in training: for instance information on incidents, accidents, analysis, actions; special safety devices for developing skills to work with them • incorporate other elements of experience or collective company learning • continuously state the relevance of the training issues with the working practice • identify the limits of a training: what	• do not train employees with irrelevant or already mastered knowledge or skills • never postpone management attendance on safety trainings because of other priorities • never start a safety meeting or a training too late • do not allow absence without good reason

Do	don't
you can not achieve with training needs supportive or complimentary actions • evaluate the training on performance and improvement in work practices • management or supervisors give positive feedback, and positive reinforcement on training outcomes • assess whether it is necessary to adjust parts of SMS as an output of discussions in the training	

2. *Learning by using practical experience from the company and implementing training results in own work practice*

Case A3.1 Training accident analyses for managers and supervisors at a chemical company
Management's view of this company was that incidents or accidents are non-conformities of the management process of supervisor or manager. So it is important for a manager or supervisor to develop the skills of investigating and analysing reported incidents or accidents. Assessing the current quality of these investigations, analyses and reports, it was obvious that these were not adequate. Most important was identifying the root causes not adequately because of superficial analyses and quick blaming the victim. So a training was designed and executed with issues like safety management, human factors, accident causation, accident modelling and investigating and reporting techniques. In the training a group works with exercises and horrible stories from the company itself, and the trainees are asked to make homework by investigating a case and making a report. This was assessed by the trainer and the company's safety adviser. One important issue was raised during the group discussions many times. It was confirmed by managers and supervisors that in the past, the company culture was such that: • people were blamed for unsafe behaviour when there was a negative outcome; • supervisor will turn a blind eye when you behave unsafely with a positive outcome; • there is lack of positive feedback or positive reinforcement if you behave competently and safely; • sometimes, during the night shift the production rate was 120 % of the designated rate. This raised no questions of management! During this trajectory it became clear that within the company nobody was satisfied

Case A3.1   Training accident analyses for managers and supervisors at a chemical company

with this and a change towards a blame free culture was needed. By monitoring the quality of the incident and accident reporting, it was concluded after a while that quality improvements were observable in investigations, reports and follow up (response time and quality of measures).

do

- design and execute trainings based on and related with daily practice of trainees
- use group works and group discussions to trigger reflection and influence attitudes
- give feedback on training results e.g. monitoring the quality of accident analyses and reports

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Appendix 4 Behaviour-Based Safety

A4.1   Introduction

One of the most demonstrably successful approaches to safety training in terms of positive evaluation from controlled studies, is that of behaviour modification or Behaviour- Based Safety (BBS), which, like other aspects of safety training, is closely linked with motivation (Cohen et al., 1979; Sulzer-Azaroff et al., 1980; Zohar, 1980; McAfee et al., 1989; Sulzer-Azaroff et al., 1999).

These evaluation studies show a strong link between learning and training through behaviour modification or Behaviour-Based Safety (BBS), and motivation through the effectiveness of the intervention technique of positive reinforcement and feedback on observed behaviour at the workplace by supervisors or peers.

A4.2   Behaviour based safety programmes

There are a lot of companies in the Netherlands, most of them international companies in the chemical industry, that apply the principles of Behaviour-Based Safety in all sorts of programmes with names like Observation and Communication or Observation Unsafe Behaviour, etc. Most of these programmes start with observation of employees at the workplace by a colleague with or without a checklist. During this observation the colleague will give feedback on the observed behaviour. This can be feedback on compliance, safe behaviour, and functions such as positive reinforcement or on non-compliance. It is also useful to have some sort of discussion about reasons or causal factors which play a role in the observed behaviour. This is an important part of observation and feedback in order to apply this sort of programme as a motivational strategy. It is of great influence to explicate the hazards of the job by this process. It supports the development of the cognitive process of hazard recognition. This is one of the aspects of the role of humans in the process of risk control (Hale et al., 1987).

During the process of observation and feedback it may be possible for the employee to control the risk by adjusting his behaviour or adjusting sub optimal performance shaping factors or environmental factors. That is the case when he is competent or mandated to do it himself or it can be done by his supervisor, for instance using the proper tools or making a professional scaffold to do the job or postponing the job because of the bad weather conditions. In other cases it is possible that the causal factors for unsafe or substandard behaviour have their roots in performance shaping factors on a higher organizational level. Reason (1990) refers in these cases to General Failure

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Types. Groeneveld (1998) uses the term Basis Risk Factors. In that case it is important that this information is delivered at the proper managerial level. In that way the BBS programme also deals with the behaviour of the manager, the designer and constructor. That is why most Behaviour-Based Safety programmes use a kind of a journal to report the findings to process it as management information within the framework of the safety management system. On that basis management actions will be possible. If a company implements the system in that way it is the best guarantee for closing the feedback and learning loops and a basis for real safety improvement.

It is obvious that in order to function adequately, an important element within the BBS programme or system is training in advance. In this training the target groups will be employees, supervisors and managers. The basic principles of human behaviour and risk management are a part of such a training, including the concept of risk perception, but also training the social skills to give positive feedback and to report the findings in a proper way will be an important element.

A4.3   Success and failure of BBS-programmes

The last decade BBS-programmes, with their origin in the United States, became more popular for our customers in the Netherlands. And as mentioned before, in literature a lot of evaluation studies were published and delivered factors for success and failing of these programmes.

Key elements of a successful programme
- A written norm of standard behaviour; relevant and easy to observe.
- Active involvement of employees in the system; ownership by employees or teams.
- Management commitment and active support.
- Gathering information only by observation not interpretation.
- (Undelayed) management response on the basis of gathered information.
- Training for all target groups in advance, on the skills of observation and giving feedback.
- Positive feedback and positive reinforcement in order to improve.
- Simple interventions, functional and integrated with the company safety policy.
- Observation of direct behaviour, not focussed on negative consequences.
- Feedback on observed behaviour as soon as possible.
- Integrated in organization and systems, with closed feedback and learning loops.

Fail factors
- Manipulation, faking observations, reports or analyses.
- Stress on output: accident statistics and not on behaviour itself.
- Negative feedback, blame and punishment.
- Modifications without commitment.
- Absence of management commitment.

Outcomes
- Reducing incidents and accidents.
- Increase in safety performance, work practices in accordance with policy, compliance as a precursor of a safety culture.
- Reducing costs by safe work processes through optimising planning, preparation and execution.
- Generalization and transfer to other aspects of work, awareness and ability to innovation.
- Culture of improvement.
- Increase in information from shop floor; developing an open and no-blame climate.

A4.4   An integrative approach

As mentioned before a BBS-programme should not be a stand alone activity. It should be a subsystem within the safety management system, like subsystems as near miss management or SHE competence management. And there should be a link with maintenance management or with safety engineering, etc.

Such an integrative approach also has a positive contribution to safety awareness of the whole community within a company because of the continuous visibility of safety in most business aspects, again a precursor for a safety culture (Hudson, 2003).

TNO Work and Employment used such an integrative approach to design an improved BBS-programme linked with the safety management system.

A4.5   Summary, dos/don'ts

There is strong evidence from evaluation studies which show a strong link between learning and training through behaviour modification or Behaviour-Based Safety (BBS), and motivation through the effectiveness of the intervention technique of positive reinforcement and feedback on observed behaviour on the workplace by supervisors or peers.

These are very popular programmes for instance in chemical, metal and constructing industry, with a lot of names like Observation and communication, Observation Unsafe acts.

From these evaluation studies there is some sort of a pattern of factors for success and failure:

do	don't
• use a written norm of standard behaviour; relevant and easy to observe • organise active involvement of employees in the system; create ownership by employees or teams • show management commitment and active support • gather information only by observation not interpretation • give quick and undelayed management response on the basis of gathered information • deploy a training for all target groups in advance, on the skills of observation and giving feedback • use positive feedback and positive reinforcement in order to improve • conduct quick simple interventions, functional and integrated with the company safety policy • stress the importance of the observation on direct behaviour, not on negative consequences • give feedback on observed behaviour as soon as possible by colleague or supervisor • integrate this technique in organization and systems, with closed feedback and learning loops	• stress on the output: accident statistics and by that forgetting that the observed behaviour itself needs the focus in functioning this system • give or tolerate negative feedback, blame and punishment • conduct modifications without commitment, you will loose ownership by employees • show lack of management commitment, you will loose motivation and trust in putting effort in the system by employees • manipulate by faking observations, reports or analyses; by that you will loose trust and ownership by employees

Appendix 5 Safety and Teams

A5.1   Introduction to teamwork

In organizations it is increasingly recognized that the effectiveness with which groups or teams perform is critical to survival and success. Working in teams has become a necessity in the current working environment since tasks have become more complex and interrelated, also in the area of safety. Organizations use teams to focus a group of people on a specific range of tasks or one single task. The activities of teams are especially apparent for groups that operate machine simulators such as those of airplane pilots crews, air traffic controllers, nuclear power plant operators and the like.
Working in teams has its impact on safety and risk perception. How do you motivate a operational team for safety? Moreover dealing with safety and risks it selves is more and more a question of teamwork (think of safety audit teams, safety committees, quality circles, etcetera), as good safety practice asks for a variety of disciplines and interference with different parts of the organization.

A5.2   Teams and groups

A team is a group of people working on the same (range of) task(s) or working for the same purpose. The term 'group' or 'team' can be used interchangeable. Groups or teams can be formal or informal, permanent or temporary. Teams tend to be more formal. An example of a permanent formal team is a safety committee or the managers in the boardroom. An accident investigation team is mostly temporary, but can also be structural. Informal teams or social group emerge spontaneously in workplaces (even within formal teams), e.g. evoked by equal interest or proximity. A special type of group is a 'reference group'. A reference group is a group to which a person aspires membership and as such influences the individual's behaviour. This can also be a team or an informal social group. Often the reference groups are very successful groups, e.g. a shift with a good reputation. Such 'champion teams' influence non-members outside the group, because they want to be associated wit this success.
As a safety and risk professional it is important to understand why some teams are effective and others are not. As concluded earlier (see also the chapter concerning 'attitudes') attitudes toward risky behaviour are very much influenced by social norms. These norms are influenced by colleagues in the working environment, especially by relevant others, by peers and by the norms of our wider society. The power of a group in determining individual behaviour should not be underestimated. Expectations of

fellow workers as well as management in adherence to safety rules can exert strong influences upon the way people act. Thus, as a result of the fact that employees work more and more together in teams, knowledge of individual's attitudes, personality traits and capacities are insufficient to motivate people for safety. The different roles, functions and dynamics of teams in organizations need to be considered too.

A5.3 Characteristics of teams

Group norms

Kelman (1985) expressed the extent to which an individual relates to the norms or expectations of a group (or organization). At the first level - compliance - the individual complies because of a rule to behave in a certain way (e.g. to wear a safety helmet) and because of the sanctions imposed on it. At the second level - identification - the worker wears the safety helmet because other members of the group do and no one wishes to stand apart from the group. At the third level - internalisation - the worker wears the helmet because he or she considers it to be the best way to behave in response to perceived risk. Kelman illustrates that behaviour may be influenced by the organization imposing rules, or by groups of workers deciding to behave in a certain way (a norm). However, only when individuals believe that the behaviour is correct (internalisation), their own safety is consolidated. Thus, an important conclusion is that behaviour can be enhanced by organizational rules, but also by group norms which are consistent with safe behaviour.

Group norms are mostly implicit, but will be become obvious when they are not followed. For example a worker who ignores safety rules in a group that sees safety as very important, is deviant. His team mates will notice his deviant behaviour very soon and will try to influence him to behave more safely. The social background of an individual worker can also have an important impact on his group behaviour. For example a plant in a small village where most of the workers know each other from outside the working environment, can experience severe safety problems. The outside social norms, e.g. provoked hierarchical standards, can influence compliance of rule and openness within a team.

Cohesiveness

Another important characteristic of teams is the cohesiveness. When group members share common values, beliefs and objectives, sharing of similar ideas and their mutual effectiveness are promoted, so advancing group cohesiveness. Mostly group cohesiveness leads to positive impact, but under some circumstances there can also be adverse

impact on safety. In a strongly cohesive group 'them-and-us' sentiments can develop, causing other groups to be perceived as hostile.

A5.4 Group influences

Another interesting feature of groups is that group membership can lead to a change in attitudes, especially when this group is an important reference group. Two important features of group influence are *social comparison* and *social control*.

- *Social comparison* means that we tend to compare ourselves with others to test our ideas in a variety of social situations. For example the safety and risk professional is continually comparing his or her views on professional matters with others experts or line managers who have to implement safety policies. People do this to check the validity of their judgements. As a result, individuals in a group tend to converge their opinions, thereby creating a norm.

For safety issues it can be very valuable to exchange views with interested parties before deciding on how to respond to a severe incident or how to cope with the aftermath. A multi-disciplinary accident investigation team can then be of great help. But working in teams can also lead to social pressure for an individual to conform to the group. Under the influence of social pressure a team can make wrong judgements.

- *Social control* is pressure exercised from above instead of team members. Experiments on obedience (Millgram,1965) have shown that people are prepared to do terrible things to other people because an authority person instructs them to do so. Moreover people who are isolated form their friends or their norm group (e.g. in brainwash experiments) can loose mental stability.

Membership of one group can also lead to friction and prejudice to other groups. In the past conflicts between groups have been the cause of accidents. Reason (1987) describes how a conflict between two groups, the operators and the experimenters in a nuclear power plant, has led to the Chernobyl disaster by failing to communicate to each other. In preventing conflicts between groups, it can be helpful to bring groups together and let them work temporarily for a common goal. It is not advisable to have other social contacts between conflicting groups, because the information of the disliked groups will be interpreted in a negative stereotyped way, and so even lead to more conflicts.

A5.5 Benefits and threats of teams

Working in teams has *benefits* for individual members and for the organization as well.

- Individual benefits are: social needs like friendship and support, self-identification, opportunity for discussion, questioning and listening to other's opinion on issues that are important for the individual, support in hard or insecure times and protection from hostile intentions of other groups or powerful individuals.
- Organizational benefits are: distribution of work to people with a unique set of skills, creation of a forum in which information is exchanged and ideas are tested, a place for generation of new ideas and creative solutions to complex problems, coordination and liaison, increasing commitment and involvement, being a forum for settling disputes, for negotiation and conflict resolution and for implementations of decisions, as well as in decision making.

There are also *negative* aspects of groups.
- Because groups serve a variety of functions and provide benefits for the organization and for individuals, it is not unlikely that conflicts could arise in the execution or appreciation of these functions and benefits. For example an individual that is looking for support of his own ideas in a group, can be disappointed if this team appears to be designed to increase commitment in the organization.
- Risky shift (Semin & Glendon, 1973) is the mechanism that people in groups make more extreme decisions (more risky and sometimes more careful). This is caused by the fact that responsibility is spread among group members and individuals feel less responsibility for potential loss. The consensus then moves towards greater acceptance of risk.
- Groupthink (Janis, 1972) arises when group norms are more important than the individual norms: conflict will be avoided, impulses not corresponding to the group's opinion will be neglected, alternatives are overlooked, own capacities are overrated and other groups' capacities are underrated.
- The mechanisms of 'groupthink' or 'risky shift' occur mostly in groups with the purpose of decision making and especially in highly cohesive groups. They can be a real threat to safety.

A5.6   Effectiveness of a team

According to Thorne (1992) there are seven fundamentals of effective teams:
1. the goals should be clear;
2. rules or norms should be followed;
3. roles should be divers and clear;
4. relationships are healthy;
5. the existence of team rituals;

6. rewards as a pay-off for membership;
7. results, a feeling of added value by working in a team.

The preferred size of a team differs dependent on the necessary skills and experience that is needed to perform a task. The optimal size of an team is 5 to 7 but sometimes more knowledge (more people) is necessary. According to Belbin (1993a) team size can go up to 11 if necessary, but the larger the team, the more a formalized structure is needed.

Hackman (1990) concludes that the following *organizational conditions* are required for effective teamwork:

*   the workgroup should be well designed (tasks, composition, norms of conduct);
*   only the ends should be prescribed, not the means;
*   a clear and engaging direction should be given to motivate the group;
*   expert coaching should be available.

Coyle and Leopold (1981) and Beaumont et al. (1982) have specified important features for the *effectiveness for safety committees*, e.g. the presence of senior managers to approve decisions and to indicate priority given to H&S, being representative of the organization, having regular meetings with good minutes, being close to the scene of the action, having members strongly committed to H&S, being regularly attended and having a manageable size.

Some researches show that effective safety committees are related to positive safety results, but this can both be a reflection of a broader safety culture (see Appendix 6, safety culture).

A5.7   Teamwork or not?

Being aware of what makes a team effective, and moreover being aware of its benefits and threats, the question arises whether to use teams or not. The most important issues would be whether this would:

*   improve the quality of the decision;
*   increase the likelihood of the acceptance of the decision (by authority);
*   be efficient in the use of time;
*   contribute significantly to subordinate development.

In general groups outperform individuals in activities that:

*   require a variety of information;
*   are judgemental instead of factual;
*   need to bring together different ideas, and need building on them prior to arriving at a decision;

- need to gain employees' acceptance of a decision and commitment to its implementation.

When choosing for groups in making decisions concerning safety, groupthink can be a major threat. The basic principle to apply in overcoming groupthink is to ensure *heterogeneity of inputs* in order to break the group norm of conformity. It is to be ensured that a diversity of decision making styles is present among group members.

Techniques for reducing homogeneity of thought among group members are:

- critical evaluations in group decisions;
- encourage openness in doubts;
- the team leader is open for criticism and avoids stating his preferences or expectations about the outcome at the beginning of the discussion;
- conclusions can only be derived after an adequate number of alternatives have past;
- decisions are tested against external parties;
- use external expertise in decision making;
- ensure heterogeneity among members. One approach to get this heterogeneity is considering team roles.

A5.8 The use of team roles to enhance effectiveness of teams

By considering team roles, heterogeneity within groups can be acquired. Heterogeneity is not only required for successful team performance, but also for preventing groupthink. Introducing team roles thus enhances effectiveness of teams and diminishes the major threat of teamwork to safety, caused by homogeneity, at the same time. One of the best known models is Belbin's model of 'team roles' (1998). This model has strong links with personality traits in particular. The 9 roles, defined by Belbin are:

1. shaper;
2. coordinator;
3. resource investigator;
4. plant;
5. monitor evaluator;
6. team worker;
7. implementer;
8. completer/finisher;
9. specialist.

According to Belbin a team role reflects the characteristic personalities and abilities to contribute in a team. When experimenting with teams comprised of individuals with similar personalities, he found that each team had its strength and weaknesses and that their effectiveness also depended on the task set. But essentially he stated that those teams composed of 'pure' personality types, while they can perform well in circumstances that match their abilities, are prone to too many weaknesses across a range of tasks in the long run. In experimenting with different combinations of team roles, Belbin found that while various combinations of roles could achieve success, the best teams were those that have a good spread of team roles represented. That means the teams were composed of individuals whose preferences and abilities naturally led them to adopt different roles within a team.

Individuals who were considered to be 'good to have in a team' (in whatever role) had the ability to:

- time their interventions appropriately;
- vary their role;
- create roles for others;
- do some of the jobs that others deliberately avoided.

Belbin (1998) summarizes 6 underlying factors that influence team role behaviour:

1. personality: extraversion-introversion and neuroticism-stability;
2. mental abilities: high intelligence can override adverse aspects of personality;
3. values and motivations: underlying values and motivation;
4. environment: constraints, e.g. available resources;
5. experience, personal experience and cultural factors which may serve to adapt behaviour to certain wider social norms;
6. role learning: awareness and learning of how to play a role improve personal versatility.

By implementing team roles, the effectiveness of teams can be enhanced and threats caused by homogeneity can be diminished. In working with team roles the following aspects should be considered.

- It is important to understand that mismatches between individuals and work roles may judge people as incompetent, when they are actually ineligible for that specific role. Also Belbin's theory changes personality-clashes in role-clashes, a less dramatic term, but a more adequate description of disharmony at work.
- Adapting behaviour is often possible as most people have a second or third choice team role. Everyone should fill in the role he feels comfortable in.
- Every role has positive behaviour and negative behaviour, and also behaviour that is really undesirable. Of course the undesirable behaviour should be minimized.
- Most important for effective team work is that the individual's own assessment of his or her team role matches the other's assessment of their team role. Especially

people with incoherent (confusing) team roles can be dysfunctional for team performance.

What to do about it?
- Training of teamwork (leadership, decision making) can be very effective next to individual training (Goldstein, 1993). Combined with simulators it can be especially effective in training crews in their safety performance, e.g. Crew Resource Management training in aviation and Bridge Resource Management training for seafarers (see also the team chapter).
- The team roles can be used in several HRM instruments, e.g. as criteria for training (see the former point), but also in selection of employees if certain roles appear to be underrepresented.
- In daily practice the team roles can be used to define effective teams and assure heterogeneity in teams.

A5.9　　Summary, dos/don'ts

Attitudes toward risky behaviour are very much influenced by social norms. These norms are influenced by colleagues in the working environment, especially by relevant others, by peers. As a result of the fact that employees work more and more together in teams, knowledge of individual's attitudes and capacities is insufficient to motivate people for safety. The different roles, functions and dynamics of a team in organizations need to considered too. For example: first an individual complies because of a rule to behave in a certain way (e.g. to wear a safety helmet) and because of the sanctions imposed on it. Second, the worker wears the safety helmet because other members of the group do and nobody wishes to stand apart from the group. Third the worker wears the helmet because he or she considers it to be the best way to behave in response to risk. So behaviour may be influenced by the organization through imposing rules, or by groups of workers deciding to behave in a certain way (a norm). However, only when individuals believe that the behaviour is correct (internalisation), their own safety is consolidated. Thus, an important conclusion is that behaviour can be enhanced by organizational rules, but also by group norms which are consistent with safe behaviour. Group norms are mostly implicit, but will become obvious when they are not followed. For example a worker that ignores safety rules in a group that sees safety as very important, is a deviant. His team mates will notice his deviant behaviour very soon and will try to influence him to behave more safely.

1. Group discussions and safety workshops

do	don't
• execute safety trainings or workshops with complete teams including supervisors	• forget the scope of the sessions by discussing issues beyond responsibilities of employees which they are not able to manage
• discuss in this training on daily safety practices, dilemmas and solutions which are relevant for the group	
• use role playing exercises in groups of workers during a safety training to alter safety attitudes	
• organize directed group discussions with workers in analysing safety problems, generating solutions and making action plans	

2. mandating of parts of SMS to groups

do
• create ownership by participation of groups, shifts, teams or departments within implementing elements of SMS. For instance review and maintenance of safety rules, procedures, training manuals
• involve employees in designing and implementing special safety projects

3. Safety committee with representatives of employees

do
• install a safety committee as a committee of the Work Council in order to contribute to the company's safety policy with special tasks or assignments on behalf of the employees
• install a safety committee as a advisory committee of management or department in order to contribute to the company's safety policy with special tasks or assignments

Case A5.1 Workshops Challenging the safety policy
In order to show management commitment towards the safety policy and to start a direct dialogue a chemical company started workshops for all employees, including managers and supervisors which were attended by the chief executive. Under direction of external moderators the discussion was stimulated between operators, supervisors and chief executive on safety policy and the practical implications of daily operation and its dilemmas. 'How do you want us to react on that?' was the permanent question. Later on the discussion and group works focused on solving the dilemmas on a safe way of working, which at the same time is good for operation and business. This trajectory was an element in the development of a process on understanding and trust between management and employees.

do	don't
• be challenged as a manager on safety policy and admit on sound arguments that adjustments in implementation of the safety policy may be needed or need improvement of resources, means or conditions • be consequent and create by that trust	• forget the importance of genuine leadership and importance of role modelling towards safety in all your behaviour and actions

Appendix 6 Safety Campaigning and Safety Culture

A6.1   Introduction

In this appendix we will discuss the concept of safety culture and safety campaigning. Why it became a useful subject of study is discussed besides the possibilities of describing a safety culture. Some definitions and characteristics of safety culture are presented, where after two different views of the concept of safety culture are described in more detail: firstly, the approach of Schein, an anthropological management consultant who has done research on organizational culture for many years in different companies. Secondly, the approach of Patrick Hudson who has developed a model of growth towards an excellent or generative safety culture for the Shell organization. Thirdly, an overview is given of characteristics of functional and dysfunctional safety culture. After that we come to a work definition of safety culture with which we can operationalise the concept. The definition is further explored in the last part of this appendix in which we describe the possibilities of changing the culture through different approaches with specific attention to safety campaigns.

A6.2   The development of safety

One can reason that in companies in which attention is given to a safety culture, accidents can be avoided because people are conscious of the risks and environmental factors that lead to unsafe behaviour. Despite the fact that a 'safety culture' is seen to be important, it is often unclear what is understood by the term, how a safety culture is created and what the advantages can be for the company.

In organizational thinking, the term 'culture' has spread immensely in the Anglo-American literature after two books published in the 80s ('Corporate culture' by Deal & Kennedy, 1982 and 'In search of excellence' by Peters & Waterman, 1982). Hofstede (1991) defines organisational culture as 'the collective mental programming which specifies members of one organisation from members of another one'. He uses the terms 'values' and 'practices' to distinguish between cultures. Practices are considered to be symbols, heroes and rituals. Values are learned early in life and can be very different between national cultures. Practices are learned later in life and can vary strongly between organisational cultures.

So the core of the company's (operations) comings and goings can be described by the shared values and beliefs of the group of people. On the one hand, this determines what people consider to be important; on the other hand, it determines 'how things are done

here'. Since the 1980s, research has shown that a 'strong' culture (Peters & Waterman, 1982) or a 'homogenous' culture (Hofstede, 1991), one that reaches into every corner of the company, leads to a successful company result. So it is not strange to consider that successful safety management is the result of a strong safety culture.

In time there has been a shift in attention to achieve safer production methods. From the 1940s there has been a strong focus on technological solutions, which can be understood by the strong and fast development of industrial process after the Second World War which made available many new substances, materials and methods. After that period until the 1960s the emphasis came to be on the human factor in a way that much effort was put into research how people made errors. Many theories created in these years (appendix 8), are still used in modern approaches towards safety. After the 1980s however a strong focus emerged on the organizational influence of safety: it became a management issue. Large accidents such as Three miles island and Piper Alpha did arise consciousness that systems were made so complex that only a very thorough and sophisticated approach towards safety could control all possible failures of the interactions between men and machines. Safety management systems were developed and installed.

The next stage of development in safety approaches is not focussed upon rational management systems or planned action taking but on the more abstract notion of 'safety culture'. With this term one can imagine useable and chaotic principles or processes which apply for a resulting culture as well as observable outings (practices) such as dress codes and ways of problem solving.

A6.3   What is safety culture?

Safety culture is a multidimensional en -facetted term. One can say that a safety culture is always present as part of a company's culture. It is that part of the culture that is:
- considering or dealing with the safety risks of the business or
- linked to safety in a way as a latent or active failure as a cause for an accident.

The safety culture becomes manifest in the way a company controls the existing hazards and risks. Research towards safety culture has shown the degree of control and how to link this with the mechanisms that are determining the culture (the different layers). So: why does a company do the things it does to control the hazards? Or why does it invest in technological measures and not in behavioural measures? Research should answer these questions within the layers of the safety culture because that represents the way (groups of) people are expressing themselves.

The existing culture is transferred to new members of the organization. The moment of 'getting used' to a new organization is a particular and critical expression of culture. In

this process people are learned how to behave and how to deal with the existing hazards and risks.

Many definitions of safety culture have been given, such as the one presented by the Health and Safety Commission (1993): 'The safety culture of an organization is the product of individual and groups values attitudes and competencies and patterns of behaviour that determine the safety programmes. Organizations with a positive safety culture are characterised by communications founded on mutual trust, by shared perceptions of the importance of safety and by the confidence in the efficacy of preventive measures.'

In his review article (2000) Guldenmund summarizes the characteristics of safety culture, as is stated below.

Table A6.1 Characteristics of safety culture

characteristic	specification
1. it is a construct	being an abstract concept it sets the stage for discussion how to operationalise it
2. it is relatively stable	researchers found a stability period of at least five years
3. it has multiple dimensionality	dimensions are almost always composites comprised of several variables, so again, this is open for disagreement among researchers
4. it is shared by (groups of) people	words involving this characteristics are: mutual, holistic, perceptions, a whole that is more than the sum of its parts
5. it consists for various aspects	safety climate being a distinct yet related concept which can be seen as the current surface features of safety culture. It can be discerned from attitudes and perceptions of employees. This also includes the possibility of subcultures within an organization
6. it is practices	seeing culture as having multiple layers, at each of these levels, the manifestations of the culture can be studied separately. Important notion is that this characteristic implies that culture is learned
7. it is functional	it supplies a frame of reference for behaviour. In this sense the influence of management and management's commitment and actions towards safety are very important. Communication of management and interaction by supervisors are considered to be strong forces as a reference for other

It is clear that although the knowledge and proof about what is important in safety culture is poor, there is some beginning of a consensus about what is important. Still there are many topics which are subject of debate between researches as is stated in the table above. Two different views on safety culture are discussed in the next paragraph.

A6.4   Different views on safety culture

The descriptive model of Schein
According to Schein (1999) culture is 'a pattern of shared basic assumptions that the group learned as it solved its problems of external adaptation and internal integration, that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems'.

In this definition the collective values are mentioned as an element of culture. Schein chooses an anthropological approach in which he searches for the real core of the culture. He describes culture as a mechanism for making the world meaningful and predictable, for avoiding the anxiety that comes with unpredictability and meaninglessness. He chooses a model with several layers which is quite dynamic in the way the layers can be filled in. Schein considers that culture can be changed or developed despite the long duration it may take (1999).

Using the concept of organisational culture of Schein, Guldenmund (2000) conceptualises safety culture as having three layers which can be studied separately (artefacts, espoused values and basic assumptions). The basic assumptions are the core layer which is defined as 'the implicit assumptions that actually guide behaviour, that tell group members how to perceive, think about, and feel about things.' Such assumptions 'have become so taken for granted that one finds little variation within a cultural unit. (…) Members will find behaviour based on any other premise inconceivable.' (Schein, 1992: p. 22). This layer can only be constructed by thorough research and forms the base of much responses groups of people will show on challenges they meet. It functions as explanatory variables to explain the attitudes found. The core is assumed to consist of basic assumptions, which are unconscious and relatively unspecific and which permeate the whole of the organization.

The next layer consists of espoused values, which are operationalised as attitudes. Attitudes have specific objects and therefore this layer is, necessarily, specific with regard to these objects. By questioning these, attitudes can be discovered. Guldenmund (2000) suggests four categories of safety attitude objects: hardware, software, people and behaviour. The safety attitude can be equated to the second layer of Schein, the espoused values. The attitude objects are specified in the table A6.2.

Table A6.2 Attitude objects (from Guldenmund, 2000)

attitude object	specification
1. hardware	• safety measures/arrangements • personal protection equipment • hazards/risks
2. software	• procedures/policy • training • information • knowledge
3. people	• management • supervisors • workers (self/colleagues) • work group(s) • staff • organisation • authorities
4. behaviour	• responsibility/scepticism • communication • recognition • control

Finally, the outermost layer consists of particular manifestations, which are also specific to the objects. These are the most observable of a culture but the most difficult to explain in terms of the other layers. With regard to safety one might think of inspections, posters, wearing or not of PPE, accidents or incidents, near misses or different types of behaviour.

A model (see figure A6.1) can be used to visualise the three layers of organizational culture. The goal of the diagnosis using this model is to construct the basic assumptions which lay underneath the observable other layers. With this one can complete the description of the culture and of the mechanisms with which (groups of) people work. For safety culture they can be constructed to see how a group of people is working with risks and hazards.

1 **Artefacts**

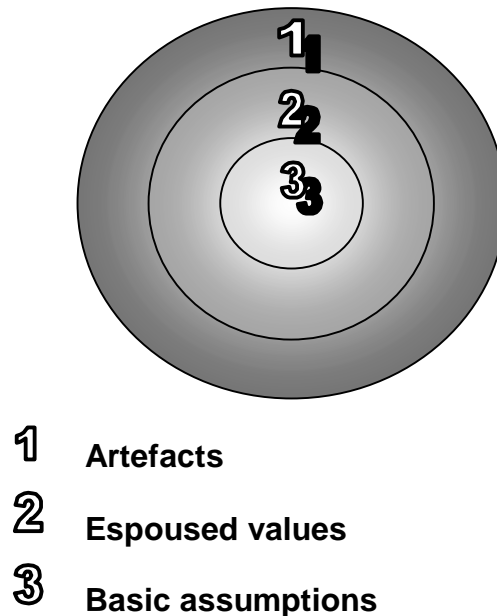2 **Espoused values**

3 **Basic assumptions**

Figure A6.1 Three levels of organizational culture

Schein has included two of the three responses commonly associated with attitudes, i.e. cognitive (perceive, think) and affective (feel) responses. He has deliberately left behaviour out, which he reserves for the outer layers, i.e. espoused values and artefacts. Schein also limits his definition to what he assumes is the core of organizational culture. Actually, in the way Schein conceives and defines culture, there is no need for a specific definition of safety culture. The basic assumptions permeate throughout the organization, including the aspects of safety. In this way Schein remains faithful to the original conception of organizational culture as an overall, integrative concept.

Some notes on basic assumptions, based on Guldenmund (2000):

1. basic assumptions do not have to be specially concerned with safety

    Although they do not have to be especially so, it is quite conceivable that some of the organization's basic assumptions in fact are, when safety is taken seriously within the organization and reflected upon by all of its members. This would certainly lead to an anchoring of safety within the basic assumptions. This supposition could be converted into a hypothesis stating that it is a good sign that, among the basic assumptions of an organization, references to safety are made. It may have profound implications for the way safety is managed. It may be that very good companies do indeed have a high value as a basic assumption, but the majority do not. Conversely, it is suspect when such references cannot be found. It

might very well be that one has to conclude that such an organization does not yield sufficient evidence for the existence of a safety culture. In that kind of companies their culture relating to safety will be driven by other basic assumptions. These can compete or conflict with safety, but guide behaviour to other goals.

For instance in a production company a high production is usually considered to be the greatest good. It should be, otherwise the company will go broke in the short run. The whole organization is generally leavened with this fact. Therefore, individuals might break certain safety rules because of the greatest good, which is production. This apparent conflict between safety and production can only be solved, if it is the basic assumption that there is no conflict between these and that synthesis is possible. These should be basic assumptions which guide behaviour to integrate good safety and business practices. The commercially successful Dupont company is convinced of that showing statements like 'the goal is zero' and 'We earn money with safety'. In cultural terms it is at least an espoused value. Whether it is a deep rooted basic assumption within all members of the company is an interesting question.

2. The basic assumptions described as the implicit assumptions that actually guide behaviour and of which group members will find behaviour based on any other premise inconceivable, might be specially safety, but do not necessarily have to be so. For example, if in some organization written rules or procedures are considered futile, safety rules will be too. Therefore, one might find negative attitudes towards software (rules and procedures) in this organization. This findings do not mean, however, that the basic assumption is that only safety rules are futile but that rules in general are. For instance, because they provide a means for excuses like 'I did not do it, because the rules didn't say I should'. In such an organizational culture safety can be achieved by better means than rules, for instance by competence: bureaucratic culture versus a culture of professionals.

3. Basis assumptions are ones whose roots lie so deep, and whose truth is so self-evident to those who hold them, that they cannot easily be interrogated or expressed in words. Only if we can see an alternative to the way we think and act, does it seem really possible to articulate the choice we make in acting the way we do. So basic assumptions can only be derived from the underlying regularities and patterns of behaviour, attitudes and beliefs, through some method of triangulation of measurements. Basis assumptions have to be deciphered, also by posing questions, why do you do that in that way, by provoking reflection on possible alternatives, by pointing at contradictions or identifying that espoused values and observed actions and behaviours are not congruent. Then you can discover a deeper layer of consistency: basic assumption with dysfunctional effects to safety, but very func-

tional to business: the greatest good is production and fixing the job quickly gives me a lot of appraisal.

4. Schein (1992) mentions particular dimensions, around which shared basic assumptions form. These dimensions are:

- *the nature of reality and truth*: these assumptions define what is real and what is not for a group of people, or, more specifically, what is safe and what is not;
- *the nature of time*: these assumptions define the importance of time within an organization and to which subject time is spent mostly; related to safety it is about the time spent on safety, preparation of work and work itself;
- *the nature of space*: these assumptions define the importance of space within an organization, how it is used and filled; related to safety it is about the layout of the workplace, their hazards and the housekeeping;
- *the nature of human nature*: these assumptions reflect assumptions about people's intrinsic qualities and what can be done about it, for example, whether some people are accident prone or likely to engage in risky behaviour;
- *the nature of human activity*: these assumptions define what work really is and how people should act in relation to their environment, to what extent they should take initiative or await instruction;
- *the nature of human relationships*: these assumptions define how people relate to each other: e.g. competition, individualism, individualistic, authority, co-operation, including issues like whether it is acceptable to correct other people's unsafe behaviour.

The basic assumptions may seem rather abstract dimensions in contrast to more concrete categories of attitude models. But the basic assumptions are not defined constructed on forehand but have to be constructed through analysis of all possible data about the other layers. So the basic assumptions are of an anthropological nature seeking understanding rather than reduction.

In short, Schein introduces a total concept in which safety culture can be described as a part of the organizational culture and has its roots in the basic assumptions that are underneath all observable outings. Changing these is possible but is most difficult to obtain and takes a long period of time.

A6.5   Types of safety culture according to Hudson

According to Hudson (2003): 'Safety cultures can be distinguished along a line from *pathological*, caring less about safety than about not being caught, through *calculative*,

blindly following all the logically necessary steps (*bureaucratic*), to *generative*, in which safe behaviour is fully integrated into everything the organization does.' A Safety Culture can only be considered seriously in the later stages of this evolutionary line. Prior to that, up to and including the calculative stage, the term safety culture is best reserved to describe formal and superficial structures rather than an integral part of the overall culture, pervading how the organization goes about its work. It is obvious that, at the pathological stage, an organization is not even interested in safety and has to make the first level of acquiring the value system that includes safety as a necessary element. A subsequent stage is one in which safety issues begin to acquire importance, often driven by both internal and external factors as a result of having many incidents. At this first stage of development we can see the values beginning to be acquired, but the beliefs, methods and working practices are still at a primeval stage. At such an early stage, top management believes accidents to be caused by stupidity, inattention and, even, wilfulness on the part of their employees. Many messages may flow from on high, but the majority still reflect the organization's primary aims, often with 'and be safe' tacked on at the end.

Table A6.3 Types of safety culture of Hudson

pathological	calculative (bureaucratic)	generative
information is hidden	information may be ignored	information is actively sought
messengers are 'shot'	messengers are tolerated	messengers are trained
responsibilities are shirked	responsibility is compartmented	responsibilities are shared
bridging is discouraged	bridging is allowed but discouraged	bridging is rewarded
failure is covered up	organization is just and merciful	failure causes enquiry
new ideas are crushed	new ideas create problems	new ideas are welcomed

The next stage, which can not be circumvented, involves the recognition that safety needs to be taken seriously. The term *calculative* is used to stress that safety is calculated; quantitative risk assessment techniques and overt cost-benefit analyses are used to justify safety and to measure the effectiveness of proposed measures. Such techniques are typical problem-solving methods. Often simple calculations suggest that failing to be safe, or at least having incidents, costs money. Furthermore organizations that are seen from outside as being uncaring about safety may have image problems that knock on to the bottom line. Despite this stance, and despite what can become an impressive safety record, safety is still an add-on, certainly when seen from outside.

This is the level of mechanical application of a management system. A true safety culture however is one that transcends the calculative and bureaucratic levels.

The foundation can now be laid, nevertheless, for acquiring *beliefs* that safety is worthwhile in its own right. By constructing deliberate procedures an organization can force itself into taking safety seriously, or can be forced by a regulatory body, but the values are not yet fully internalised, the methods are still new and individual beliefs generally lag behind corporate intentions. This shows us a significant characteristic of a true safety culture, that the value system associated with safety and safe working has to be fully internalised as beliefs, almost to the point of invisibility, and that the entire suite of approaches the organization uses are safety-based. This also stresses that the notion of a safety culture can only arise in an organizational context in which the necessary technical steps and procedures are already in place and in operation. Yet again, these are necessary but not sufficient preconditions for a safety culture.

We can see that safety has undergone a development from an unsystematic, albeit well-meaning, collection of processes and standards, to a systematic approach specific to safety. Within the Oil and Gas industry Piper Alpha served as the catalyst for this major change. Once a Safety Management System (SMS) is in place it becomes possible to extend the range to include other elements such as Environment and Occupational Health, leading to an integrated approach to HSE as a whole.
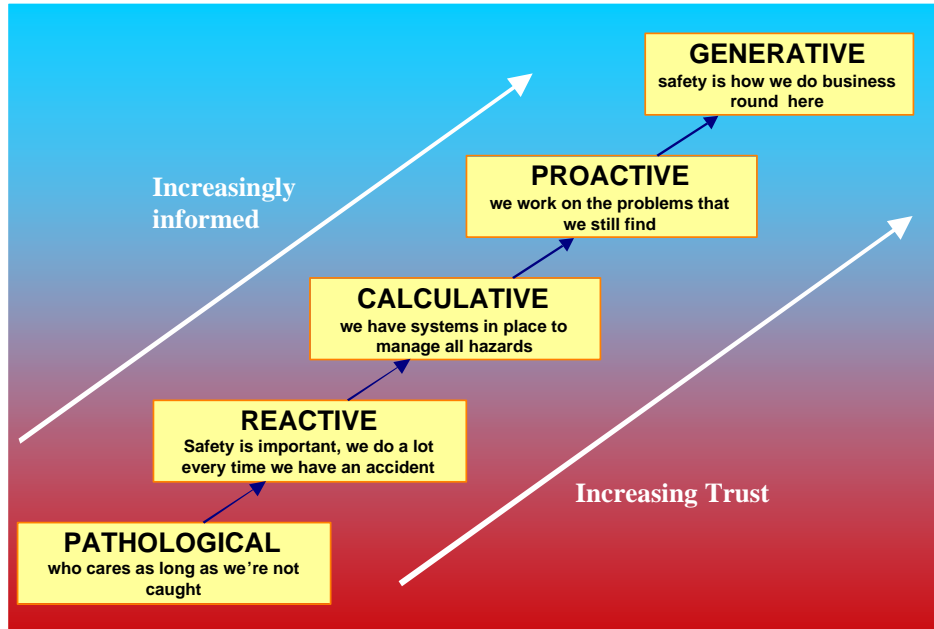

Figure A6.2 The evolutionary model of Safety Culture

The answer lies in the way in which safety management is carried out. Management systems are primarily rational inventions, defined on paper in offices and capable of objective evaluation in audits. The next stage is one in which the aims and intentions can be allowed to flourish, even if there are gaps. This is a situation in which formally indefinable characteristics such as enthusiasm, care and belief are to be found. This kind of support is provided by the safety culture. In a managed organization it is still necessary to check and control externally. In a safety culture it becomes possible to find that people carry out what they know has to be done not because they have to, but because they want to. It is at this point that worker involvement becomes both meaningful and necessary. Advanced safety cultures can only be built upon a combination of a top-down commitment to improve and the realisation that the workforce is where that improvement has to take place. The workforce has to be trusted and has a duty to inform. What this means in practice is that in an advanced safety culture it becomes possible to reap extra benefits, beyond having fewer accidents, such as reductions in the audit frequency.

To progress further towards a real safety culture, one has to undergo a process of cultural change. These changes have to take place incrementally. It appears logical, at least, that it is impossible to go straight from the reactive to the proactive without going through the calculative stage if only because the proactive culture includes systems typical of the calculative. Similarly it is probably impossible to go from the pathological straight to the calculative stage.

The approach of Hudson is a hands-on model in a sense that it is characterized by 18 elements which are a combination of structural topics (such as Contractor management and Audits and reviews) and cultural issues (such as Rewards of good HSE performance and How do HSE meetings feel?). In a management workshop all participants can score their attitudes in one of the stages mentioned above. The tool discerns management, supervisors and workforce. In this way it is possible to place the company in a specific stage and to discuss with management whether they are happy with it and what they would like to do to improve on it.

In short Hudson describes a model of growth which is useful for an interactive approach once the decision has been made to change or improve on the safety culture.

A6.6   Functional and dysfunctional safety culture

Pidgeon (1991) describes safety culture in a way similar as Schein. For him the core is formed by the implicit and explicit norms towards safety. On top of that are the attitudes of people towards safety. At least there is the day-to-day practice of observable

things. Pidgeon says that a functional safety culture is characterized by a frequently returning conversation about safety in daily practice:

- 'Norms and rules for handling hazards: the norms and rules governing safety within an organization, whether explicit or tacit, are at the heart of safety culture. As corporate guidelines for action, these will shape the perceptions and actions of the individuals in the organization in particular ways, defining what is and is not to be regarded as a significant risk, and what will be an appropriate response.
- Attitudes towards safety; safety attitudes refer to the individual and collective beliefs about hazards and the importance of safety, together with the motivation to act on those beliefs.
- Reflexivity on safety practice: a good safety culture can be characterised by an ongoing reflexivity over current safety practices and beliefs. This can be seen as a learning process and as such is a search for new meanings in the face of uncertainty and ambiguity about risk. Reflexivity acts as a precaution against the over-rigid application of existing rules to the neglect of unanticipated hazards.'

Several other authors describes research performed after accidents and come to lists of elements of functional and dysfunctional safety culture. The list is given in table A6.4 (some notions are mentioned earlier but others may envisage a new way to look at organizations).

Table A6.4 Elements of functional and dysfunctional safety cultures (Work and Stress 1998;12(3))

elements of a functional safety culture	elements of a dysfunctional safety culture
Pidgeon, 1991; Turner, 1991; Pidgeon and O'Leary, 1994 • senior management commitment (in both actions and words) • attitudes of shared care and concern for hazards, and a solicitude over their impact upon people, distributed throughout all levels of an organization • norms and rules that permit a flexible approach to dealing with both well-defined and ill-defined hazardous conditions • reflection on practice (or organizational learning) through such things as monitoring, incident analysis and feedback systems	Characteristics of crisis-prone organizations (Turner & Pidgeon, 1997): • rigid perceptions • decoy problems • organizational exclusivity • information difficulties • violations • failure to recognize emergent danger
features of 'High-reliability organizations' (La Porte, 1996; Roberts, 1993): • safety as primary goal • decentralized authority • systems redundancy • organizational learning • senior management commitment	tendency for over optimism (Perrow, 1984; Pauchant & Mitroff, 1992; Vaugh, 1996; Reason, 1997) • complacency • role ambiguity • poor communication • low prioritisation of safety against pressure for performance
Cox and Cheyne (1998): • management commitment • management action • priority of safety • communication • employee involvement	precursors of disaster; features of the hazard incubation period (Turner & Pidgeon, 1997): • wrong assumptions about significance of warnings • communication problems • uncertainty about violations of regulations
literature late 90s (Williamson et al., 1987; Flin, 1998; Cox & Cheyne, 1998): • management commitment to safety • workforce involvement • personal responsibility • attitudes to hazards • rule compliance • workplace conditions	

In the domain of crisis management Mitroff and colleagues (1989) have developed an 'onion' model of culture, the layers of which comprise (a) core beliefs and values at the

centre, through (b) organizational assumptions and beliefs, (c) organizational structure, and finally (d) physical manifestations such as symbols, artefacts and behaviour at the periphery. They point out that, at the core, crisis prone organizations have insular cultures which suppress warnings of crises.

A6.7 Operationalisation of safety culture

Having discussed the characteristics of safety culture above and considering the fact that operationalisation of the concept has been done in many different ways, we come to a definition to be used in developing the checklist. Before we present our definition the following points are taken in consideration:

- the descriptive approach of Schein (as presented by Guldenmund 2000) is an approach which takes much research to do properly by its anthropological character. It is not easy to use in a checklist to assess company plans of improving on safety culture. Although TNO considers this approach the best way of dealing with safety culture (because of its neutral and explanatory nature), it is considered to be too complex to fully integrate in the checklist of this project;

- the definition however should grasp the core-elements of the Schein approach. These can be obtained by looking at the description in terms of the cultural layers of high-reliability organizations with a functional safety culture. These elements are stated in table A6.4; however they are not translated to the Schein layers. As is said in paragraph A6.4 about the espoused values (the second layer) which can be equalled with the attitudes towards safety objects, so the elements of a functional safety culture can be seen as safety objects in itself. An organisation which has these elements fully integrated has a positive attitude towards these objects of hardware, software, people and behaviour;

- so the basic assumptions will be explanatory for the attitudes. We don't think it is necessary to construct the basic assumptions using the checklist, it is even not possible. However, literature shows that when these elements are present the organisation can be considered having a functional safety culture. So, in our search for a definition we have to find the common, general principles which we would like to see and which cover all elements mentioned. Table A5.5 leads to these general principles.

Table A6.5 General principles of a functional safety culture

attitude objects	elements of a functional safety culture	general principle
hardware/physical environment	• attitudes of shared care and concern for hazards, and a solicitude over their impact upon people, distributed throughout all levels of an organization • attitudes to hazards • systems redundancy • workplace conditions	1. understanding the nature of hazards and risks and taking action to control them
software	• norms and rules that permit a flexible approach to dealing with both well-defined and ill-defined hazardous conditions • reflection on practice (or organizational learning) through such things as monitoring, incident analysis and feedback systems • rule compliance	2. insight in safety performance and the willingness to improve unsafety
people	• management commitment • safety as primary goal	3. management commitment
behaviour	• management action • workforce involvement • personal responsibility • organizational learning • decentralized authority • priority of safety • communication • employee involvement	4. management action, employee involvement and the need to learn from mistakes

Following the general principles we come to a definition with three main elements: 'Safety culture is a construct to describe the influences an organization has on the behaviour and attitude of its employees. Safety culture can be characterized by:

1. the way management propagate a safety philosophy and is taking actions based upon it (management commitment);
2. the way an organization is willing to learn from mistakes and incidents;
3. the way an organization has insight in safety performance and the willingness to improve unsafety in a structural way.'

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Some elaborate explanation of the three main characteristics:

1. involvement of management, and all other levels of the organization, both bottom-up and top-down;

2. a learning organization (the error culture or the 'learning' culture). This is an organization with an open culture in which danger (accidents and near-accidents) are discussed and in which (both long and short term) the company and its employees learn from their mistakes (for example, with flexible procedures, function-related education and training, and work discussions). An atmosphere of trust exists and employees are motivated, even rewarded, for providing essential safety-related information. The line between which sort of behaviour is or is not accepted is known by everyone. The creation of such a culture is a pre-requisite for making risks transparent within an organization;

3. insight into dangers (the 'reporting' culture). People must have insight into the safety-critical activities in which people play a role. In order to be able to measure safe or dangerous behaviour, the establishment of a safety system is a good resource. Registering and analysing accidents and near-accidents give insight into the chance that a certain accident will occur. If the number of incidents is small, the reliability and predictability decrease. In such a situation, in order to be able to measure the 'safety performance' of a company, a good approach is to examine safety risk factors instead of accidents. These factors include: errors made, unsafe acts or circumstances and all known types of causes of accidents. This can even go as far as latent failures in management processes such as communication, decisions between economy and safety, introduction training of new personnel, etc.

This definition with three characteristics or cornerstones makes it possible to operationalise safety culture in a way that the measures taken by companies have to say something in respect to these three characteristics. For example, a company with plans to organise a training for all employees including supervisors, will only be successful in terms of safety culture if it is embedded in a system where the safety performance is known and understood, lessons are drawn from that information and management is committed to act upon that information. When these three add-ons are not in place a training (and most other safety measures) will have no effect on safety culture whatsoever.

A6.8   Changing and improving on safety culture

Mechanisms of culture change
Understanding the ways of changing a organizational culture starts with understanding some of the history of the company. According to Schein (1999) it is useful to consider

different stages in the life of a company. The following growth stages of a business can be distinguished:

1. in *the founding and early development stage*, founders and leaders embed cultural elements which leads to a situation that assumptions will be strongly held; these define the group's identity and distinctive competence which is needed to grow in the market;

2. in *the midlife stage* culture is now more differentiated and embedded; culture is no longer linked psychologically and emotionally to founders and family members; dysfunctional assumptions can be discussed and transformed; culture becomes part of the tradition of success; this can be a strong conservative force; the transition to midlife can be fraught with cultural issues because of succession problems;

3. in *the mature stage* culture is now highly differentiated in terms of subcultures and a highly integrated culture is difficult to maintain; the founding family is no longer in an ownership or dominant position and graduated, promoted general managers create the management processes; they have learned to deal with the pragmatic problems of running the business and keeping it financially viable; now, culture creates leaders.

The effort required for changing or improving on safety culture will highly depend on the necessity for the change and the developmental stage of the company. Schein (1999) illustrates in several business cases that the following mechanisms are working in cultural change:

1. *general evolution* means that the culture (and structures) evolves by continuing to assimilate what works best over the years;

2. *specific evolution* means that specific parts of the organization adapt to their particular environments, thus creating subcultures that eventually have an impact on the core culture;

3. *guided evolution through insight* means that making explicit the cultural themes and elements can have a therapeutic effect; it can help a group to decide the direction of its future development;

4. *managed evolution through promotion of hybrids* means that particular 'insiders' with assumptions that are in varying degrees different from those at the core can be stimulated in their career to promote other or new assumptions which are better adapted to external realities;

5. *empowering managers from selected subcultures* means that subcultures of engineers, CEOs, marketers and operators for instance can be functional but different from the core culture; so it is especially crucial to understand the differences between them and to enforce the subculture which is most adaptive to external changes;

6. *planned and managed cultural change* means that change is established through a systematic process involving change leaders and change teams operating as parallel structures;

7. *drastic culture change* means that a strong change leader uses drastic measures to enforce the desired change; often an new CEO or turnaround manager is appointed and is clearing up dysfunctional elements (middle managers for instance) of the old culture.

So combining the developmental change of a company's culture to understand what kind of intervention will be useful, Schein describes the first five mechanisms as useful ways of transforming a culture for a company in the developing stage. While these mechanisms may also apply to midlife and mature culture companies, they use often the sixth or the seventh approach to change the culture. In the case of the checklist safety culture the sixth mechanism '*planned and managed cultural change*' is particularly interesting because this gives checkpoints to consider.

Changing culture step by step

Many theories about managing change exist. Hudson (2003) uses a transformed model for developmental change which has been proposed by Prochaska and DiClemente. This model was originally developed for getting people off drugs and other dependencies such as smoking, alcohol and over-eating. Important is the stage of realisation that further improvement is possible. To realise the actual change one has to prepare oneself for the necessary steps to take and one has to perform the actions needed. After the actions one has taken the next step is maintenance of the new behaviour. Once one has become aware it is not possible to revert as far as the pre-realisation mode. The remaining stages are unfortunately quite possible to fall back to as anyone who has tried to give up smoking knows.

Hudson uses within the Shell company a more articulated model that has been developed for managing successful change within organizations. Its strength comes from the fact that it is intended to change both the individuals and the organizations they constitute, and realises that changing the one without the other is impossible. This model represents necessary steps and puts together the requirements for change of individual beliefs that are so crucial in cultural development.

The model is very similar to any quality system Plan-Do-Check, but the internals of the stages, especially the Awareness and Planning stages, are often missed or treated very summarily. All too often, the active participation of those involved, in the awareness and planning stages, is replaced by a plan of action defined elsewhere. Such models are purely top-down, with plans typically handed down from senior management, external corporate departments or consultants. What is really needed is:

- the creation of a personal need to change;

- a belief in the ability to effect such change;
- the clear understanding that individuals have control over their own process.

So the steps undertaken are Awareness-Planning-Action-Maintenance and are undertaken particularly with all groups that have to be part of the cultural change involved.

Zwetsloot (2000) also stresses the importance of involvement of the workforce by developing plans. He considers it a prerequisite for organizational learning together with a very sharp two-way style of communication.

Other important notes on cultural change are (Hearts & Minds program (Shell), developed by Hudson (2003)):

- a change agent can be installed who has authority by his/her track record and whom people believe because of his/her integrity and ideas;
- defining the starting point and the desired outcome is most important since these are the elements needed to get a sense of direction for people; every stakeholder has to be involved in the process of definition;
- a feeling of ownership of the change process has to be installed by the group of people who are (in)formal leaders.

In short, realising a cultural change towards a culture more directed on safety requires an initially understanding of the starting point of a company. It requires insight in the dominant sector in which the company operates, the subcultures which have grown strong inside the company and the desire and need of the people within the company for the change. If one wants to be able to estimate the chance of success of a particular safety measure it is important to understand why this topic is proposed and how it is linked to the core assumptions or subcultures. Also, the need for change has to be clear and the persons involved have to feel ownership to realise the change.

Case A6.1   Safety culture in transport companies
More competition leads to increasing pressure on transport companies to perform in time and at low costs, which leads to a pressure to become more productive. This, together with much more traffic on the roads can be a causal factor for the increasing involvement of trucks in deadly accidents. So the likelihood of 'normal' accidents to occur increases.

Enough reason for the Dutch government to set out research on the safety culture of transport companies with the aim of influencing the truck drivers' behaviour on the road and to diminish the involvement of trucks in deadly accidents. This research (Gort et al., 2001) used the model of Schein and shows that the transport branch regards safety only as a disturbance when it conflicts with production i.e. deliverance of goods in time and with the same quality as it was loaded. The companies don't use safety considerations as part of their decision making but they say they would like to pay more attention to it under better circumstances. So the basic assumptions specified for

Case A6.1 Safety culture in transport companies		

safety found within the transport sector declared why the companies didn't do much about (road) safety but were content with what they did. Safety is defined by others namely the insurance companies and the clients. In terms of Hudson's approach to safety one should say that the frontrunner companies are calculative but the large majority of companies are reactive (or even pathological).

So the next step in the approach of the Dutch government has been to develop some kind of system with which transport companies can integrate safety ideas into their decision making. The government invited the transport sector organizations and TNO to develop safety performance indicators. With these individual transport companies can assess themselves to see how they perform with regard to safety and where they can improve and save money by doing so. The indicators were developed using the three cornerstones of safety culture: management commitment, willingness to learn and insight in safety performance and the will to improve (Gort et al., 2003).

However, a sense of urgency for the companies is not strongly felt. So, it remains the question whether the sector organizations are capable of broad implementation of the safety performance indicators into the sector. One way of achieving this may be to give incentives such as more access to inner cities for safe companies or to increase the enforcement from the transport inspectorate.

Do	don't
• define a sense of urgency for change • create commitment of management with carrot and/or stick • develop safety programs which have no conflict with the basic assumptions • make visible what the costs of unsafety are and the benefits of safety • involve the network a company is part of by including the clients, distribution channels and law enforcers • build safety awareness first and accept that a real change can take a long time • use all three cornerstones of safety culture to develop a well-balanced improvement scheme.	• think that cultural change will be an self-initiated automatic process • develop safety measures which are in conflict with the basic assumptions • make safety something of experts (but try to involve actively the shop floor and management in developing plans) • ask more time of employees above the time they already spend for the company to achieve the change (but let it be integral part of day to day work)

To summarise, we have discussed an operationalised definition of safety culture and different ways of changing a organisation culture towards a more functional safety

culture. Changing a culture will take a considerably long time (Schein, 1999) but when we look at the way different organisations are introducing elaborate safety programs, TNO thinks this reflects the need to grow towards more functional safety cultures in companies. It is possible to distinguish different ways of actions on changing undesired safety practices by all sorts of safety programs. This will be explored in the next paragraphs, in which different ways of safety campaigning are discussed.

A6.9   Provoking change in safety practices by safety campaigning

It seems to be clear that changing a culture is something which is not easy to do. There will be several alternatives for action on undesired safety practices depending on several criteria, like:
* desired effect (solving a temporarily problem, increasing safety awareness of introducing safety procedures);
* depth of the change (better in control of practical situations, learning a new way of thinking, fundamentally changing the attitude towards safety);
* amount of money spent (how long will the program take, are external consultants to be hired, is everybody involved?);
* commitment of management (do they attend the meetings or is a workgroup in-volved?).

These topics seem to be interrelated; a deep change will have a lasting effect and takes much time and money and will only be a success if management is supportive. So, a distinction can be made in several alternative ways of changing the undesired safety practices by safety campaigning.

A6.10   Reasons behind safety campaigns

Dissatisfaction with daily working processes regarding safety are often the reason why organizations start up safety campaigns. In such a situation alertness to risks seems to diminish. Severe accidents have not yet happened, but one realizes that actions are needed to prevent things happening. The edge of the safety margins seems to have been reached.

Campaigns can be a useful instrument to resist this fading alertness to safety. With safety campaigns organizations try to enlarge the safety margins by emphasizing the formal, agreed level of standards, procedures and safety behaviour. At first effects of a campaign are mostly enthusiastic, especially when small changes become visible. Sub-sequently the feeling arises of resistance. The enthusiastic start of the campaign seems to fade away. Everybody seems to be back to doing what they have always done.

The main issues here is that campaigns can only be effective if they fit the safety problems that are present in the organization. There is a diversity of types of campaign with different sizes, types and effects. These types of campaigns should fit to the safety issues an organization perceives, and also to the organization's ambitions, their underlying motivations, available means and also to a company's size. So, there is no standard recipe for an optimal campaign, but the company's earlier experiences in combination with principles of a good campaign can give some clues about what an effective campaign looks like.

A6.11 Ingredients of types of campaigns

All safety campaigns have in general the same goal: enhancing safety practices or safe behaviour in an organization. In some organizations this is called 'preventing accidents', in other organizations it is called 'achieving a safety culture'. These definitions of goals show a clear difference in ambitions and probably also available resources and means.

Before choosing for a special kind of campaign, on organization needs to make clear what the problems are, and what they expect the impact of a campaign should be. A company without structural problems, doesn't need a campaign with high ambitions. Such a campaign can be modest in its means. On the other hand, a company with structural problems needs to put more effort in it. In short: campaigns differ in motivations to initiate campaigns, their aimed effects and the available resources/means.

A6.12 Three types of safety campaigns

Taking into account these differences, the following three types of safety campaigns can be identified in the consultancy practice of TNO Work and Employment. The three types of safety campaign differ in the depth of the impact they have to the safety management system and safety culture.

Campaign type 1: enhancing safety awareness
- *Motivation to initiate:*   the company is not satisfied about the accident rate and the behaviour of employees. Safety needs to be on the agenda again.

- *Aimed effect:*   safety in the heads of people, enhancing awareness.

- *Available resources/means:* single, theme based action of limited duration. E.g., a thematic week event, in which addressing the use of PPEs is the central theme.
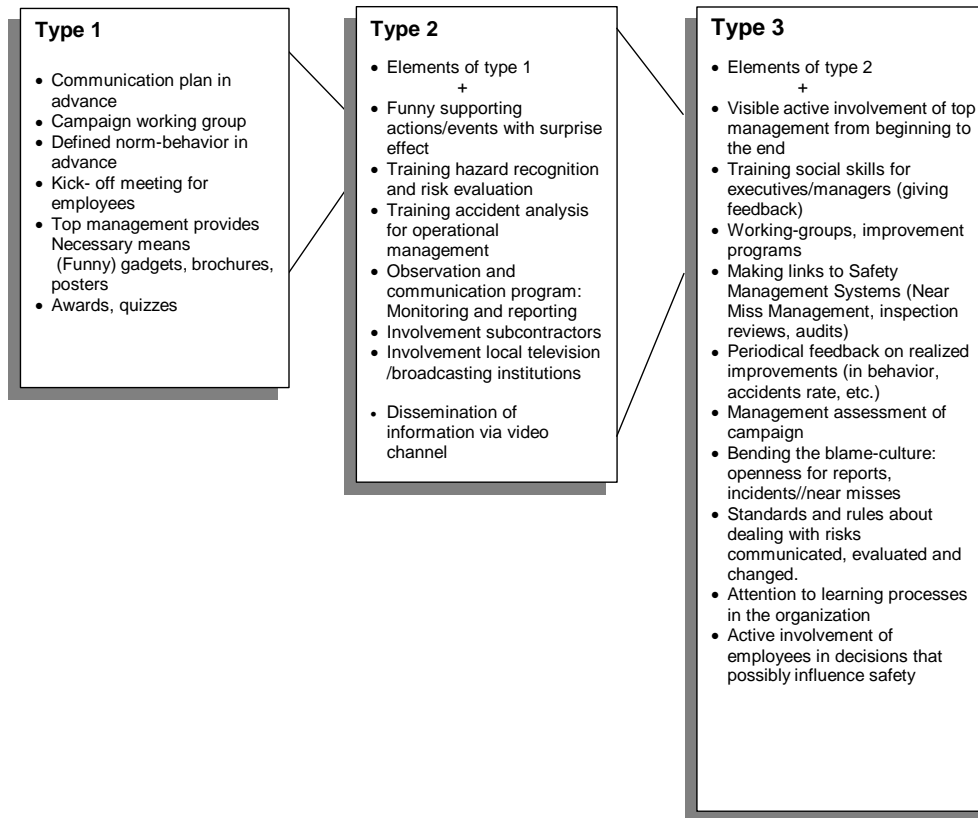
Campaign type 2: system improvement
- *Motivation to initiate:*   the company is not satisfied about the working of (parts of) the safety management system.

- *Aimed effect:*   by giving maintenance to parts of the system, the safety management system will be effective again.

- *Available resources/means:* the safety campaign is designed as a project, in which the working group of one part of the safety management system is evaluated: e.g., observation of unsafe situations, recent changes in procedures or working permits.

Campaign type 3: towards cultural change
- *Motivation to initiate:*   the company is not able to structurally control and so enhance their safety performance. Safety output (incidents and accidents level) as well as the actual and visible daily safety practices are disappointing.

- *Aimed effect:*   a radical change in thinking and doing with regard to safety. And so: a culture change.

- *Available resources/means:* the campaign consists of a framework of planned actions that structurally enhance the safety level. In the end this will also lead to structural changes in the safety management system.

The three types of safety campaigns are visually presented below.

3 Types of safety campaigns

Type 1	Type 2	Type 3
• Communication plan in advance • Campaign working group • Defined norm-behavior in advance • Kick- off meeting for employees • Top management provides Necessary means (Funny) gadgets, brochures, posters • Awards, quizzes	• Elements of type 1 + • Funny supporting actions/events with surprise effect • Training hazard recognition and risk evaluation • Training accident analysis for operational management • Observation and communication program: Monitoring and reporting • Involvement subcontractors • Involvement local television /broadcasting institutions • Dissemination of information via video channel	• Elements of type 2 + • Visible active involvement of top management from beginning to the end • Training social skills for executives/managers (giving feedback) • Working-groups, improvement programs • Making links to Safety Management Systems (Near Miss Management, inspection reviews, audits) • Periodical feedback on realized improvements (in behavior, accidents rate, etc.) • Management assessment of campaign • Bending the blame-culture: openness for reports, incidents//near misses • Standards and rules about dealing with risks communicated, evaluated and changed. • Attention to learning processes in the organization • Active involvement of employees in decisions that possibly influence safety

Campaign type 1 consists predominantly of loose (funny) actions. Campaign type 2 consists of structural activities like maintenance and improvement of the Safety Management System. Campaign type 3 closes organizational control loops, facilitates organizational learning and finally involves 'culture'-aspects. It is clear that the last campaign type (no. 3) has much more impact on the organization than the first does. The third kind of campaign tackles the deeper underlying causes of dissatisfaction and probably will take years, while the first one is more superficial, asks for less means and can be a one-time action.

These three different types of campaigns have different effects on their own. Moreover the campaigns can also be integrated in one program. In fact the three types of programs can be seen as a stepwise approach to a higher safety level:

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Campaign type 1    ------------------------------------------------    temporary change of behaviour
              Campaign type 2    -----------------------------    improvement of the safety system
                        Campaign type 3    ---    improvement of safety culture
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Companies with underlying cultural problems, that execute campaigns of the first type, will probably be disappointed. It takes a lot of effort to get the attention to safety and the efforts appear to be temporary. The character of such a campaign is to eliminate overdue maintenance. Sometimes this is the only possible way in an organization, regarding available resources. On the other hand in the long run, this kind of campaigns will be very costly, because it needs permanent attention.

Another option is to start a campaign that will change into structural changes in the system. Optimising the working conditions (ergonomic changes, managerial and organizational changes) can embed safety improvements in the system.

Nevertheless, for sustainable results, control of physical or organizational conditions for behaviour is not enough. The values underlying overt behaviour are crucial for the motivation of people to behave safely. Here cultural aspects come into play, like leadership style, what is considered important or what not, what kind of behaviour is regarded as successful and what is not, and: what's the involvement of top management regarding to safety? These cultural aspects are very important to consider when structurally improving the safety performance.

A6.13   Conclusion

In conclusion: a campaign aimed at sustainable effects, needs to get to the core of the organization, to its culture. A blueprint will not be sufficient to reach structural changes. The organization needs to reflect its core values and objectives. This can even be threatening. Campaigns need to contain more elements than those with regard to contents, but also elements regarding the attitude of top management, employees' competencies, active learning and bending the blame culture.

Insight in the different kinds of safety campaigns and their characteristics can help diminishing feelings of disappointment on the effects of campaigns and the belonging costs in the future. This three-step approach helps organizations to choose an approach for a campaign that fits their own situation and can lead to structural safety changes in the end.

Case A6.2 Safety campaign in Basic Chemicals Company
A Basic Chemicals company was confronted with serious accidents. How could this happen?
Result of the investigation was that procedures were not followed, leading to a serious accident. First investigation pointed towards the employee not having followed the right procedure. However, a later investigation, taking into account more aspects of the working environment in the company, pointed out that the accident happening was not surprising.
The working spot was a dusty, dirty one. Several procedures were malfunctioning. In some cases own inventions of employees or circumventions and non-routine actions were needed to keep the process running. In fact, one only had to wait for a accident to happen.
The safety coordinator who initiated the investigations initially focussed on rule-compliance. A campaign with self-designed posters, by employees, was started to attract the attention towards unsafe situations, the importance of housekeeping, etc. Once the broader cultural view was reported, management got involved. A new mission statement regarding safety was drawn up, a long term safety planning was made and some self-reflection of the management, their responsibilities and the message they proclaimed in the past took place. Management workshops were the starting point towards a more safety cultural approach.
While some employees were sceptical to the new approach, the involvement in the campaign and the general change in management course was seen by other employees as a welcome new sound.

do	don't
• commitment of management; a change is needed; even admitting they had mis-judged at first	• blame on employees when it is obvious that root causes of accidents are management responsibilities

Appendix 7   The Organization of Safety

A7.1   Introduction

In this appendix we will discuss organizing safety with the use of a structured safety management system. We will not discuss safety management systems extensively, only in the way it deals with the matters of the previous appendices concerning safety awareness, safe behaviour and safety culture. By that we only want to emphasize that these issues and corresponding intervention techniques should not be stand alone activities, but they need an integrated approach and by that prevent sub-optimalization.

Although Safety Management Systems can have several forms and can vary in age some basic elements can be distinguished. In this appendix some considerations about management systems will be presented and following recent standards some essential building blocks will be selected. In the end of this appendix we will combine the structural elements with cultural features towards identifiable safety-indicators in an integrated table. In our opinion it can be used for assessing an organization on both structural and cultural features. It is less useable for an assessment of detailed safety plans on paper. For that reason we decided finally, after the last meeting of the steering committee, not to use it for the development of the checklists of this project e.g. checklist, part I and II.

A7.2   Safety management systems

Glendon et al. (1995) stated that management should manage health and safety risks with the effectiveness and commitment with which they manage other organizational functions. Wright (1994) considers a safety management system to be the 'means by which the organization controls risk through the management process' with features as:

- the importance of top management commitment;
- setting clear safety objectives;
- communicating required information adequately.

Waring (1991) describes a systems approach to safety. A system consists of:

- structural elements;
- processes;
- interconnections;
- external influences;
- subsystems.

Structural elements are relatively lasting system components such as: roles and responsibilities, reporting relationships, committees and other groups, safety documentation. Processes are the more dynamic aspects: action, decision making, problem-solving, information provision and communication. Interconnections between system elements and processes include feedback and learning loops and provide a framework for the system. If you make it a safety management system it may have the following elements (HSE, 1991):

- policy;
- organizing;
- planning and implementing;
- measuring performance;
- reviewing performance;
- auditing.

These elements are supported by processes such as employee involvement, continuous improvement, resource provision and risk control and there are interconnections between them which include feedback and learning loops.

By describing a safety management system (SMS) in such words it emphasises not only the functional part, but also the human part: it depends on and influences human behaviour. Waring (1991) argues that the conditions necessary for effective SMSs are both *functional*, involving management control, monitoring, executive and communication sub-systems and *human*, involving leadership, political and safety culture sub-systems. Thus political will and top management commitment need to be reinforced with a common set of safety beliefs, values and behaviours from all those within the organization, comprising the safety culture. From the other way around, safety culture can be seen as the way in which different companies drive and use the essential functional elements of the structure of the safety management system (Hale, 2000).

The systematisation of safety efforts within the framework of a safety management system can take several forms. Standards like the BS or ISO-standards use a simple or more complex management cycle, wherein the basic Deming-circle still is recognisable. This is of great importance because a great part of the target group of the Ministry of Social Affairs and Employment are SMEs. A lot of these companies have implemented quality systems like ISO 9000. So it is easy for them to see the resemblances between working with a safety system or a quality system. Even if companies of the target groups have not implemented a quality system, we think it is essential to adopt a systematic and strategic approach in safety management (Glendon et., 1995). By that using a format for a management cycle like the Deming-circle is the bottom-line.

Inspired by the BS 8800 we'll use a combination of the HS (G) 65 and OSHAS model (see figure A7.1, A7.2 and A7.3) to distinguish some basic functions of the manage-

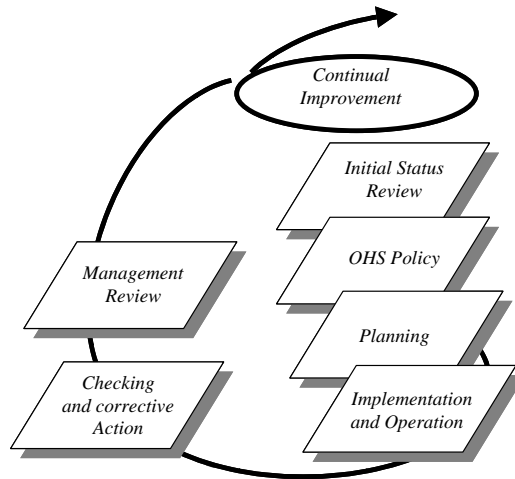ment system. In the next paragraphs key elements from this report will be connected with these basic functions.
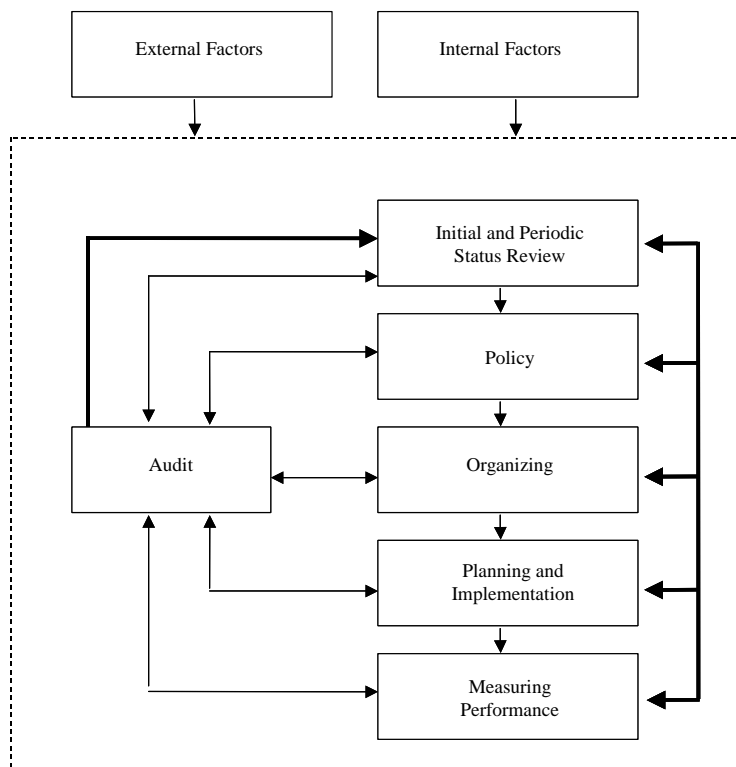

Figure A7.1 OSHAS

Figure A7.2 HS (G) 65

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In figure A7.3 some basic features of a management system are presented. First the starting point for action should be defined before a policy is formulated and tasks and responsibilities are being assigned. Plans have to be made and implemented, performance should be monitored and measured. In order to assess the effectiveness of the system, audits and (management) reviews can be held. These action and especially the feedback and sensitivity for non-functioning elements should lead to correction and improvement.

As stated before, the functioning of the safety management system and safety culture are closely linked. Hale (2000) makes a resemblance between the parallel concepts of a safety management system and safety culture. He states: 'assessing the structure of the safety management system can be done with the safety audit as a measuring tool. It determines whether there are policies, plans, and procedures, whether responsibilities are allocated and communication channels exist and operate, whether risk assessment takes place, design solutions are implemented and monitored, feedback and learning systems are in place. It is a top-down assessment, which should penetrate through the paperwork systems to the actual behaviour (reported and observed) which indicates whether the structure is in place and producing output.
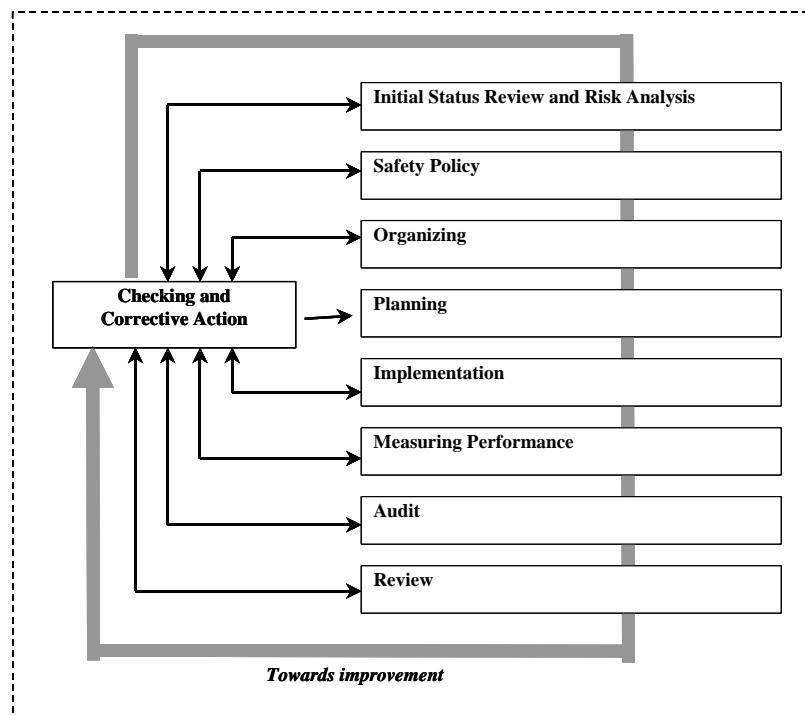

Figure A7.3 Basic elements of a safety management system

A safety culture assessment should be telling us why the structure is, or is not, working. It is a bottom-up approach which seeks to understand what is the motor behind, or even in conflict with, the safety management structure. There is some overlap, both are interested in whether the structure is working, the one more from a factual sense of producing results, the other more from the perceptions which the employees have of whether it is working and whether they trust it.'

The result of managing safety in a systematic way should be safe working processes. As stated before safety can incorporate, besides the 'hard' figures of numbers of accidents, etc., measures for the more 'soft' factors like cultural elements.

A safety management system or plans for safety should help to prevent unwanted outcomes in the cultural field as well. In paragraph A7.3 the elements of the management system will be specified and the link with safety culture be made. In other words: in the description of the functions and the deliveries of the management system the functional and dysfunctional elements of a safety culture (see Appendix 6, table A6.2) will also be addressed. The elaborated model of the management system with its structural and cultural aspects will presented on the end of this section.

A7.3 Specifying the management model, structural and cultural characteristics

A7.3.1 Structural characteristics

The management system of figure A7.3 contains the following elements:
- Initial Status Review;
- Safety Policy;
- Organizing;
- **Planning**;
- **Implementation**;
- **Measuring Performance**;
- Audit;
- **Review**;
- **Checking and Corrective Action**.

This will guide as a basic framework of a safety management system from which a sound safety improving plan should be derived. Not in de way that all these elements should be present in a formal verifiable way, but the basics should be present as evidence for a systematic and strategic approach. In **bold** you can identify the Deming cycle, which should be part of the company's diagnosis or initial audit, for instance for a SME if it has not got a formal SMS.

A7.3.2   Cultural characteristics of the SMS

From this structure you can derive the cultural conditions to drive and use the functional elements of the SMS (Hale, 2000).

Hale (2000): 'although the poor state of our knowledge and proof about what is important in safety culture, there is some beginning of a consensus about what is important. In terms of the structure of safety management systems this consensus is undeniable. It has even led to certifiable standards of Health and Safety management systems (Cottam, 1999). Safety culture can then be seen as the way in which different companies drive and use the essential functional elements of that structure.'

Hale presents a list of elements for a good culture for safety:

- the importance which is given by all employees, but particularly top managers to safety as a goal, alongside and in unavoidable conflict with other organizational goals; are actions favouring safety sanctioned and rewarded, even if they cost time or money?
- the involvement felt by all parties in the organization in the process of defining, prioritising and controlling risk; the sense of shared purpose in safety;
- the creative mistrust which people have in the risk control system, which means that they are always expecting new problems, or old ones in new guises and are never convinced that the safety culture or performance is ideal. If you think you have a perfect culture, proves that you have not. This means that there must be explicit provision for whistleblowers. A role for health and safety staff in very good organizations may be as a professional group constantly questioning and seeking the weak points in the prevailing culture;
- the caring trust which all parties have in each other, that each will do their own part, but that each (including yourself) needs a watchful eye and helping hand to cope with the inevitable slips and blunders which can always be made. This leads to overlapping and shared responsibility;
- the openness in communication to talk about failures as learning experiences and to imagine and share new dangers, which leads to the reflection about the working of the whole risk control system. If coupled with a willingness only to blame in the case of unusual thoughtlessness or recklessness, this can drive a responsible learning culture;
- the belief that causes for incidents and opportunities for safety improvements should be sought not just in individual behaviour, but in the interaction of many causal factors. Hence the belief that solutions and safety improvement can be sought in many places and be expected from many people;

- the integration of safety thinking and action into all aspects of work practice, so that it is seen as an inseparable, but explicit part of the organization.

In the same way Hudson has some cultural characteristics for the SMS. Derived from his description of a generative safety culture a table with the structural and cultural aspects of the SMS will be presented in paragraph A7.4.

Case A7.1 Implementing a near miss management system (NMMS)
An important part of a Safety Management System can be an NMMS. The conditions for success are perceiving dangerous situations or near misses, reporting and registering them, processing data with a good coding or classification scheme, analysis, feedback and learning, management review.
For that trust is very important: a no blame culture. Everyone must feel the security to report any kind of deviation as delivering management information in order to act upon by responsible management in an adequate way.
Trust can be a part of a culture already developed or has to be achieved during a long process. Within the company it was management judgement that there was such an atmosphere after investing for years in that, e.g. in building and operating the NMMS. Management was quite satisfied with reporting frequencies and quality of the information delivered etc … A sound basis for improvement.
Everyone realised that an important condition was appraising the delivery of management information and absence of throwing blame on the reporter. Then, a time after a report, a manager put blame on an employee. The consequences were dramatic, trust was gone and the reporting rates dropped. Top management realized that this could mean a loss of years of investment in the system and culture of trust and no blame. So the manager was fired to show management commitment to the value of system and culture.

do	don't
• design for a NMMS a user friendly system • train employees in perceiving and acting on dangerous situations or near misses; they should be trained in proper classification skills in order to process and analyse the data in a adequate way • invest in feedback and communication about reports, analyses and actions • create ownership by participation of the system, employee in steering committee	• blame persons on reporting, or on their role in a deviation, except if it is beyond clear communicated standards of acceptability • change the system without involvement or participation of employees

do	don't
• create trust, show top management commitment • make clear that there are limits to deviations e.g. unacceptable situations or behaviour; make clear what is not tolerated • communicate standards of acceptability	

A7.4   Assessing the organization and its culture

Table A7.1 can be used to assess a company for checking if necessary conditions for the initiation of safety improvements are met. It helps to identify the extent to which some basic conditions are met before coming to initiate cultural change. The essence of culture: the result of a long collective and at least commercially successful (we are not out of business yet) learning process in coping with the big bad world.

Once a company is coming to an all-embracing cultural project it is wise to look at it from a systematic starting point. The table on the next pages contains the elements of a management system as described in this appendix and they, inspired by Hudson (Hudson, 2003), are translated into cultural prerequisites and concrete measures to be looked for. The focus is on the process and involvement of employees as well as the discussion of norms and values in an attempt to bridge the gap between structural and technological solutions and the cultural context in with they should be effected.

Table A7.1 Cultural elements linked to the structural components of a safety management system

system component	cultural prerequisite		verification
1. Initial Status Review	• cultural awareness • senior management commitment	• norms and values are being discussed • two-way communication on safety issues • management behaviour and attitude towards safety is example for employees	• what are the norms and values about safety? • are these norms shared by both employees, supervisors and management? • is there an understanding about how to behave safely? • are there shared role models for safe behaviour? • are norms and values being discussed in meetings, topics for toolbox-meeting etc.?
2. Safety Policy	• safety as primary goal	• HSE makes money • a safety paragraph is part of all policy-items • contractor safety is dealt with • delay is accepted for safety reasons • hazard and safety awareness and sensitivity are present • risk-analysis is being performed • danger is recognized	• is safety part of company's policy? • what is the position of safety versus production and other issues? • is there time and money for safety? • how far stretches the responsibility of the company towards others (contractors, society, etc.) • are risk-analyses being performed? • Is risk-analysis stopped once the legal requirements are met?

system component	cultural prerequisite		verification
3. Organizing	• decentralized authority	• safety is part of all employees' responsibility • employees actively take part in planning and decision making • information about relevant issues is shared with all employees • employees are being relied on for making proper decisions • a safety department is present and all employees have access to safety personnel • employees are being stimulated to come forward with problems • employee selection is based on safety skills and competence • roles throughout the organization are clear for everyone • procedures are designed/accepted by employees and 'resistant' to compliance • organization is capable of adequate and flexible reactions to unforeseen events	• are safety responsibilities part of the job description • does the company have its own safety personnel? • are safety issues and accidents reported, communicated and known to all employees? • do employees have the autonomy to make their own decisions? • is the decision making process part of discussion? • is there backup for employees who stop tasks or processes because of possible unsafe and unwanted outcomes? • what route/platform is available to share ideas and suggestions? • are safety matters part of the selection process and job interviews? • what contribution do employees make in their working procedures? • how are unforeseen events tackled in day-to-day activities?
4. Planning		• safety is addressed in plans and schedules	• is there a safety paragraph in every plan? • is time reserved for safety precautions?

system component	cultural prerequisite		verification
5. Implementation	• employee involvement	• no blame • safety initiatives are being rewarded • safety matters and unsafe behaviour are subject of open discussion • job-safety analysis and inspection rounds are being held • conflict sensitivity and resolution	• what causes for accidents/incidents/mishaps are found? • what rewards are being given (appraisal/ bonuses, etc.) • which inspection/observation system is in use? • is it common to address colleagues in cases of unsafe behaviour? • in what way are conflicts resolved?
6. Measuring Performance	• awareness of cultural 'temperature'	• safety performance is measured both company wide and individually • safety performance and behaviour are part of job interviews and feedback • incidents/accidents/near misses are being investigated	• which indicators are being used to measure safety? • how often is feedback given on performance? • is safety part of this feedback? • in what way are accidents/incidents being analysed? • what is done with the outcomes of an incident/accident investigation? • how are the results communicated and preserved?
7. Audit	• reflection on practice	• evaluation takes places, in terms of both performance and safety performance • both 'hard' and 'soft' aspects are subject of audits	• are there any formal or informal audit systems? • who is performing the audits? • what aspects are taken into account during audits?

system component	cultural prerequisite		verification
8. Review	• senior management commitment	• outcomes of audits and performance measurement are being discussed in the management team	• what is done to feed back information bottom-up (e.g. towards the management team)?
9. Checking and Corrective Action	• organizational learning	• once problems or deviations come forward they are dealt with in time • evaluation in terms of lessons learned instead of blaming the victim • lessons learned are being communicated	• what examples of lessons learned can be given? • in what style is information coming from learning experiences shared? • is there a knowledge management system active?

A7.5   Summary, dos and don'ts

The message of this appendix is that organising safety can best be done using a management model that includes some basic elements. We have chosen a model, other models are possible, but in our opinion its essential that:

- information about the initial status will be gathered;
- there is a clear safety policy/philosophy;
- personnel, material and equipment are organised and lined up before implementation;
- there is proper planning;
- feedback and registration of progress and/or deviations are ensured;
- lessons are learned and incorporated in the systems;
- time will be spent considering and reviewing systems performance;
- it will be an ongoing process.

In this way safety can be managed. For managing cultural change the same sort of elements can be very useful. The checklist presented in table A7.1 is an illustration of linking cultural change to structural safety management system elements.

Derived form the case of the introduction of a near miss management system the following dos and don'ts are presented for an SMS in general which is aimed at participation and ownership of employees.

do	don't
• design a user friendly system • invest in feedback and communication about reports, analyses and actions • create ownership by participation of the system, employee in steering committee • create trust, show top management commitment • make clear that there are limits to deviations e.g. unacceptable situations or behaviour; make clear what is not tolerated • communicate standards of acceptability	• blame persons on reporting, or on their role in a deviation, except if it is beyond clear communicated standards of acceptability • change the system without involvement or participation of employees

Appendix 8   Human Error

A8.1   Introduction: GEMS

Correct performance and systematic errors are two sides of the same coin. Ernst Mach (1905) put it well: 'Knowledge and error flow from the same mental sources, only success can tell the one from the other'. But why do people make mistakes? To understand the human errors we have to look at the working conditions in which the errors occur. A widely accepted structure to organize human error is the generic error-modelling system (GEMS) (Reason, 1990), which is based on Rasmussen's skill-rule-knowledge classification of human performance.
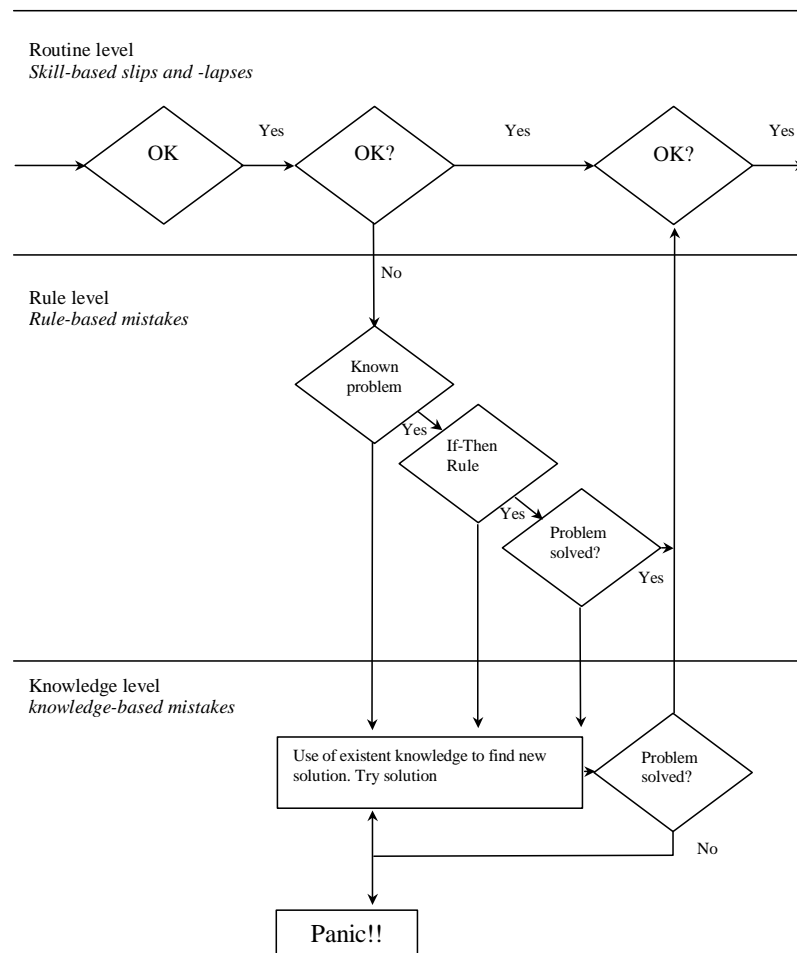
Routine level
Skill-based slips and -lapses

Rule level
Rule-based mistakes

Knowledge level
knowledge-based mistakes

Figure A8.1 Generic Error Modelling System (GEMS)

A8.2   Skill-based level

The lowest performance level is the *skill-based* level. At this level, people perform tasks almost automatically. Little attention is required, although occasionally a check must be made as to whether things are happening according to plan. Precisely because people can perform these activities without much thought means that errors do occur. A conscious check should be made that everything is OK, which is not always done. On the skill-based level, lapses and slips (forgetfulness and mistakes) do occur. These occur almost always naturally from a lack of attention or incorrectly directed attention, because the operator is preoccupied with other matters or distracted by external things. When driving a car, the driver is acting almost all the time at the skill-based level. After a great deal of training and experience, even very complex activities can be performed almost automatically. Examples of errors on the skill-based level are:

1. *mistakes out of habit*
    These mistakes occur in situations in which people have to perform automatic activities under slightly different conditions. A known example is that many people often still use the number for the previous year in January of the next year. When operating a machine, that is very similar to (but slightly different) from a machine that they are used to, the operator can quickly make mistakes out of habit;

2. *objective blurring*
    When people perform very automatic activities and forget why they are doing them, this type of mistake occurs. For example, when someone must hand over waybills and vaguely remembers having cleared out all the non-essential papers from the dashboard compartment, it can happen that he has also thrown away the important waybills and then hands over old documents. The chance of objective blurring increases when it is not very clear why someone has to perform a certain activity or when someone is distracted. Objective blurring occurs when someone performs the correct activity but with the wrong item;

3. *omitting a checking activity after an interruption*
    For example, someone is routinely checking whether a load is well lashed. Their cell-phone rings and, after the phone call, that person forgets to check the rest of the ropes. Checks of attention are often omitted because a person is interrupted during his normal routine;

4. *reduced intentionality*
    Occasionally, someone automatically drives to the wrong destination. This occurs because that person has something to do but on the way is busy thinking about other things, thus allowing the original plan to diminish. Reduced intentionality often occurs when delays take place between the moment of planning and the moment of execution;

5. *functional mistakes*

On many pieces of electronic equipment, one button can have more than one function, without it being clear in which function the button now stands. We talk in this case about 'modes'. For example, in most portable radios, the volume button is also the on/off switch. Imagine that someone is listening to the radio when someone else asks them a question. The person turns the radio down so that he can hear the questioner properly, but not so far that the radio is switched off. After finishing the discussion, the person then forgets that the radio is set to soft, thinking that it was turned off.

Examples of mistakes and forgetfulness on the skill-based level due to incorrect attention are:

1. *omission*

In an omission, attention is indeed given to the check but not at the right moment, so that other activities are forgotten. Usually this means that a number of steps in the automatic activity schedule are missed out;

2. *repeats*

This sort of mistake occurs because people get the idea at the wrong moment that they should be doing something. For example, starting the car while it is already running;

3. *incorrect movement*

When someone routinely goes through a checklist, for example when setting up a machine, there is a tendency to put the buttons into settings in which they should not be. One button that was correctly set can now be set incorrectly. Incorrect movements are a result of incomplete checks for which the operator has many options.

Mistakes and forgetfulness on the skill-based level cannot be avoided by training and becoming aware of them. Everyone who performs activities on 'autopilot' will make them occasionally. If consistent ergonomic criteria are applied in the task support environment, the chance increases that these type of errors will be acted upon in time. Mistakes and forgetfulness take place unintentionally and when it is seen that things are not going according to plan (usually after the entire cycle of activities has been performed) and there is still the opportunity to correct them, this correction will be performed immediately.

Errors on the skill-based level can be avoided, for example, by always making clear in which 'mode' a piece of machinery stands. If the errors still do occur, the task should be so set up that it has no disastrous consequences (no 'single person error'). This can be done by making the possible effect of an error visible at the moment that recovery from the error is still possible. Others in the area can also correct someone who has made a mistake or been forgetful. In general, the person's physical condition is also of

great importance. If a person is tired or has used substances that might influence his mind, then the chance of an error on the skill-based level is much bigger.

A8.3 Rule-based level

People faced with problems for which they already have ready-made solutions (*if* this is the case, *then* do this and then that) have the tendency to function on the *rule-based* level. Their memory sets of internalised regulations are automatically activated by signals from their surroundings. This could be a sign which urges them to perform a certain activity. It can also be a problem that the person has experienced more than once and knows what to do to solve the problem. On this level, no detailed analysis of the problem is required. The person starts to apply the rules as soon as the first signal indicates the standard problem. The application errors occur because the situation has been wrongly estimated or because the standard rules which are available are not suitable. Incorrect habits and inexperience play a major role in application errors on the rule-based level.

Examples of application errors on the rule-based level are:

1. *rule reliability*

    When people have solved a problem in the past by applying a certain procedure, they also have the tendency also to apply the same rules if the conditions are slightly different. Imagine that in the past it has always been successful to bring the temperature of the cooling water down by shutting a certain valve. A person will again perform this action when the cooling water becomes too hot, although this time nothing will happen because the origin of the problem is different;

2. *general rule*

    If in almost all situations certain rules apply, but in certain situations they do not, then people have a tendency also to apply those same rules. For example, in cases of differing priority rules for roundabouts;

3. *excess information*

    In difficult situations in strange surroundings, people have the tendency to fall back on a set of rules that appeared to be successful in the past. If people are on a new ship and they are confronted with a difficult situation, such as busy shipping lanes, then they have the tendency to perform activities that were fine for the equipment they were used to operate, but may not be for the new situation;

4. *first exception*

    Imagine that someone is used to getting to work by catching the train that leaves platform 7 at 07:15 am. One morning, they notice that their usual travelling companions are standing on platform 5. This information is ignored and that person

remains on platform 7. When someone is confronted with a situation for the first time that is different from the usual, they often hesitate to accept the new situation. Habit plays a big role here;

5. *rigidity*

By the introduction of quality-assurance systems, such as the ISO standards and the ISM Code (safety management system) for shipping, procedures have been written to cover all imaginable situations. Errors due to rigidity occur when someone believes so strongly in the correctness of certain procedures that they also apply them in situations for which they are in fact unsuitable.

Errors on the rule-based level are more difficult for the involved person to detect than errors on the skill-based level. This is because on the former level the procedures take place according to the plan of the involved person. It is their intention to perform an activity which at a later stage is found to be unsafe. The application of incorrect rules to a situation that is apparently well judged is in fact a violation. The difference between the category of violations and the application of incorrect rules is gradual/small. For violations, a person is fully aware of the fact that they are performing an incorrect activity; and when using incorrect rules (errors on the rule-based level) the use of these rules has become so normal that the operators do not even know that they are incorrect. More about violations later.

Application errors on the rule-based level can be approached successfully by training, experience, setting up procedures, clear task division, good communication, etc. It is important that in cases of unusual but still serious problems, people automatically have available a set of correct rules and procedures. These can be well learnt on simulators and in on the job training sessions.

A8.4 Knowledge-based level

When people are faced with problems for which no ready-made solutions are available, they must first analyse the problem before starting procedures to solve them. This requires thought processes, and people then function on the level of symbolic or abstract thought, the *knowledge-based* level. In order to be able to function at this level, a person must be able to arrange information, predict side-effects, and take data out of its context in order to be able to make the correct decision. At the same time, using already stored knowledge (or experience), often in the form of abstract rules, the correct strategy for a solution must be developed. Thinking at this level requires a great deal of effort; people do not enjoy functioning at this level. Often, a strategy is applied without being thought out properly. Sometimes a rough solution is simply tried: the so-called trial and error method.

Errors made at this level are the result of bias during the analysis of the problem and of the application of incorrect strategies for solution. Examples of bias are:

1. *bias due to selective attention*

    In a certain system, if a breakdown occurs, the operators, especially if they are working against the clock, have the tendency to only use a part of the signals and meter readings while solving the problem. These are usually very noticeable signals, such as a loud alarm. In this way, relevant but less clear information can be ignored that is essential for solving the problem;

2. *bias due to searching for confirmation*

    This is the tendency to resolve problems into already known problems. Information that agrees with what was previously expected (the hypothesis) is accepted, but contradictory information is rejected. For example, when someone sees that the temperature of a certain component is too high, due to water-cooling problems, they will only look for information that confirms this hypothesis and will ignore contradictory information;

3. *bias due to estimation of chance*

    If someone must choose between something with many advantages and a small chance of it going wrong, and something with no advantages and also no risks, that person will tend to choose the option of advantage with risks. For example, when someone has to travel in bad weather with unfavourable conditions (poor visibility, fog) and can choose between the car (20 minutes of travelling) and the train (60 minutes travelling) most people will choose the car despite the enlarged change of an accident due to fog;

4. *bias due to an excess of self-confidence*

    People who have been working somewhere for a long time, or those who have just taken a course are under the impression that they know it all. Their feeling of superiority means that they will not be able to listen to comments from others and they are not prepared to listen to signals that point to unexpected danger.

The quality of the human-machine interface plays an important role in the prevention of errors on the knowledge-based level. Designers of this type of interface should take care to ascertain which information is required and how it should be presented in order for appropriate decisions to be made. Feedback must be available at the right moment and must be able to be clearly interpreted. The right information needs to be present on the machine ('hardware') and also in the organization ('software'). This means that people must know to whom they should go when they need to solve a problem.

A8.5   Violations

Violation also is a typical human error. Violations often represent a quite deliberate intention not to follow (safety) procedures which will put everyone at peril. There are five main violation types that cause problems for organizations attempting to control behaviour:

1. *the unintentional violation* occurs because it is impossible to follow a certain procedure. They arise from procedures which are written in an attempt to control behaviour that is impossible for the employee to control, like don't make mistakes. Second, unintentional violations may occur when employees do not know or understand the rules. This may be particular relevant to new employees or when completing tasks adhere to a large number of rules. Strictly speaking, the definition of violation requires that deviation is deliberate, i.e. intentional. However, to avoid unintentional violation of formal procedures it is important to know whether this plays a significant role in an organization;

2. *the routine violation* is common practice. It occurs with such regularity that it becomes automatic and unconscious behaviour. Such deviations from formal working practice are often seen by employees to involve little risk and are accepted by the particular workgroup as the normal way of doing the job. This can be seen in work-to-rule actions;

3. *the situational violation* occurs as a result of factors from the work space or environment, which makes it difficult for the employee not to commit a violation. Factors such as time pressure, lack of supervision, unavailability of equipment all have implications in terms of situational violations. For example, when an operator improvises maintenance using equipment that is different from the one laid down in the procedures;

4. *the optimising violation* frequently occurs in an attempt by the employee to make a job more exciting or interesting. This type of violation is related to the non-functional aspects of work. It is a common violation for staff members or maintenance workers testing the boundaries of a system. It is also a common violation for employees involved in monotonous or overly restrictive work;

5. *the exceptional violation* is very rare and only occurs in unusual circumstances or when something goes wrong. Exceptional violations can be the result of either conscious decision making or instinctive reactions. For example trying to save un unconscious colleague who has been overcome by fumes. The rules forbid such actions.

These five types of violation are all intended errors with a 'good will'. We must differentiate these five types from the criminal form of violation, sabotage.

Safety Management Systems are not constructed with violation in mind and only truly inherently-safe systems could be automatically expected to survive all sorts of violations.

A8.6   Resumed

You can say that there is a different kind of danger in every error. A slip usually doesn't have big consequences, and can very easy be recovered from. A lapse is slightly more dangerous, and a mistake can be much more persistent and therefore difficult to recover from. This also means that the consequences can be very unwanted and even fatal. The worst of all error types however is the violation.
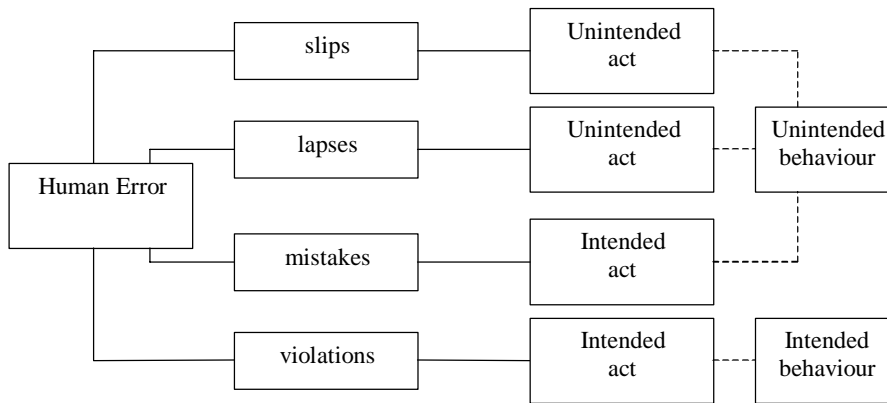

Figure A8.2   Human error and unsafe acts.

A8.7   Prevention of human error

Previously we already gave some practical possibilities to overcome slips, lapses and mistakes. More generally, and more structurally, you can think of two different approaches to solve problems with human error, the *reactive* and the *proactive* approach. The reactive approach involves waiting until something goes wrong, and then finding out what the problems are, and why they happened. The proactive approach requires some analysis before things go wrong, followed by fixing problems before they turn into accidents.

Reactive methods, like accident investigation, are strong because something really has gone wrong for an accident to happen. A proactive method is always open to the argument that what hasn't gone wrong yet, won't necessarily go wrong in the future.

There is a variety of techniques within both proactive and reactive approaches. Because the types of violation and the reasons for violations are so many, it is necessary to first find out what and where the problem might be, and then to select the remedial approaches that are most likely to be effective. There are many perfectly effective steps that can be taken. What should be avoided at any time is taking unnecessary action for problems that don't exist, ones that have already been solved. For example, the problem of intention is usually not really a problem, people have good intentions. The steps needed to solve intentional problems are therefore only necessary to ensure that intention is not becoming a new problem if conditions ever change. The question is however, if intention is not a problem, what is? Because people are still violating rules the answer to this question is probably positive. The reasons for violating are bound up in the way the work is done, the people who are hired, and the expectation of them going about their business.

Managers need to ask themselves a few questions before embarking on a mission to ensure compliance with all existing rules and procedures:

- Do employees know and understand the procedures?
- Do we need all the procedures?
- Are there situations when it is impossible to apply procedures?
- Does the job itself encourage violations?
- s it possible to have a procedure for every situation?
- Are there alternatives to procedures?

A8.8   Summary and conclusion

Using GEMS human error can be divided in different categories: slips, lapses, mistakes occurring on the different levels of Rasmussen's skill, rule and knowledge classification system of human performance. At the routine level slips and lapses occur, mostly stemming from lack of attention or incorrectly directed intention. At the rule-based level mistakes occur due to the incorrect use of rules, the correct use of rules in the wrong situation and the use of incorrect rules. At the knowledge-based level mistakes are made due to the application of incorrect strategies for solutions.

Violations form a category closely related to the mistakes. In these cases however the actions are intentionally and deliberate actions contrary to existing rules.

Once the causes of errors or mistakes are known, a suitable reaction can be chosen. The reactive approach involves waiting until something goes wrong, and then finding out what the problems are, and why they happened. The proactive approach requires some analysis before things go wrong, followed by fixing problems before they turn into problems.

Knowing what kind of error has been made (or can be made) can lead to different reactions. Slips and lapses require different remedies than rule-based mistakes. So insight in the process of human error gives direction to where to solve the problem. Do skills have to be renewed, is training of the application of rules needed or need the rules and procedures to be revised, is there enough knowledge available in situations when needed?

Appendix 9 Conceptual Framework

A9.1   Introduction

The model presented on the next page summarises the issues presented in these appendices. Central to the model is the behaviour of employees, resulting from intentions, attitudes and subjective norms. This is represented by the individual model.

The individual model is being influenced by the group model and the underlying cultural model. Individual attitudes are formed by beliefs and underlying basic assumptions. As a result of the evaluation of behaviour and outcomes feedback influences the (re)formation of attitudes.

The left hand side of the model contains the more 'preconscious' part, the right hand sides contains the more observable behavioural acts.

This conceptual model is just a means to visualise the separate safety concepts we presented in the previous appendices in one picture as a sort of summary. This is not an attempt to present a theoretical or an empirical model.
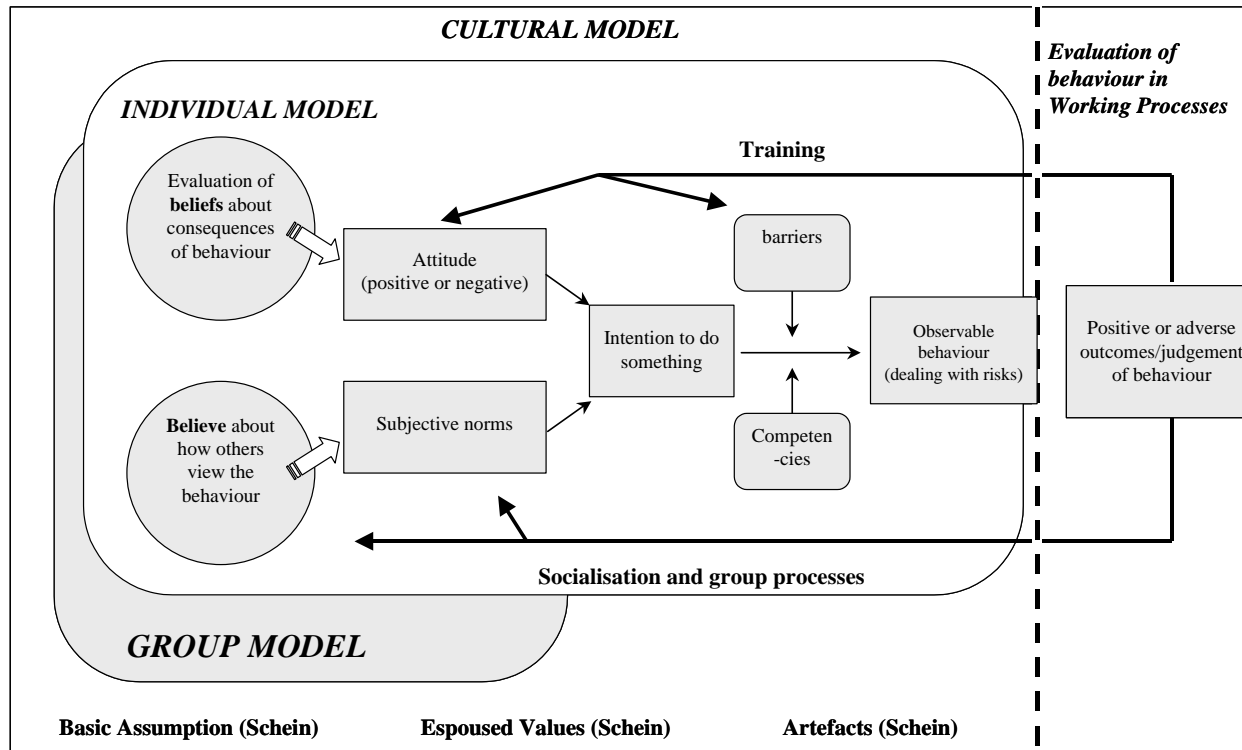
CULTURAL MODEL

Evaluation of behaviour in Working Processes

INDIVIDUAL MODEL

Training

Evaluation of **beliefs** about consequences of behaviour

Attitude (positive or negative)

barriers

Intention to do something

Observable behaviour (dealing with risks)

Positive or adverse outcomes/judgement of behaviour

Believe about how others view the behaviour

Subjective norms

Competen -cies

Socialisation and group processes

GROUP MODEL

Basic Assumption (Schein)   **Espoused Values (Schein)**   **Artefacts (Schein)**

Figure A9.1 Conceptual framework

Appendix 10 Literature

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