Near miss management

near miss reporting as a tool for managing total safety at Akzo Nobel Coatings

Witteveen, Marjolein

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AKZO NOBEL

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Report of the final project performed at Akzo Nobel Arnhem

Student: Marjolein Witteveen
Identity number: 328061
Date: 06-01-1995
tu/e Eindhoven University of Technology
Graduate School of Industrial Engineering and Management Science
Department of Technology and Work
Safety Management Group

First TUE-tutor:	dr. T.W. van der Schaaf
Second TUE-tutor:	dr. J.D. van der Bij
Reviewer TUE:	Prof. dr. P.M. Bagchus
First Akzo Nobel tutor:	dr. ir. G.J. Kok
Second Akzo Nobel tutor:	dr. ir. A. Ohm

Summary

Introduction
This report is the result of my final project which has been executed at Akzo Nobel Coatings in Arnhem, on behalf of the Coatings Health, Safety and Environmental Group Staff, Headquarters. This department works directly for the Akzo Nobel Board of Management and indirectly for the locations of the coatings group.

Recently, safety has become a prime management target. Since the late 1980s, and particularly with the rise of the Responsible Care concept in Europe and North America, managers stopped seeing safety as a technological add-on, but as a bona fide management issue. The Responsible Care program is an answer of the chemical industry to societal criticism. Main elements of Responsible Care are dialogue and adjustment. 'Be good and tell it', is the slogan. Like the other aspects of Responsible Care, safety performance is at its core a matter of 'continuous improvement'.
Yet in addition to the primarily humanitarian motives for providing a safe working environment, improving safety performance also bears firm financial clout. For, as one expert has calculated, Lost Time Injuries (LTIs) cost employers on average more than $20.000 per accident. Add to this the negative impact of a bad accident record to the industry's image, and it's easy to see why safety performance is increasingly dealt with as an indicator in management evaluations and operation planning reports.

Within Akzo Nobel, safety is also a prime management target. The attention will be directed towards prevention of injuries. This is stated in the corporate safety police:

> Akzo Nobel works towards the prevention of all injuries associated with its activities and those of its contractors

Safety policy

On the road to zero accidents, Akzo Nobel holds a frequency rate of 1.0 as a short term corporate goal. The frequency rate is equal to the number of lost time injuries per 100 employees per year. This figure is partly based on the safety performances delivered by other major international players in the chemical industry.

Recently, Chemicals and Coatings have joined forces to develop a new, broad-based safety management program and training course. The pilot projects are running at this moment. Other groups and business units will ultimately be able to profit from a training program aimed at improving safety performances by for example recognizing and correcting 'near misses' and unsafe situations and acts. The program is called 'Managing Total Safety' (MTS).

After management at a location has attended the MTS training program they are facing a great challenge to 'make it happen' at their site. The practical implementation aspects will have to follow the general framework of safety management, which is

discussed during the MTS training.

The question how to deal with these practical aspects raised at Coatings staff, Headquarters. Specifically, they were looking for a way to deal with near misses. This because of the fact that Akzo Nobel sees near miss management as an important part of the MTS training.

Aims of the project
A structured and practical way of dealing with near misses has been found in the Near Miss Management System (NMMS), developed by v.d. Schaaf (1992).
After discovering this system the question was raised whether and, if so, how NMMS could be a part of the MTS. This would primarily be investigated for the coatings-sites.

When the answer concerning 'whether NMMS would fit in the MTS' is positive, an implementation plan will have to be constructed. This plan will have to describe in what way the NMMS delivers its benefits. This implementation plan will be specified for Akzo Nobel Coatings, at least at the level of necessary organizational changes.

Near Miss Management System description
To start with a complete overview of the NMMS, the famous incident-iceberg is shown with the near misses in it (figure 1).

The Near Miss Management System is a system for registration, analysis, feedback and evaluation regarding near misses, as a tool for safety improvement.
The definition for a near miss can be stated as follows: A near miss is an occurrence with potentially important (safety related) effects which in the end was prevented from developing into actual consequences by adequate recovery.

The Near Miss Management System is built as follows (seven steps):

- detection: usually on the basis of voluntary reporting by employees;
- selection: those reports with the highest informative value;
- description: the selected event, by means of qualitative fault tree techniques
- classification: each of the basic causes, in terms of the system failure model; a near miss (or accident) is often triggered by a human, but is caused by a combination of technical, organisational and human factors;
- computation: statistical analysis of the database of incidents to uncover (patterns of) causal factors;
- interpretation of the classification results: to come to theoretically supported suggestions for management actions;
- evaluation: by means of an explicit feedback loop, analyze the effectiveness of implemented actions.

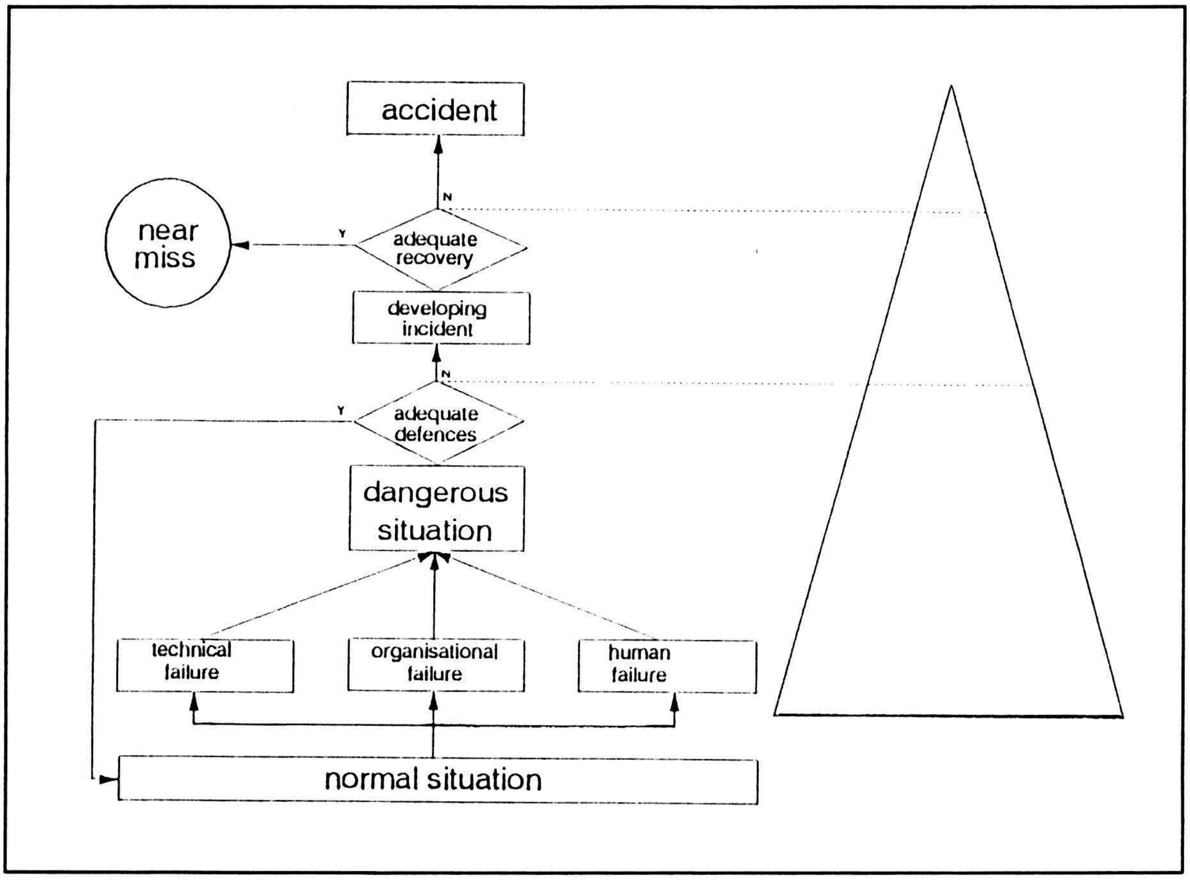

Figure 1 Incident iceberg

At the classification, basic causes are classified into technical, organisational and human failure modes. The classification is in this particular order to anticipate the inclination to start and stop the analysis at the level of the end user and leave the technical and organisational context of any incident unquestioned.

Method

To determine the factors which will have to be present in an organization in case of a successful near miss based safety program, an 'Ideal Safety Situation' (ISS) has been determined. A literature survey revealed opinions concerning success factors of a near miss reporting and analysis system.

The present safety situation, measured in ISS factors, at several Coatings-sites has been measured next.
At first a database with present data of reported incidents has been analyzed. This concerns just brief incident information at a standard form.
Secondly, a questionnaire has revealed the necessary information concerning the ISS factors. This questionnaire has been to 23 sites in Europe and to the safety supervisor of the USA.
As a third element, the first results of the questionnaire were presented at the IHSE-meeting in Montataire. Here a discussion delivered more insight.

The results of the present safety situation were compared with the ideal safety situation.
In determining the main benefits, possible difficulties and results of implementing the NMMS practices within an existing safety culture/situation, a pilot project has been executed.
In Bergen op Zoom, Akzo Nobel Resins, Critical Incident Interviews have taken place. The information which was revealed has been input for the reference database. The construction of a reference database is a phase of the general implementation plan. Interviews were held with 15 operators/ foremen who reported an accident or incident lately.

Practical information out of the questionnaire, combined with information of Bergen op Zoom, implementation aspects of other NMMS research projects (Hoogovens, ARCO) and expert information have lead to a practical way of dealing with certain elements.

Results

Ideal Safety Situation (ISS):

The resulting factors of the ideal safety situation are from different kinds.
Firstly aspects of an organisational attitude, such as the giving of support and feedback. These organizational attitude-factors have to be taken care of by management.
Secondly 'tools', such as training modules and software.
Thirdly 'human' factors, such as operator motivation. The ideal combination of these factors will be given below in table 1.

'Arnhem Database':

In getting results out of the database, the underlying causes as mentioned in the standard form were translated in terms of technical, organizational and human factors. These terms refer to the general failure types which characterize the NMMS. These failure types are described in the Eindhoven Classification Model (ECM). The resulting failure type distribution is an indication of the underlying error causation philosophy. The predominant model of human error appeared to be traditional safety model. An investigator holding this approach to human error will typically question the motivation of a person to carry out the system of work safely.

The result of the analyzed forms concerning failure types will be shown in figure 2. The failure types are expressed in their percentile distribution.

Table 1 Factors Ideal Safety Situation

Organizational attitude	Tools	Human factors
-top level commitment: goals motivation awareness right use -proactive rather than reactive (not consequence driven) -general repair actions instead of ad hoc (not event focused) -multicausal instead of mono-causal oriented -feedback to operators -state clear responsibilities -support staff and operators -appreciate operators knowledge and participation -give training/ instruction (no variability in quality) -decisive style of management -cause instead of action oriented (no technical myopia) -system induced error approach -no blame policy: forgiveness learning only	-methods for: detection selection description classification computation interpretation monitoring (=system documentation) -training programmes -design of feedback loops -software -written responsibilities	-motivation -awareness -commitment -participation (in analysis) -unbiased reporting -clearness of system, including responsibilities and actions

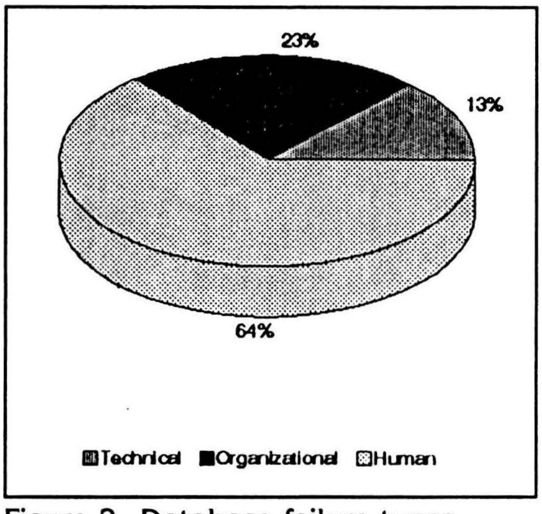

Figure 2 Database failure types

Other resulting aspects of the database are:

- Less near misses have been reported. It appeared that of all reports, 70% concerned LTIs. The reported n-LTIs appeared to be mainly from 1 site.
- In most cases just one option has been marked at the standard forms.

Questionnaire:
The results of the questionnaire/ISS confrontation will be based on the 7 NMMS modules.

Detection:
Concerning top level goals and a proactive policy, the intention is good, practice not yet, however. The aspects concerning the 'no blame policy' and the unbiased reporting differ from the ideal situation at least in the encouragement part and the 'no guilt' question. This 'no guilt' aspect shows also the fact that top level commitment can be improved. Reporting procedures and forms exist, but the training is mostly limited to spoken instructions. Re-informing sessions concerning the reporting system seem to lack a structured approach. These aspects differ from the ISS in which is stated that management should inform, train and support the operators. A system clearness and incident awareness to the operators should then result. This awareness seems to be absent in most sites, measured in the rate of incident reporting. This low rate of incident reporting can also be due to operator motivation problems, which seem to appear. Operator motivation should be present according to the ISS, but will be influenced by, for example, training. Concerning operator anonymity, no binding statements of the ideal situation will be given. The optimal organization of this aspect is not agreed upon by experts.

Selection:
At the moment, most sites state to make no selection. This is of course depending on the rate of incident reports. Regarding the fact that in a lot of sites just a few incidents are reported yearly, no selection will have to be present yet. Concerning the analysis depth of various incidents a selection seems to exist. The ISS advises a structured selection method also for analysis detail in case of a lot of reported incidents.

Description:
Responsibilities concerning the analysis and operator participation, although not optimal, seem to be in place in most sites. The analysis variability, determined by using a structured uniform approach and the presence of training, can be improved. The structured uniform approach lacks in a lot of sites, but training programmes even hardly exist. This structured approach should be based on multi causality in case of an incident. This is not really practised at the moment. The taken measures seem to be in accordance with the causes, so no technical myopia exist.

Classification:
The underlying incident causation model is based on multi causality in terms of technical, organizational and human failure types. This philosophy is not yet practised at the Coatings sites. Because of the fact that basic causes are not yet classified, no variability in classification exists.

Computation:
Most sites seem to lack structured data storage. In the ISS this aspect is mentioned because trends of causes are the basis for measures. These trends will have to be

determined.

Interpretation:
The aspects which have been measured concerning this interpretation are mostly positive and in compliance with the ISS. Responsibilities are stated in a lot of cases, management is reasonably fast with decision taking and everyone agrees that near misses are as important as real accidents in indicating action areas. An aspect which needs improvement is the fact that in most cases actions are directed to individual incidents on an ad-hoc basis. The ISS advises to take measures based on general cause patterns. This is closely related to the second aspect which needs improvement: linkage between causes and measures. This linkage is mostly not present yet.

Evaluation (including feedback and monitoring):
The aspects which refer to feedback aspects seem to be rather positive. Responsibilities seem to be stated, feedback loops are present in a lot of sites and the reaction to a structural feedback giving to operators and management was also positive. Visual feedback to operators in terms of time between decision and implementation of a measure can be improved. This is important to keep the operators motivated. Operator complaints seem not to occur however.
Evaluation aspects lack totally in most sites. No standard evaluation time and no responsibilities seem to in place. Because of this evaluation lack, variability statements do not make sense. This evaluation part is an aspect of the ISS, which have to be taken care of.

The results concerning the second part of the questionnaire are all very positive. Almost everyone sees the necessity of investigating near misses and is interested in its possibilities. The underlying near misses philosophy is in most cases agreed upon.

IHSE meeting:
The reactions at the IHSE meeting were mainly an affirmation of the database results. It appeared that the choice of a specific underlying cause concerning an incident refers to different underlying error approaches. Some of the HSE responsibles are convinced of the idea that 70% or more of the underlying causes is due to carelessness of the operators. Other HSE responsibles think more like the NMMS philosophy in a Technical, Organizational and Human part. The culture in Morocco is different from the European and should get individual attention. The religion plays an important role there in that Allah is responsible for human behaviour.
Furthermore it appeared that the low rate of near miss reporting indicates a more reactive approach towards incidents. Not all sites follow this reactive approach. Some do report data about near misses internally and/or externally. These are just a few, however.

The 'no blame policy' appeared to be not practised yet in the Coatings sites.

The reaction to the NMMS in general was very positive. The HSE responsibles understood the necessity of reporting and analyzing near misses. The practical aspects were just the thing they were insecure of.

General implementation plan and Bergen op Zoom pilot:
The reference database in Bergen op Zoom has been constructed as part of a general implementation plan. The steps of the general implementation plan are:

Step 1 Description site safety situation
Step 2 Management and staff workshop (NMMS philosophy and techniques)
Step 3 reference database (start data)
Step 4 organizational factors preparation and staff-training
Step 5 practical implementation
Step 6 evaluation

In Bergen op Zoom, the reference database has been constructed as step 1.
Steps 4, 5 and 6 can not be changed of order.

The resulting distribution concerning technical, organizational and human failure types in Bergen op Zoom appeared to be as follows (Figure 3):

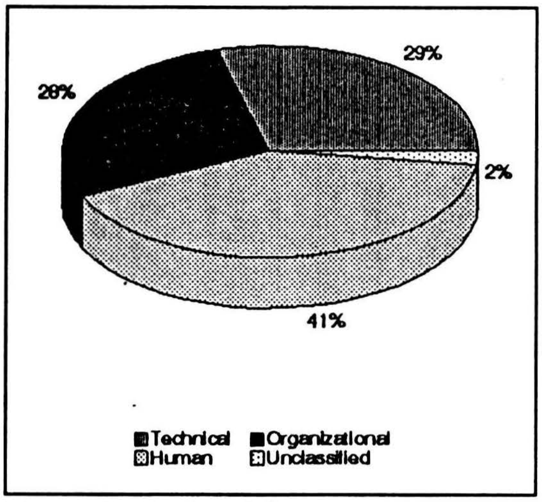

Figure 3 Resins failure types

It appeared that present measures are mainly focused on technical aspects. The measures are very local, focused on the specific department. The organizational learning aspect is not yet in use. Other (less) measures were focused on the interface of the organizational and human field. These were vary vague and kind of: discuss control, treatment in shifttalk. These were again very vague and local.

Review
Structure (linkage) will have to be brought into the safety system elements. This structure and uniformity lack in most sites (questionnaire result). Present actions seem to be rather ad hoc and by heart instead of general and structured. Besides this, top level commitment and support is very essential. This top commitment mainly refers to the underlying incident causation model with error types. The present situation indicates that the human component is regarded as being dominant (about 70%,

database and questionnaire result).

The reference database showed that the NMMS analysis reveals more, more specified and more comprehensive data concerning incidents and their causes than the present way of working. Most important is the percentile contribution of the human failure component. Human failure contribution appeared to be 41%. This NMMS result is contrary to Du Pont's statement that 90% or more of all failures is due to human acts. The NMMS result corresponded with the operators' and first line managers' feeling.

The attitude of the HSE supervisors concerning a near miss reporting and analysis system seemed to be rather positive. This appeared in the questionnaire, during the HSE meeting and in Bergen op Zoom.

Some aspects of the ISS have been chosen to be discussed in more detail. These are: operator motivation, unbiased reporting, selection method, classification model, database availability, responsibilities structure and feedback and evaluation structure. These factors are not yet present in most sites, apart from the feedback responsibilities and structure. These have been discussed because of the experiences in Bergen op Zoom.
The advises are not prescriptive. They can and will often be adjusted to local circumstances. An exception is the classification model. Definitions concerning the local situation can be added, but the model in itself is prescriptive. In case of data comparison, for example on BU-level, database uniformity is also advised.

Implementation of the NMMS is recommended. It will deliver a structured and comprehensive safety management program. Most important aspect to be changed at the start is management commitment. This aspect is very diverse at the moment. Management has to accept the underlying philosophy and has to put enough time in the system. This will act as a catalyst for the other implementation aspects as operator motivation and appropriate techniques.

Implementing the NMMS as advised, the following benefits will show up:
-In short term:
- -a structured method for reporting, describing, analyzing and interpreting incidents and near misses
- -more insight (quantitatively as qualitatively) in the basic causes of incidents

- In long term:
- -possible prevention by early risk identification
- -cost savings by improved safety performance ($ 20.000 per LTI)
- -more operator involvement in safety related cases
- -relevant data for system improvement (design aspects)
- -relevant data for training programmes
- -more efficient treatment of safety budget by more effective measures
- -possible integration with quality, environment and health approaches

Abstract

This report is the result of my final project, which has been carried out at Akzo Nobel Coatings, Arnhem. The main objective of this project was to explore the possibilities of a Near Miss Management System as a tool for safety improvement at the Coatings sites. This exploration was done by means of a database investigation, a questionnaire and a pilot project at a site. The exploration resulted in implementation advices.

Preface

This report is the reproduction of my final project, performed at Akzo Nobel Coatings, Staff QHSE, Headquarters Arnhem. The study Industrial Engineering and Management Science at the Eindhoven University of Technology will be concluded by it.

I am grateful to all persons who cooperated and/or gave support. Special thanks to Tjerk van der Schaaf, Hans van der Bij and Paul Bagchus from the Eindhoven University of Technology and to Gerard Kok and Arthur Ohm from Akzo Nobel. In addition, I like to thank Roel Munnik, Bas Haas, Piet Geuze and the operators from the BPO for letting me construct a reference database.
From Akzo Nobel I like to extent that to the HSE supervisors who cooperated with the construction and completion of the questionnaire, Larry Aiken for his interest and support, Jan Willem Lubberhuizen and Leo Kniest for their support concerning the software and Jenny van Kooten for guiding me in getting familiar with Akzo Nobel.

From the Eindhoven University of Technology in combination with Hoogovens, I wish to express my appreciation to Annemarie Mulder. I received a lot of support and advice from her.
From the Eindhoven University of Technology I also like to thank Wim van Vuuren for his support and advice.

I am also grateful to those people who checked the report on its language and gave advice about it. You gave very professional advice.

Last but not least I like to thank all those persons who made it possible for me to fulfil this study and supported me in completing it.

Contents

Chapter 1 Introduction

1.1 Report motives

During the study 'Industrial Engineering and Management Science' at the Eindhoven University of Technology, a student enters a company or organization three times for a longer period. Firstly with a group project, the second time with a short, two to three months, individual project. The last time an eight month period, which is called the final project. This project completes the study.
This report is the description of my graduating project which is executed at Akzo Nobel Coatings in Arnhem, on behalf of the Coatings Health, Safety and Environmental Staff, Headquarters. This department works directly for the Akzo Nobel Board of Management and indirectly for the locations of the Coatings group.

Recently, safety has become a prime management target. Since the late 1980s, and particularly with the rise of the Responsible Care concept in Europe and North America, managers stopped seeing safety as a technological add-on, but as a bona fide management issue. The Responsible Care program is an answer of the chemical industry to social criticism. Main elements of Responsible Care are dialogue and adjustment. 'Be good and tell it', is the slogan. Like the other aspects of Responsible Care, safety performance is at its core a matter of 'continuous improvement'.
Yet in addition to the primarily human motives for providing a safe working environment, improving safety performance also delivers firm financial benefits. For, as one expert has calculated, Lost Time Injuries (LTIs) cost employers on average more than $20.000 per accident. Add to this the negative impact of a bad accident record to the industry's image, and it's easy to see why safety performance is increasingly dealt with as an indicator in management evaluations and operation planning reports.

Within Akzo Nobel, safety is also a prime management target. The attention will be directed towards prevention of injuries. This is stated in the corporate safety police:

> Akzo Nobel works towards the prevention of all injuries associated with its activities and those of its contractors

Safety policy

Recently a corporate safety goal has been stated by the President of the Board of Management. He stated that within a couple of years, accident rates should have been lowered with 75% to 25% of the present numbers.

This project on safety aims at gaining insight in specific tools to reach the above mentioned goal.

1.2 Necessity of tools

To clarify the need for tools in making the right and most effective management decision, a short story will do (internal paper AGCO-TQE).

<u>The Boat race</u>

British Gas plc and the Japanese decided to have a competitive boat race on the River Thames. Both teams practised long and hard to reach their peak performance and on the big day they were as ready as they could be.
The Japanese won by a mile!
Afterwards, the British Gas team became very discouraged by the result and morale sagged. Senior Management decided that the reason for the crushing defeat had to be found and a special project team was set up to investigate the problem and recommend action.
Their conclusion: the problem was that the Japanese had eight people rowing and one steering. British Gas had one rowing and eight people steering.
Senior Management immediately hired an expensive consultancy company to do a study of the team structure. Millions of pounds and several months later, the consultancy company concluded that too many people were steering and not enough rowing.
To prevent losing to the Japanese again next year, a Regional Organisation Review was undertaken and the team structure was changed to four 'Steering Managers', three 'Senior Steering Managers' and one 'Executive Steering Manager'. A new 'Quality Performance' system was set up for the person rowing the boat, to give him more incentive to work harder and become a 'key performer'.
'We must give him empowerment and enrichment. That ought to do it'.
Next year the Japanese won by two miles.
British Gas laid off the rower for poor performance, sold off the paddles, cancelled all capital investment for new equipment, halted the development of a new canoe, awarded high performance awards to the consultants, and distributed the money saved to senior management.

1.3 Structure of the report

Chapter 2 deals with a Akzo Nobel description. Apart from the total company, specific attention will be given to HSE-treatment.
Chapter 3 deals with the assignment and the followed approach during the project.
In chapter 4, the Ideal Safety Situation in terms of essential factors will be determined.
Chapter 5 consists of techniques and results of determining the Present Safety Situation of several Coatings locations.
Chapter 6 deals with the differences between the factors of the ideal and the present situation.
A general implementation plan for a near miss management implementation, including an elaborate discussion of a reference database, constructed in Bergen op Zoom, will be discussed in chapter 7.
Chapter 8 deals with advise concerning specific implementation aspects of the tool.
The last chapter of the report, chapter 9, will consist of a summary of the main conclusions and advises.

Chapter 2 Organizational description

2.1 Akzo Nobel general

Akzo Nobel, headquartered in Arnhem, the Netherlands, is a worldwide industrial organization with operations in more than 50 countries and upward of 73.000 employees. Starting with Akzo, a short historic overview will be given.
Unlike many of their competitors, Akzo has not grown organically -that is to say chiefly from one company -but by mergers and acquisitions. The principal merger was that of AKU -Algemene Kunstzijde Unie- and KZO -Koninklijke Zout Organon- in 1969. Akzo was formed by a group of individual divisions and companies with divergent views, cultures and modes of operation but also with their own -sometimes excellent- reputations.
The divisions each possessed their own identity and great deal of autonomy within Akzo. Actually, Akzo resembled more a federation of divisions than one company whose activities were conducted by a number of product groups. In 1987 a corporate identity campaign was started to give Akzo -until that time the world's largest unknown chemical company- a new face both externally and internally.
In this way the meaning of the Akzo Nobel symbol, it represents Mankind -individuals striving together- and achievement, became reality.
In 1989 the BU organization was introduced throughout the company. The business units possess sufficient autonomy to anticipate and respond promptly to changes in market conditions. A new top structure was formed by the merger of the division and holding level.
The BUs are clustered in four groups on the basis of their potential commercial and technological synergies: Chemicals, Coatings, Fibres and Pharma.

Recently Akzo merged with Nobel (25-02-1994). The result is a company with leading positions in the field of chemicals, coatings, healthcare products and fibres.
The presidents of the four groups, together with the Chairman and the Deputy Chairman constitute the Board of Management. The group presidents in the Board of Management are being assisted by max. 2 Group Directors, the Group management. Functional directives are given at a central level at the areas human resources, control & administration, finance and strategy. Hierarchical responsibility continues to rest with the general manager of the BU. Technology -including Safety- differs so strongly from one group to the next that only coordination is provided at holding level.

Besides the corporate level, country organizations exist. This geographical line has no control function. In principle, country organizations are to be considered as service units that work for the business units active in the country concerned or for the corporate holding. They perform also a juridical function. It is important to note that country organizations do not have direct influence on the business. They do not interfere with the hierarchical line between the BoM and the BUs.

2.2 Health, Safety and Environment (HSE) in general

The policy statement on health, safety and environment at Akzo Nobel is constituted by the Policy Committee. This committee is formed by the Board of management enlarged with the Executive Vice President Technology and Environment. Main part of the statement is as follows:

> Health: Akzo Nobel seeks to conduct its activities in such a way as to prevent harm to the health of its employees and other persons;
> Safety: Akzo Nobel works towards the prevention of all injuries associated with its activities and those of its contractors;
> Environment: Akzo Nobel protects the environment by preventing or reducing the environmental impact of its activities and its products through appropriate design, manufacturing, distribution, use and disposal practices.

HSE policy statement

Proposals for the policy are being prepared by the council for Technology and Environment, constituted by the executive vice president T&E, the group directors T&E and the corporate director S&E. To make this story more visible, a figure of the HSE organization of Akzo Nobel nv will be shown (Figure 2.1).

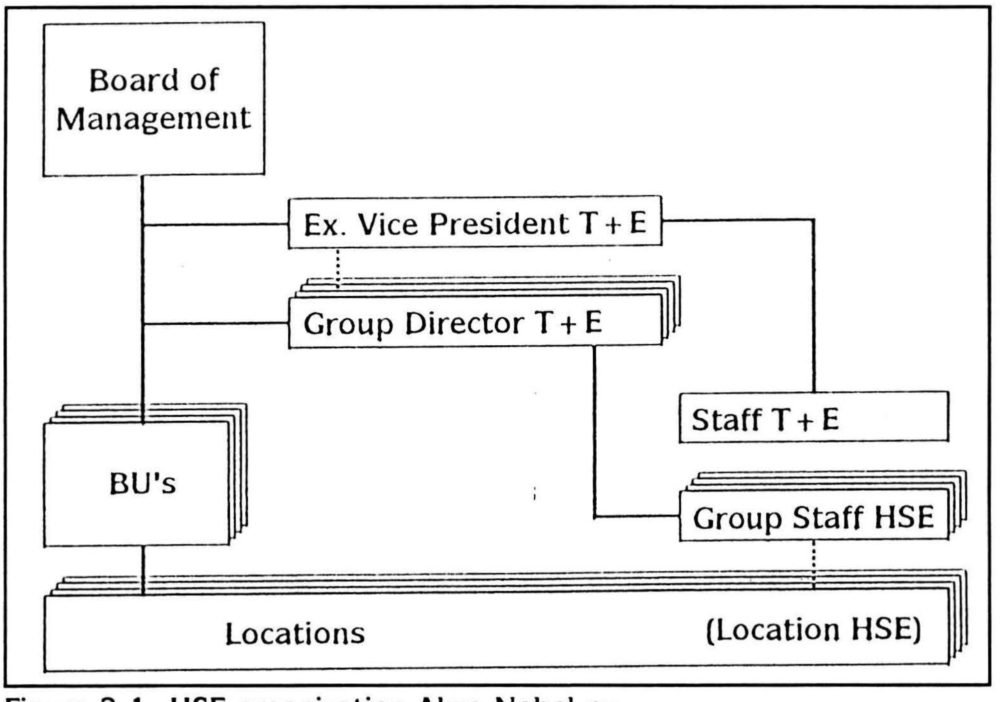

Figure 2.1 HSE organization Akzo Nobel nv

Figure 2.1 shows the relations between the various functions and organization parts.

The ideas of the BUs are most represented (indirectly) by the third (policy)-committee, the HSE Consultative Group. This one is constituted by the Group Director S&E, the Group managers HSE and the Group Advisor S&E.
The policy implementation is at the level of the BU at the site. Line management will be held responsible for all aspects of the HSE policy.

To summarize the most important staff tasks, the following list will do:
Staff helps the BoM to manage the BUs in the hierarchical line. Directives and Guidelines which are imposed by the BoM to the BUs support the policy. These Directives and Guidelines are prepared and constituted by staff members.
This is part of their policy preparation activities. An other part of the policy preparation is constituted by initiation and execution of projects on Health, Safety and Environmental matters.
Furthermore, they are asked for advise and appraisal in case of important decisions. These are decisions which have to be taken by the BoM after a request of a BU.
Staff also audits sites. When a site is audited (according to a checklist) the results are communicated to the site itself, the BU, the group director T&E and the auditing department.
There are no direct obligations for the sites to act upon the recommendations. The Three year Operating Plan (TOP), constituted by the BU, contains a HSE-part and is discussed every year, however. The recommendations can be integrated in this part.
In this way the staff gives advice, but is not responsible for implementation.

2.3 Safety at a location

As explained in the previous paragraph, the locations do not have any hierarchical line with the Group staff. The locations follow the directives and guidelines which are constituted and affirmed by the BoM or BoM-members.
Safety is a line responsibility. This means that a safety supervisor, which is often present, is not direct responsible for the safety performance of a site. He/ she acts as an advisor towards the line managers and the operators.
One of their tasks is to report accident and incidents[1] to the Group safety coordinator. This is part of one of the directives.
The safety situations at the various sites are not similar. There is no corporate or group safety management system. This has resulted in sites with a good organization of their safety management and sites which almost lack any organization around safety management.

[1] Accident/incident definitions:
Accident: An undesired event which did result in an unwanted impact on the safety or health of people, property or the environment.
Near Miss: An undesired event which could have resulted in an unwanted impact on the safety or health of people, property or the environment.
Incident: This is the summary of accidents and near misses.

Chapter 3 Assignment and approach

3.1 Background

Attention to safety, trying to prevent all injuries associated with their activities, and those of their contractors, is an explicit part of Akzo Nobel's policy statement.
To actually implement safety improvement, a change in the mentality and behaviour of both management and workers is needed. This is the general opinion at Akzo Nobel.
In order to provide everyone with visual objectives, frequency rate indexes for the four product groups and Akzo Nobel as a whole are published and distributed on an annual basis. These figures equal the number of lost time injuries per 100 employees per year.
On the road to zero accidents, Akzo Nobel strives for a frequency rate of 1.0 at the end of 1995 (Coatings' HSE masterplan 1990). This figure is based on a moral issue, but also on the safety performances delivered by other major international players in the chemical industry.

3.2 Motives

Recently, Chemicals and Coatings have joined forces to develop a new, broad-based safety management program and training course. The pilot projects are running at this moment. Other groups and business units will ultimately be able to profit from a training program aimed at improving safety performances by for example recognizing and correcting 'near misses' and unsafe situations and acts. The program is named 'Managing Total Safety' (MTS).

The MTS program consists of several complementary subjects. These are:
- Reasons for safety
- MTS-corporate
    - Safety cornerstones
    - Safety building blocks
- MTS-personal
    - Recognition of Unsafes/'Near Misses'
    - Actions for prevention
    - Basic actions with people
- MTS tour procedure
- MTS tour practice
- MTS action plan

The program is a cascade, top down training. Facilitators and management train all employees. In this way the 'Boss is involved in the training of his or her employees'. The learning, using and training cycle will be followed in this approach. During the whole training but also afterwards, the slogan regarding safety will be:
'NO ONE WORKS TO GET HURT'.

3.3 Problem description

After management at a location has attended the MTS training program they are facing a great challenge to 'make it happen' at their site. The practical implementation aspects will have to follow the general framework of safety management, which is discussed during the MTS training.
The question how to deal with these practical aspects was raised at Coatings staff, Headquarters. Specifically, they were looking for a way to deal with near misses. This because of the fact that Akzo Nobel sees near miss management as an important part of the MTS training.

3.4 Specific assignment

A structured and practical way of dealing with near misses has been found in the Near Miss Management System (NMMS), developed by v.d. Schaaf (1992).
After discovering this system the question raised whether and, if so, how NMMS could be a part of the MTS. This would primarily be investigated for the coatings-sites.

When the answer concerning 'whether NMMS would fit in the MTS' is positive, an implementation plan will have to be constructed. This plan will have to describe in what way the NMMS delivers its benefits. This implementation plan will be specified for Akzo Nobel Coatings, at least at the level of necessary organizational changes.

3.5 NMMS, an introduction

In this paragraph, a short explanation of the NMMS will be given.
To start with a complete overview of the NMMS, the famous incident-iceberg is shown with the near misses in it (figure 3.1).

The Near Miss Management System is a system for registration, analysis, feedback and evaluation of near misses, as a tool for safety improvement.
The definition for a near miss can be stated as follows: A near miss is an occurrence with <u>potentially</u> important (safety related) <u>effects</u> which in the end was prevented from developing into actual consequences by <u>adequate recovery</u>.

The underlying philosophy of the NMMS will be discussed shortly by some statements:

* Not WHO made WHEN WHICH fault, but especially HOW OFTEN and WHY is and could the fault have been made.
* Not the system is a threat, the dangerous situations the operators face are.
* Interaction between management and operators in practice leads to effective (safety) management.
* Causes for accidents and near misses are the same.
* Waiting for accidents is not necessary. They can be prevented by announcing near misses, analyzing those and taking appropriate actions before something serious has happened.

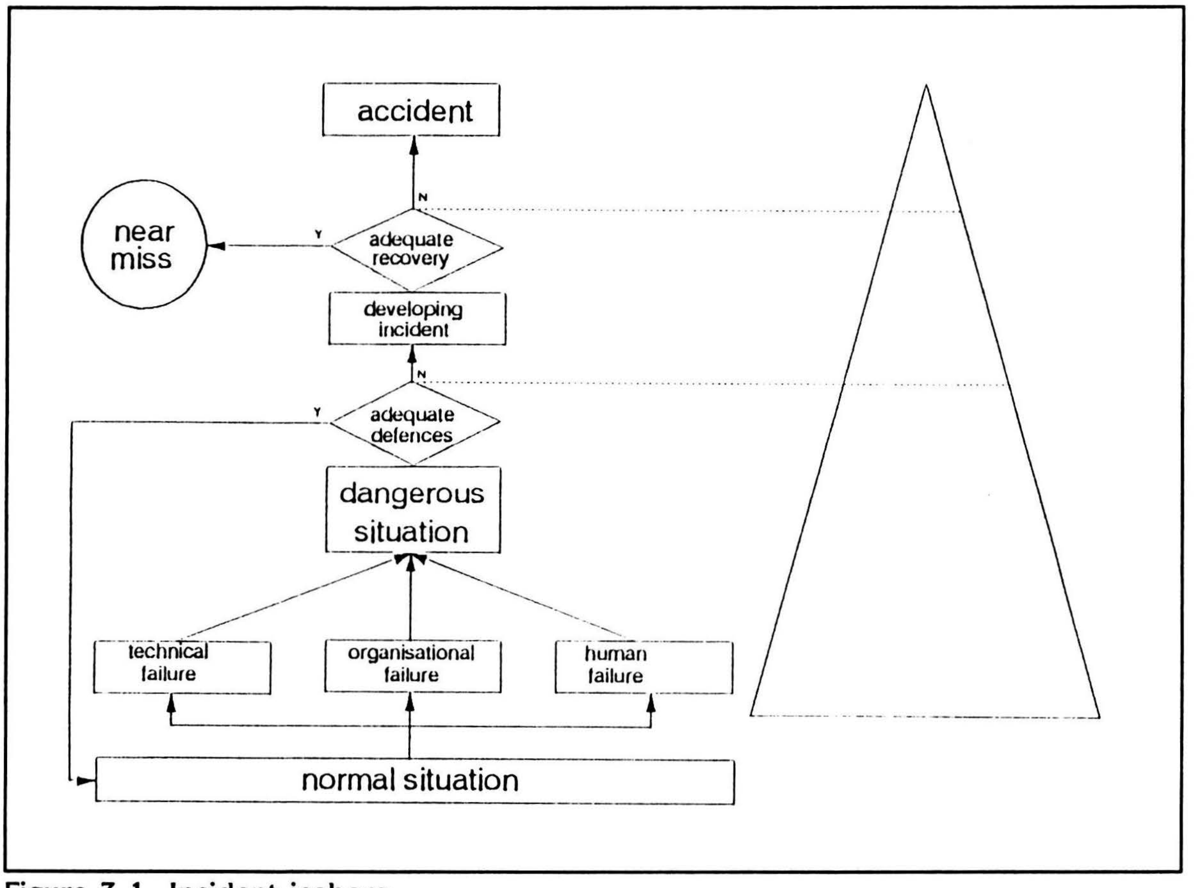

Figure 3.1 Incident iceberg

- Most accidents are unique. Measures should therefore be aimed at basic causes, revealed after a range of incidents.
- Zero accidents is not synonym for a safe situation.
- Incident reporting is mainly meant for organizational learning, not for operator monitoring
- Incidents are being causes by several (more than 1) basic causes.
- Causes of incidents can be classified in terms of technical, organizational and human failures.
- Human failures may be the largest part, but certainly not dominant or the only part.

The near miss management system is built as follows (seven steps):

- detection: usually on the basis of voluntary reporting by employees;
- selection: those reports with the highest informative value will be selected;
- description: the selected event will be described, by means of qualitative causal tree techniques. An example of a causal tree will be shown in figure 3.2;
- classification: each of the basic causes will be classified in terms of the Eindhoven Classification Model; a near miss (or accident) is often triggered by a human, but is caused by a combination of technical, organisational and human factors;
- computation: statistical analysis of the database with incidents will take place

to uncover (patterns of) causal factors;
●interpretation of the classification results: to come to theoretically supported suggestions for management actions;
●evaluation: by means of an explicit feedback loop the effectiveness of implemented actions will be analyzed.

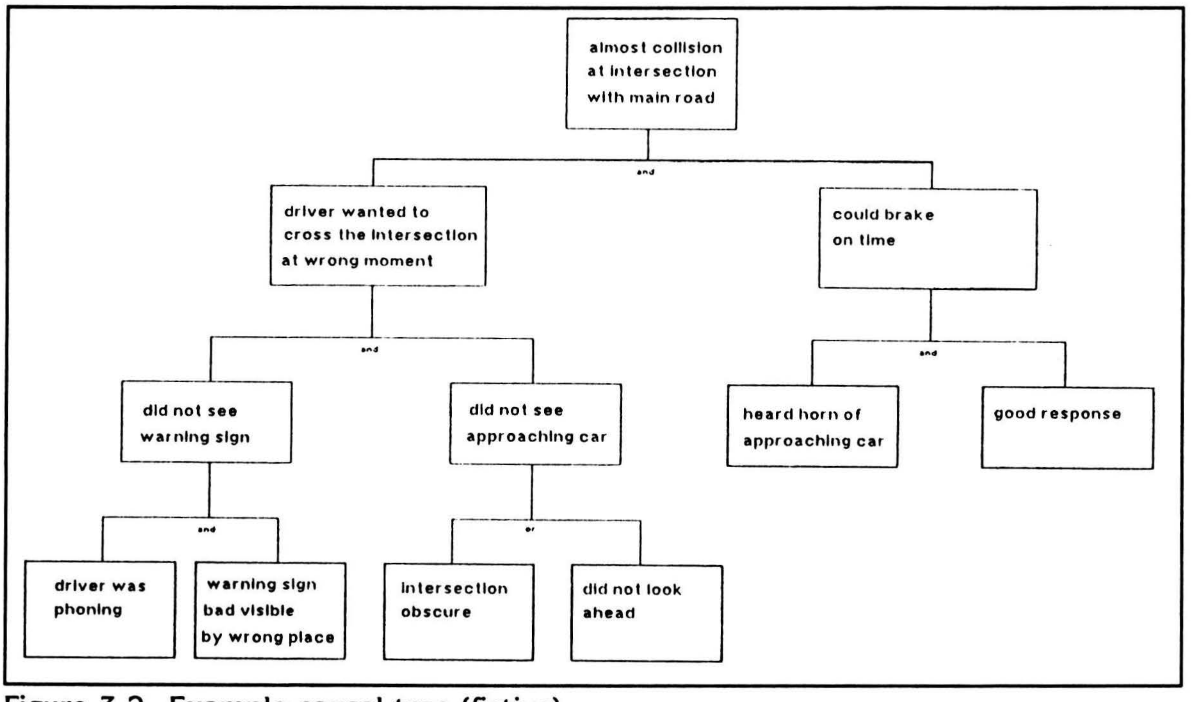

Figure 3.2 Example causal tree (fictive)

As shown in the Eindhoven Classification Model (figure 3.3), basic causes of incidents are classified into technical, organisational and human failure modes. The classification is in this particular order to anticipate the inclination to start and stop the analysis at the level of the end user and leave the technical and organisational context of any incident unquestioned.

A short explanation of some classification types will be given after the figure in a text box.

The NMMS pursues three goals. These are:
Modelling; Monitoring; Motivation, by keeping up alertness.
In case of modelling, the only objects of interest are new near misses (incidents). The description will have to be very comprehensive. The classification model will have to be flexible enough to deal with these qualitative insights. Modelling reveals qualitative insight. These qualitative insights will then have to be formalised in a monitoring version of the NMMS. In this case there will only be looked at known causes of incidents. These causes will be classified on routine basis, after which they are stored in a database. Trends can be determined then. The goal is to check whether the taken measures are sufficient in controlling the known dangers. The third goal is of a different kind: improving the operators alertness.

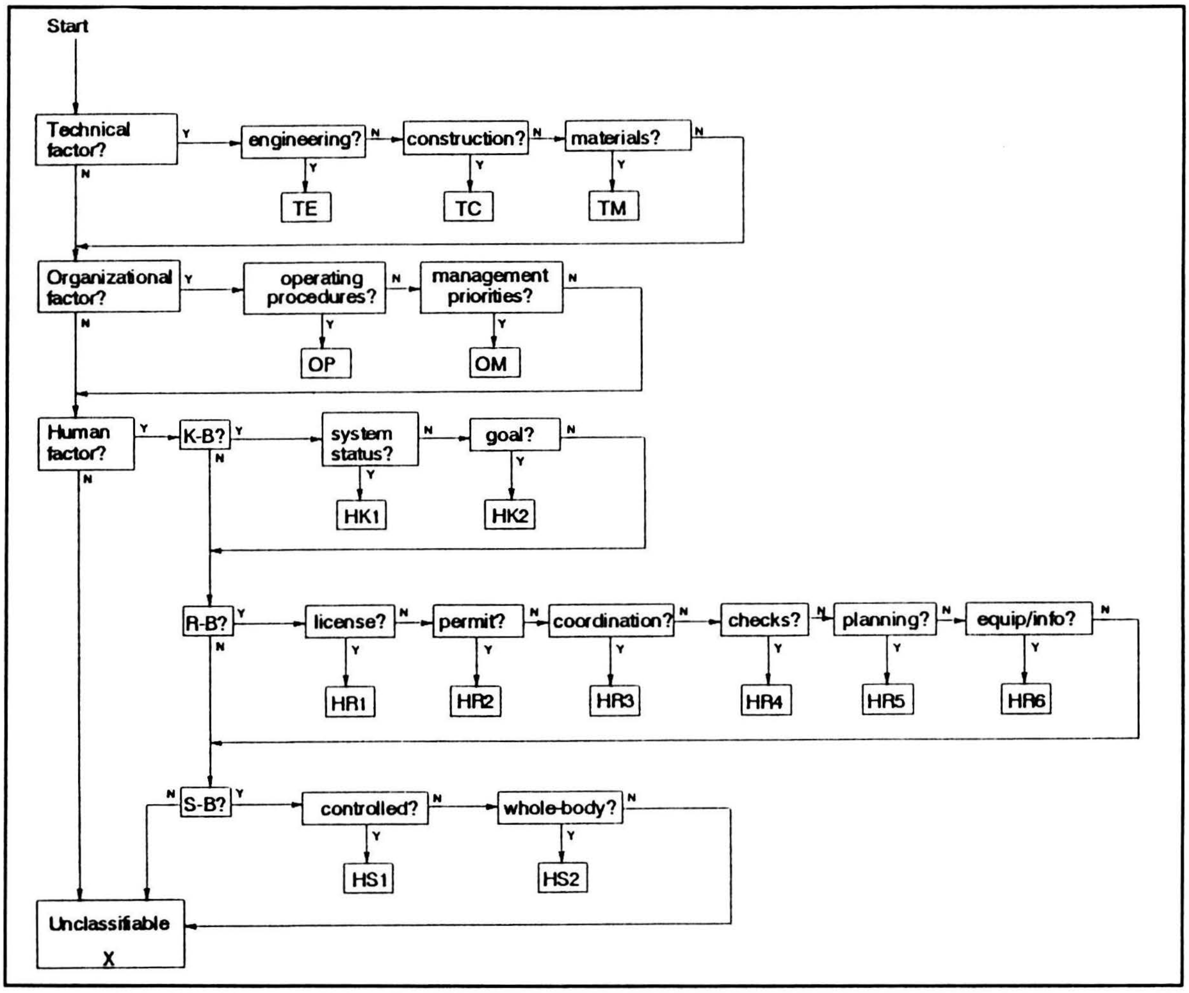

Figure 3.2 Eindhoven Classification Model (v.d. Schaaf, 1992)

Especially in organizations with a long period with zero accidents, it is hard to keep the operators alert at the hidden dangers. Reported and analyzed near misses function in this way as a reminder to work safely. These different goals of NMMS have their consequences for the execution of the different modules of the NMMS. These consequences will be shown in enclosure 1.

Reasons for implementing the NMMS can be summarized as follows:
- In short term:
  - a structured method for reporting, describing, analyzing and interpreting incidents
  - more insight (quantitatively as qualitatively) in the basic causes of incidents
- In long term:
  - possible prevention by early risk identification
  - cost savings by improved safety performance ($ 20.000 per LTI)
  - more operator involvement in safety related cases
  - relevant data for system improvement (design aspects)
  - relevant data for training programmes
  - more efficient treatment of safety budget by more effective measures
  - possible integration with quality, environment & health approaches

The classification model as developed by v.d. Schaaf (1992) is divided in mainphases: technical factors, organizational factors and human factors. Each of these mainphases is specified in more detail. Each basic cause (mostly more than one) of an incident will have to be classified.
Some definitions of factors which are not self-evident are:
Technical:
TC, construction failure, means that the design was correct, but was not followed accurately during the construction phase.
TM, material failure, refers to those material defects which can not be classified as TE or TC. This refers to unique situations which occurred completely as a surprise.
Organizational:
OP, operating procedures, refer to the quality of procedures (completeness, accuracy, ergonomically correct presentation), not whether they are followed or not.
OM, management priorities, refer to any *de facto* pressure by top- or middle management to let production prevail over safety.
Human:
Concerning this end user level, three main categories will be explained. These categories refer to Skill, Rule and Knowledge based errors of the SRK Model, developed by Rasmussen (v.d. Schaaf, 1992).
Skill based behaviour refers to routine tasks. Little or no conscious attention is required during task execution. In this way enough 'mental capacity' is left to perform other tasks in parallel.
Rule based behaviour refers to familiar procedures applied to frequent decision making situations. The separate actions themselves will again be performed on a skill based level. Making these familiar decisions and monitoring the execution of the skill based actions require some part of the total mental capacity, but not all.
Knowledge based behaviour refers to problem solving activities. This occurs for instance when one is confronted with new situations for which no readily available standard solutions exist.

Explanation Eindhoven Classification Model (ECM)

3.6 Approach

Phases:
1. Preliminary investigation

Question: How is the present way of safety management at Akzo Nobel Coatings sites; How diverse are various sites; Is there any site cooperation.

Technique: Visits to dutch sites and accompanying talks took place. Furthermore a report about the Sassenheim site situation was read.

Justification: Too little information about safety practice in the paint industry was present in the beginning. Conversations were just allowed in the Netherlands, with a few sites. For these reasons, 3 sites were visited and a report about Sassenheim was read in getting a starting idea about safety.

2. Ideal Safety Situation

Question: Which factors will have to be present in an organization in case of a successful safety program, based on near miss reporting and analysis. In this way an Ideal Safety Situation (ISS) will appear.

Technique: A literature survey will reveal opinions concerning success factors of a near miss reporting and analysis system.

Justification: In getting an overview as complete as possible, it is necessary to combine the opinions of a lot of people. Because it is not possible to talk to all persons with near miss reporting experience and literature is dealing with the interesting subjects, a literature survey will do.

3. Present Safety Situation

Question: What is the Present Safety Situation (PSS) at several Coatings sites. The way of dealing will be expressed in the factors which are revealed by the ideal safety situation.

Technique: To answer this question, a few techniques will be used.
At first the 'Arnhem' database with data of reported incidents will be analyzed. This concerns brief information at a standard form.
Second, a questionnaire will have to reveal information concerning the ISS factors. This questionnaire will be sent to 23 sites in Europe and to the safety supervisor of the USA.
As a third element, the first results of the questionnaire will be presented at the IHSE-meeting in Montataire.

Justification: In getting information about the present site safety situation it would be ideal to visit the various sites and take a look at the safety organization. Besides the fact that this would take a lot of time, it is impossible because of the amount of production sites. Therefore, a sample of the sites will have to be chosen.
The reason for choosing a questionnaire is that Akzo Nobel Coatings Headquarters imposed some restrictions on the way of obtaining the necessary data. Interviews will not be allowed. During telephone calls the data can not be obtained, because of the large amount of questions and the fact that some data will not be available at the moment the questions were asked. The next best solution is a questionnaire, with specified categories for the answers. This will make it possible to compare the data. The restriction concerning the questionnaire is that it will not take too much time to complete it. Furthermore it will at first be limited to Europe with selected persons.

4. Differences between ideal and present situation

Question: What are the main differences between the ideal safety situation and the present status of its factors at the sites?

Technique: The results of the 'Arnhem' database research, the questionnaire and the reactions at the IHSE-meeting will be compared to the ideal safety situation.

Justification: To indicate major differences, a reference point and appropriate data are needed. The ideal safety situation acts as a reference point for the present safety situation data.

5. Research at a location as part of a general NMMS implementation plan
   - Question: What are the main benefits, difficulties and results of implementing NMMS practices in an existing safety culture/situation. In other words: Will the NMMS fit in today's practice?
     Secondly, this will reveal important information concerning available time and knowledge of the persons who are possibly the ones who are going to work with it.
   - Technique: In Bergen op Zoom, Akzo Nobel Resins, Critical Incident Interviews will take place to construct a reference database. The reference database construction is part of the general implementation plan. The interviews will be held with 15 operators/ foremen who reported an incident lately.
   - Justification: To get information concerning incidents and its basic causes, the CIIs proved to be an important tool which reveals a lot of information.
6. Construction practical implementation plan
   - Question: Which steps will a site have to take in implementing the ideas and structure of the NMMS. Specific attention shall be given to those ISS-factors that are crucial.
   - Technique: Practical information out of the questionnaire, combined with information of Bergen op Zoom, implementation aspects of other NMMS research projects (Hoogovens, ARCO) and expert information will lead to a practical way of dealing with certain elements. The elements indicated as most crucial, are the ones with the greatest differences, yielded in mainphase 5.
   - Justification: As explained at the technique, it will be obvious that in this way practical and theoretical implementation ideas are combined.

Chapter 4 Ideal Safety Situation (ISS)

4.1 Philosophy of ISS

When looking at the possible success or failure of a safety program, in particular a near miss management program, everyone agrees that a specific safety situation should be present. Because of the fact that the term 'safety situation' is rather vague, an explanation is necessary.
Safety situation refers to the way a location deals with safety, in terms of the way of determining and looking upon failures and failure types and the way a follow up to incidents is given. Because of the fact that the NMMS will be taken as basis, some of its system elements are part of the ideal safety situation. These elements belong to the safety situation as far as they have to be taken care of before starting the real system implementation.
Safety situation refers in this way to those organizational attitude, tools and human behaviour which need to be present before running the system. After the start, some factors or tools need perhaps some adjustment. This is part of the system implementation, however, and does not belong to the safety situation.
The safety situation elements are from different kinds. Firstly organisational attitude-factors, such as the giving of support and feedback. Secondly 'tools', such as training modules and software. Thirdly 'human' factors, such as operator motivation. The ideal combination of these factors will be given in this chapter.

4.2 Method

In determining the various factors of the ideal safety situation, literature about success factors in near miss reporting and analysis has been studied. The most important part of the studied literature is a book which is the result of a three day discussion meeting held in Eindhoven, September 1989 (v.d. Schaaf e.a, 1991). Its theme was 'registration and analysis of near misses' and it brought together a dozen safety professionals, academics and consultants from Western-Europe and Canada. Almost all had practical experience with near misses and accident reporting schemes in either the process industry or in transportation.
The ideas of various authors will be summarized in paragraph 4.3. In determining the ideal combination of factors, the ideas of all authors have been put together. They can be seen as complementary.

4.3 Results

REASON (v.d. Schaaf et al, 1991) :
Reason distinguishes different safety styles, which relate to top level commitment (motivation and resources), competence (technical competence) and cognizance (awareness) factors. At present there is no standardised form for this stylistic assessment. The following 7 point rating scale summarises some of the issues that might be considered:
1 Pathological; Safety practices at the barest industry minimum. No top-level commitment to the pursuit of safety goals.

2 Incipient-reactive; Keeping just one step ahead of the regulators, but showing some signs of concern about accident trends.
3 Worried-reactive; Beginning to get seriously worried about continuing runs of incidents or accidents.
4 Repair-routine; Reasonable sensitivity to past events and possible future ones. Safety data collected and analyzed, but problems dealt with only by local repair actions.
5 Conservative-calculative; Possess a wide range of auditing techniques and workplace safety measures, but still highly 'technocratic' in their remedial measure. The organization remains firmly locked into the technical and human error safety areas.
6 Incipient-proactive; Characterised by an early awareness that 'engineering fixes' selection, training and motivating are not enough. Actively searching for better solutions. Beginning to acknowledge the importance of organizational and managerial factors.
7 Generative-proactive; Many proactive measures in place. Organizational safety measures under constant review. Top level commitment to improve safety culture. A range of diagnostic and remedial measures continuously being reviewed and implemented. A marked absence of complacency.

v.d. SCHAAF (v.d. Schaaf et al, 1991 and v.d. Schaaf, 1992): This part mainly deals with NMMS elements. Parts of these elements will be included in the ISS. This refers to initial element documentation and worked out methods, which has to be taken care of before starting the practical system implementation.

Persistent motivation to be aware of the dangers of one's workplace or of the system as a whole is crucial to any organization's safety culture and therefore to the safety related behaviour of all levels of its employees.
By taking the NMMS modules as a descriptive checklist, it becomes a framework for NMMS support systems. This means that system documentation and methods concerning detection; selection; description (not only human failure but also human recovery); classification; computation; interpretation; monitoring will have to be present.
Other important aspects concerning NMMS success are:
- management commitment.
- management support, needed to provide the level of trust required for any voluntary reporting system: employees are guaranteed that the NMMS acts as a learning instrument only.
- supporting the safety staff in appreciating the underlying system philosophy and ensuring an objective and uniform approach in description, classification and interpretation of the reported event.
- extensive end-user participation in the design of all modules.
- feedback to personnel about all NMMS aspects.
- unbiased reporting (training in recognizing, showing the way data will be treated.

ARCO, EXXON and Hoogovens experiences revealed that the distribution of technical, organizational and human failure types is respectively about 30%: 20%: 50%. (Mulder, 1994; v. Vuuren, 1992 and v.d Schaaf, 1992).

IVES (v.d. Schaaf et al, 1991):
Effective reporting and analysis systems can only serve to improve performance if the information provided is acted on. Actions necessary to improve performance which get lost in the bureaucratic system or get blocked as a result of organizational conflict may quickly lead to safety, availability and financial penalties. Reporting and analysis systems must have full management support. Unscrupulous managements who use reporting systems for purposes other than those intended can quickly destroy systems which may have taken years to develop. Reporting systems should be monitored throughout their entire life, especially at times of intense activity, in order to demonstrate their effectiveness. Potential problems without decisions and actions tend to become real problems. Near miss reporting is likely to yield more beneficial results with a decisive style of management.

LUCAS (v.d. Schaaf et al. 1991):
In organizations, 5 central problems arise:
- Technical myopia (most approaches are oriented towards hardware failures rather than human failures. This is despite the known predominance of human performance problems for which figures of between 20% to 80% are cited).
- Action oriented (tendency to focus on what happened rather than why the problem occurred).
- Event focused (individual accidents rather than general patterns. Hence accident reporting systems are often anecdotal in nature).
- Consequence driven (incidents with serious consequences are recorded and investigated, near misses and potential problems are not often perceived as necessary or worthy of analysis. Even if the advantages of near miss reporting are appreciated adequate resources of time or personnel are not always available in existing safety departments).
- Variable in quality, regarding reports (this implies problems with the in-company training of accident investigators and in the lack of systematic methods of incident analysis).

Three of these problems are particularly relevant to the issue of near miss reporting. Firstly, the investigation of only those incidents with serious consequences. This problem is fundamentally a question of an organization holding a reactive management style towards safety which is discussed in detail by Reason. Secondly, the event focused nature of current reporting systems which makes accident reporting systems largely anecdotal in nature. The search for patterns of causes is dependent to a great extent on the underlying perception of the causes of accidents and human failures held by an organization. This model of accidents and errors is a key element of an organization's 'collective memory' and of its prevailing safety culture (Middleton and Edwards, 1990; Westrum, 1988; Lucas, 1991). This issue is discussed in more detail below. Thirdly, the tendency to focus on actions rather than causes which is again related to the underlying model of human error held by an organization. The other two aspects are not specific for near misses, but safety in general.

The features of data collection schemes listed above are not only characteristics of the data systems but they also relate to features of the organization and, in particular, the underlying view of human error causation. Three broad philosophies of how human errors arise in relation to accidents may be distinguished.
- The traditional safety model: human error is seen as motivational problems. The fundamental belief is that errors are caused by a person 'not trying hard enough' or 'not paying sufficient attention' to the task.
- The man-machine interface approach: human error is seen as a man-machine mismatch. This view maintains that human errors tend to result from a mismatch between the demands of a task, the physical and mental capabilities of the human, and the characteristics of the machine 'interface' provided to do the task. This model concentrates on the individual operator and his/her immediate work situation. Design changes and the provision of job aids such as procedural support are typical solutions which this view would produce.
- The system induced error approach: human failures are caused by certain preconditions in the work context. These preconditions can range from poor procedures and poor equipment design to unclear allocation of responsibilities, lack of knowledge and low morale.

These three models of human error may be mapped on to three major types of organizational safety culture respectively: Occupational safety management, risk management, systemic safety management.

Lucas (1987) identified 5 general areas which contribute significantly to a data collection system's success or failure (implementation factors). The first three relate predominantly to design issues whilst the remaining two are concerned with organizational and management factors affecting the implementation of reporting schemes. The 5 areas are as follows:
- the nature of the information collected (only descriptive or also causal and whether near misses are reported and which form).

- the use of information in the database (3 key aspects: feedback, generation of summary statistics, specific error reduction strategies generated and implemented).
- the level of help provided to collect and analyze the data (analyst aids, f.e. software).
- the nature of the organization of the scheme (reporting mandatory/voluntary, local or central system, responsibilities).
- whether the scheme is acceptable to all personnel (3 issues: shared ownership, data collection by a known person, introduction training and ideas).

Three factors under the direct management control are vital for the success of any accident and near miss reporting scheme. These factors are: anonymity, forgiveness and feedback.

ALL ABOVE MENTIONED WRITERS -MULTI CONTRIBUTOR CHAPTER- (v.d. Schaaf et al, 1991):
They stress the pre-eminent importance of defining the purpose of a NMMS before any decisions are made about its design and introduction.
Hale et al., van der Horst and van der Schaaf stress the importance of training in the implementation phase. Managers must be trained to use accidents not in terms of guilt and blame, but in terms of a socio-technical system failure to which they must respond with a system design change.
Operators must be trained what to report and why it is important. Investigators must be given appropriate models of the complexity of causal chains in accidents, leading back to all levels in the organization and the way it works. Since many of these people will have relatively unsophisticated ideas about accident causation to start with, this is a significant training burden.

4.4 Elements safety situation

The resulting combination of factors is given below (table 4.1).

Table 4.1 Factors Ideal Safety Situation

Organizational attitude	Tools	Human factors
-top level commitment: goals motivation awareness correct use -proactive rather than reactive (not consequence driven) -general repair actions instead of ad hoc (not event focused) -multicausal instead of monocausal oriented -feedback to operators -state clear responsibilities -support staff and operators -appreciate operators knowledge and participation -give training/ instruction (no variability in quality) -decisive style of management -cause instead of action oriented (no technical myopia) -system induced error approach -no blame policy: forgiveness learning only	-methods for: detection selection description classification computation interpretation monitoring (=system documentation) -training programmes -design of feedback loops -software -written responsibilities	-motivation -awareness -commitment -participation (in analysis) -unbiased reporting -clearness of system, including responsibilities and actions

4.5 Purpose of ISS-development

The construction of ideal safety situation factors serves two purposes.
Firstly, the factors will act as the basis for the questionnaire.
Secondly, the factors will act as a reference point.

Chapter 5 Present Safety Situation (PSS)

5.1 Method

In determining the present situation at the sites three sources have been used.
- At first a database with present data concerning a lot of Lost time Injuries (LTIs) and a few near misses has been analyzed. This incident data refer to brief information on a standard form (enclosure 2). This standard form is part of Akzo Nobel Coatings Directive and Guideline number 2. In this is stated that at least for each accident/ incident and material damage the required information has to be sent to the Group staff in Arnhem. The information is stored in Arnhem. This is only indicative information since it concerns fixed items.
- Secondly, a questionnaire will have to reveal the necessary information concerning the organizational factors, tools and human factors of the site safety situation. This questionnaire has been sent to 23 sites in Europe and to the safety supervisor of the USA. The questionnaire construction is based on the factors of the ideal safety situation.
- As a third element, the first results of the questionnaire were presented at the IHSE-meeting in Montataire. Reactions concerning the elements will be taken into account.

Although great differences between the various sites are expected, a general Coatings present situation will be determined.

5.2 The 'Arnhem' Database

As stated in Directive and Guideline number 2, the following information concerning a reportable incident should be given: the location; a brief description of the incident; the class of incident; the people involved; the department; the primary causes; the underlying causes; the nature of injury; the part of body affected; cost assessment and a recommendation to avoid reoccurrence. The aspects from 'class of incident' to 'part of body affected' are subdivided in fixed options.
In looking for possible relations between these factors and in constructing trends of individual factors, 152 standard forms were analyzed.
Most important will be the resulting trend in underlying causes.

The underlying causes as mentioned in the standard form will have to be divided in terms of technical, organizational and human factors. These terms refer to the general failure types which characterize the NMMS. The overall resulting percentile distribution of these failure typifications will be an indication of the underlying error causation philosophy. This refers to the predominant model of human error. This can be the traditional safety model (fundamental motivation belief), the man-machine mismatch and the system induced error approach (Lucas in v.d. Schaaf et al, 1991).

The general failure types according to the Eindhoven Classification Model (ECM) were explained in chapter 3 at the NMMS introduction. An example of a transformation of

an underlying cause in terms of the standard form to terms of the Eindhoven Classification Model (ECM) is as follows:
Inadequate personal protection in terms of Akzo Nobel Coatings has been transformed in a HR6 failure in terms of the Eindhoven Classification Model. This means a human failure concerning equipment.

The complete comparison between the elements of the standard form and those of the ECM will be shown in enclosure 3.

The 152 analyzed forms resulted in about 185 failure typifications. The percentile distribution of the failure types will be shown in figure 5.1.

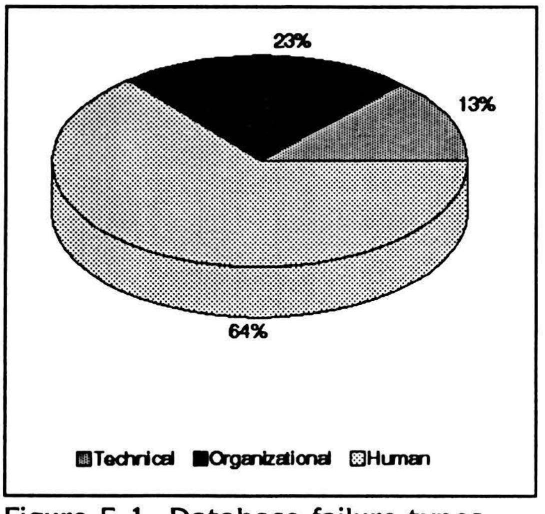

Figure 5.1 Database failure types

Because of the fact that the underlying causes of the form are translated in ECM-factors in a fixed way, no unclassified causes (X) remain.

Other resulting aspects concerning the database are:
- Few near misses have been reported. It appeared that of all reports, 70% concerned LTIs. The reported n-LTIs appeared to be mainly from 1 site.
- In most cases just one option has been marked at the standard forms.

The above mentioned results can be summarized as follows:
The human failure type has appeared to be dominant in the standard reports up till now. This is an indication of the underlying error approach. It indicates the traditional safety model of error causation. This means that an investigator holding this approach to human error will typically question the motivation of a person to carry out the system of work safely (Lucas in v.d. Schaaf et al, 1991).

5.3 Questionnaire

The questionnaire has been constructed on basis of the ideal safety situation. The factors have been translated into questions. These relations will be given in enclosure

4. The questions concerning the safety situation form the first part of the questionnaire. The second part deals with opinions regarding near misses and the NMMS. The questionnaire is enclosed (enclosure 5).

In structuring the results of the first questionnaire part, the factors of the ideal safety situation are combined with the 7 modules of NMMS (Detection; Selection; Description; Classification; Computation; Interpretation; Evaluation. The resulting table is given below (Table 5.1).

Table 5.1 Combination NMMS modules and ISS factors

Modules NMMS:	Organizational factors measured in questionnaire
Detection	top level goals, no blame policy, top level commitment (time and no guilt), proactive policy, procedure/ standard form for reporting, operator training, clearness reporting system to operators, operator motivation, operator awareness, unbiased reporting
Selection	selection method whether to analyze the incident or not, selection method concerning the detail of incident analysis
Description	responsibilities for performing the analysis, no variability in descriptive analysis of the incidents (method and training program), operator participation (management appreciation and motivation), system induced error approach, cause instead of action oriented measures (no technical myopia)
Classification	multicausal incident causation model
Computation	statistical analysis from database
Interpretation	proactive measure determination, decisive management, general repair actions, responsibilities for determining whether or not and the kind of measures
Evaluation	visual feedback, defined responsibilities for giving feedback, explicit feedback loops, structural giving of feedback to operators and management (method), evaluation responsibilities, no variability in evaluation quality (method)

The questionnaire has been sent to 19 persons, of which 16 responded before the internal deadline. In this way the results which are presented do not refer to all Coatings sites, only to those sites of which the safety supervisor filled in the questionnaire. The main results of the questionnaire in terms of 'ideal safety situation' factors are shown below.
The percentile distribution of each individual question is enclosed (enclosure 5).

Detection

Top level goals:

81% of the respondents do have a written policy concerning incidents available in the organization. In this policy goals concerning the rate of accidents are stated in 81% of the cases. It appears that almost everyone who stated the exact numbers of present and goal rates, already have gone beyond the goal for this year. Besides this, the majority (56%) thinks it is possible to reduce the number of accidents with 10% to 50% in 1994-1995.

Unbiased reporting and 'no blame' policy:

This aspect is 'measured' in terms of the management attitude towards the reporter of the incident. 81% answer that his/ her name is mentioned to the management. More persons (31%) answer that reporters get a reprimand than that reporters receive encouragement (19%).

Top level commitment:

This is firstly stated in offering enough time to report the incidents. The reactions are equally divided. 56% of the respondents think there is enough time to report the incidents. As a second measurement the guilt question is asked. Here the majority (56%) thinks it influences the reporting of incidents. This means that in these locations a guilt-question exists. These factors are not representative for a total view of management commitment, but are indicative.

Proactive or reactive reaction towards incidents:

The reaction towards the importance of different categories of incidents is on one hand very positive. 69% of the respondents stated that they think it is important to report internally data concerning incident seriousness of dangerous occurrences. This includes near misses, medical treatment etc. On the other hand, it appears (question 12) that in most present cases these incident categories are not yet reported. The incidents reported up till now refer most of the time to Lost Time Injuries.

Procedure about the reporting/detection method:

Almost everyone (88%) claims to possess a written/ confirmed procedure concerning the internal reporting of incidents. At my question to enclose the reporting form, only few responded. Concerning reporting obligations: This concerns all other incidents than the ones, mentioned in guideline and directive 1 (G&D 1). 56% of the respondents state that there is an obligation to report all incidents. Some (31%) state that there are some criteria, but only one person states that all reporting is completely voluntary.

Operator training:

Operators are informed almost in every case (88%) by spoken instructions. Most of the time (75%) this is combined with written material with procedures. Only few (18%) inform operators by visual means as slides or video.

Operators' clearness of incident reporting systems:

The operators are most of the times (68%) informed about the (reporting)-system the first time they enter the organization. After this, less structural re-informing sessions seem to take place. Also is stated (43%) that informing takes place after an incident happened. Personal consequences, in terms of reward or punishment, after an incident are most of the time (69%) not stated in an official document.

Operator motivation:

81% of the respondents state that the operators have to be stimulated during their employment to report incidents other than the ones mentioned in G&D 1, because of not seeing the necessity of reporting. On the other hand is the reaction of 62% (question 22) that the operators see the analysis of reported incidents as useful or as a learning system.

Operator awareness:

This aspect cannot be measured isolated. Because of the fact that the numbers which are given in question 12 -reported incidents last year- are in most cases very low or even zero, the idea raises that the awareness of the incidents or the reason of incident reporting is not quite clear to the operators.

Selection

Selection method whether to analyze the incident or not:

This refers to the fact whether all reported incidents are analyzed. 44% of the respondents state that certain factors influence the rate of analysis. The other half (56%) claims to analyze every reported incident.

Selection method concerning the detail of analysis:

The way of analyzing also depends on certain factors with the majority (56%). Seriousness concerning the kind of injury is mostly stated as the main criterium (50%).

Description

Responsibilities

Analysis of the reported incidents. Concerning this point, the majority (63%) claims to have stated personal responsibilities.

Variable quality in the analysis/ description of the incident:

-Method:Concerning this point, the reactions are almost equally divided. 50% claim to have a procedure for the analysis of incidents. Some less than the other half (43%) states to make the analysis by heart and lack a structured approach. In question 19 the presence of checklists concerning possible causal incident factors is asked. 56% claim to lack these checklists.

-Training:Secondly concerning staff (or line responsibles) for analyzing reported incidents: Almost everyone (75%) states to lack a training or instruction for performing the analysis of incidents.

Participation of operators:

In almost every case a team is involved in the incident analysis. The operator who reported it is in a lot of cases (63%) present as a team member. The motivation of the operators concerning this participation is about 50/50 in favour respectively not in favour.

System induced error approach:

The error inducement philosophy is part of the underlying incident causation model. This refers to the type of cause which has been determined. At the question to state the percentile causation division, not all responded or completely. The reactions were in 85% of the cases that the human component is the largest. In all of these cases however, the human figures raised above 60%.

Cause instead of action oriented (no technical myopia):

The kind of measures which are taken, expressed in a percentile distribution was asked at question 31. The percentages which were given are in the same order as the error percentages. Just a few people gave both figures of the error percentile distribution and the measure percentile distribution.

Classification

Multicausal incident causation model:

The answering categories were divided in, on one hand: a multi cause model, which means that more than 1 cause will be determined, and on the other hand the other possibilities. In this way just a few (31%) possess a multi cause model.

Computation

Statistical analysis from database:

This refers to a kind of database with the data of past incidents. In this way computation of the stored data can take place. Most (56%) do not store the data of past incidents in a kind of database.

Interpretation

Proactive measure determination:

Almost everyone (94%) stated to take action after incidents which have a potential risk to turn into serious consequences, although nothing serious happened yet.

Decisive style of management:

This is only expressed in time between the reporting of an incident and the making of a decision whether to take any action or not. This is not sufficient to measure exactly the management style concerning decisions, but is indicative.

The reactions mostly fell (62%) into the 2 categories with time periods less than 1 week.

General/ ad hoc repair actions:

Question 25 referred to action/ measures being based on a separate incident or after a few comparable ones. It appears that the majority (56%) takes action immediately after a single incident. The other ones state that it varies.

Question 42 refers to the sequence of comparable incidents after measures have been taken. Almost everyone (75%) states that this sequence does not occur.

Responsibilities:

Determination and execution of measures:

56% of the respondents state to have written procedures concerning these responsibilities. This is less than for the analysis. The persons who are involved in this phase (most of the time a team, so more than one person, is involved), are mentioned in the implementation advises concerning this point.

Evaluation

Feedback in a visual way

-expressed in the most common time period between decision and measures being taken:

The majority (about 60%) states that this takes about 1 month to half a year.

-expressed in complaints by operators concerning not hearing or seeing anything about the incidents they reported:

The majority (63%) states that these complaints do not occur.

Responsibilities:

The giving of feedback:

69% of the respondents, even more than in case of analysis responsibilities, claim to possess clear responsibilities concerning the giving of feedback concerning the reporting, analysis and measures regarding the incident.

Explicit feedback loops:

56% of the respondents claim to possess a clear written routing regarding the incident reporting.

Structural giving of feedback to operators and management:

-Feedback towards operators:

The majority (74%) states to have a regular form of feedback regarding incidents and the accompanying decisions to the operators. This is then equally divided into a) every few weeks, and b) quarterly.

-Feedback towards management:

Even more persons (81%) claim to have a regular form of feedback regarding incidents to the upper management. This is again ranging from every few weeks to quarterly. Some mention after each incident.

Responsibilities:

Execution of evaluation:

Here the majority (75%) states that they lack written and clear responsibilities to perform this evaluation.

No variability in evaluation quality:

The first aspect which measures this factor is the presence of a standard period after which an evaluation of the measures has to be taken care of. Almost everyone (75%) states that they lack this kind of evaluation/ monitoring. Secondly, procedures in a standard written form available for this (probable) evaluation lack also in most cases (81%).

Results concerning the second part of the questionnaire:

- Everyone agrees that the difference between a near miss and a real accident is very small.
- Recovery aspect, correction actions, are often made by operators, state 93% of the respondents. These recovery actions are, however, not yet made consciously, state 86%. 57% state that this recovery is more often build in technical barriers.
- Again everyone states that causes for near misses and real accidents are the same.
- 71% of the respondents agree that the severity of the potential effects is not important for the analysis of incidents.
- Everyone agrees that near misses are important for improving the safety performance. 93% of the respondents agree that the (Eindhoven) NMMS will be a useful tool then. 86% state then to be interested in the NMMS and its specific operation.
- 72% claim to report near misses already, according to their own definition. Half of them (50%) states to treat them, concerning reporting, the same way as accidents are treated.

Not all ISS factors mentioned in table 4.1 have been discussed here. This concerns the following factors: top level motivation; top level awareness; top level correct use (partly dealt with at no blame policy); employee commitment; support of safety staff; training/instruction for classification, feedback giving and evaluation (as part of 'no variability in quality').
Parts of these factors were measured. This refers to formal aspects. These factors have to be practised however. The fact whether this 'liveliness' is apparent is hard o measure with a questionnaire.

5.3.1 Discussion of reliability aspects of the questionnaire:

To test the reliability of the questionnaire partly, some factors have been measured by more questions. The answers were compared to each other. The results which are contrary or at least remarkable are mentioned.

The majority of the respondents thinks it is important to report internally data about incidents dangerous occurrences, incidents and accidents. 72% of the respondents even claim to report near misses, according to their own definition, already. It becomes remarkable however, when at the question how many of these incidents were reported, only few gave numbers above 50 per year. The reason why this is strange is because of the fact that science has proven that a ratio between accidents and incidents exists. This ratio is according to Frank Bird 1: 50: 600 for respectively LTI-AFW: Minor injuries and property damage: Near misses and unsafes (Health and Safety Executive, 1993). In the MTS program even higher ratio's are mentioned.

The second point deals with feedback aspects.
More persons claim to have responsibilities concerning feedback than claim to have a clear written feedback routing.
Concerning this routing: 74% respectively 81% of the respondents state to have a regular form of feedback to operators respectively management. Just 56% state to have a clear written feedback routing. Taking also the responsibilities concerning feedback into account, 69%, it is clear that high response to regular feedback is at least remarkable.

The last remark is about recovery aspects. On one hand 93% of the respondents state that correction actions, recovery is most often made by operators. On the other hand, 57% state that this recovery is more often built in technical barriers.

5.4 Reactions to and validation of results (IHSE)

At the International Health, Safety and Environmental meeting (IHSE) in Montataire at 5 and 6 October 1994, the global results of the questionnaire were discussed. In the IHSE, mainly European country HSE-representatives were present. Because of the fact that most of them had already returned the questionnaire before the meeting first results could be presented.

The reactions were mainly an affirmation of the database results.

It appeared that the choice of a specific underlying cause concerning an incident refers to different underlying error approaches. A lot of the HSE responsibles are convinced of the idea that 70% or more of the underlying causes is due to carelessness of the operators. Other HSE responsibles think more like the NMMS philosophy in a Technical, Organizational and Human part.
The culture in Morocco is different from the European and should get individual attention. The religion plays an important role there. Human behaviour is controlled by Allah. This results in a no existence of human failure types.
Furthermore it appeared that the low rate of near miss reporting indicates a more reactive approach towards incidents. Not all sites follow this reactive approach. Some do report data about near misses internally and/or externally. These are just a few, however.

The 'no blame policy' appeared to be not practised yet in the Coatings sites.

The reaction to the NMMS in general was very positive. The HSE responsibles understood the necessity of reporting and analyzing near misses. The practical aspects were just the thing they were insecure of.

5.5 Purpose of PSS

The results of the present safety situation will be compared to a standard. This standard is the ideal safety situation, which is discussed in chapter 4. In this way the PSS reveals information for main improvement factors.

Chapter 6 Difference between ISS and PSS

6.1 Conclusion confrontation

In this chapter the results of the previous 2 chapters will be confronted. This means that the present situation as pictured in chapter 5 will be compared to the elements of the ideal safety situation as determined in chapter 4. The main differences determine the most important aspects of the implementation plan and the key factors which should get attention during the MTS. At the end the NMMS consequences will be stated. Because of the fact that the IHSE meeting mainly revealed the same results as the database, they will be discussed in the same paragraph as the database.

6.2 Database versus ISS

The database has revealed mainly information about the underlying incident causation model. The three main results and their accompanying interpretation in terms of ISS will be discussed separately.

It appeared that in 64% of the cases a human failure type had been chosen. This idea of human failure being dominant and even in about 70% of the cases has also been affirmed at the IHSE-meeting.
As explained in the previous chapter, the predominant model of human error is the traditional safety model.
When comparing these conclusions to the ISS, it is clear that this situation is not ideal. The ISS states that the underlying incident causation model should be the 'system induced error approach' in which is stated that human failures are caused by certain preconditions in the work context. By former research (v. Vuuren, 1993 and Mulder, 1994) the human component of the failures seemed to be about 45%.

A second aspect of the underlying incident causation model is multi causality. Concerning most incidents, it is a combination of basic causes which eventually lead to the incident. Most Coatings HSE supervisors seem to determine just one basic cause for an incident.

A more reactive approach appeared after analyzing the database. This approach has been affirmed at the IHSE meeting by the HSE supervisors. This results in paying more attention to LTIs than nLTIs. This is different from the ideal safety situation. The ISS advises a proactive approach, because it reveals a lot of benefits above a reactive approach.

The IHSE-meeting revealed that the 'no-blame' policy is not practised yet. This aspect concerns organizational learning and is an important part of the ISS.

6.3 Questionnaire versus ISS

The conclusions of the questionnaire will be based on the 7 NMMS modules as shown at the questionnaire results. The differences with the ISS will be indicated.

Detection:
Concerning top level goals and a proactive policy, the intention is good, practice not yet, however. The aspects concerning the 'no blame policy' and the unbiased reporting differ from the ideal situation at least in the encouragement part and the 'no guilt' question. This 'no guilt' aspect shows also the fact that top level commitment can be improved. Reporting procedures and forms exist, but the training is mostly limited to spoken instructions. Re-informing sessions concerning the reporting system seem to lack a structured approach. These aspects differ from the ISS in which is stated that management should inform, train and support the operators. A system clearness and incident awareness to the operators should then result. This awareness seems to be absent in most sites, measured in the rate of incident reporting. This low rate of incident reporting can also be due to operator motivation problems, which seem to appear. Operator motivation should be present according to the ISS, but will be influenced by, for example, training.

Selection:
At the moment, most sites state to make no selection. This of course depends on the rate of incident reports. Regarding the fact that in a lot of sites just a few incidents are reported yearly, no selection will have to be made yet. Concerning the analysis depth of various incidents a selection seems to exist. The ISS advises a structured criteria also for analysis detail.

Description:
Responsibilities concerning the analysis and operator participation, although not optimal, seem to be in place in most sites. The analysis variability, determined by using a structured uniform approach and the presence of training, can be improved. The structured uniform approach lacks in a lot of sites, but training programmes even hardly exist. This structured approach should be based on multi causality in case of an incident. This is not really practised at the moment, as explained in paragraph 6.2. The measures taken seem to be in accordance with the causes, so no technical myopia exist.

Classification:
The underlying incident causation model is based on multi causality in terms of technical, organizational and human failure types. This philosophy is not yet practised at the Coatings sites. This aspect has already been discussed in paragraph 6.2. Because of the fact that basic causes are not yet classified, no variability in classification exists.

Computation:
Most sites seem to lack structured data storage. In the ISS this aspect is mentioned because trends of causes are the basis for measures. These trends will have to be

determined.

Interpretation:
The aspects which have been measured concerning this interpretation are mostly positive and in compliance with the ISS. Responsibilities are stated in a lot of cases, management is reasonably fast with decision taking and everyone agrees that near misses are as important as real accidents in indicating action areas. A part which needs improvement is the fact that in most cases actions are directed to individual incidents on an ad-hoc basis. The ISS advises to take measures based on general cause patterns. This is closely related to an other part which needs improvement. This refers to the logical linkage of causes and measures. It appears that this linkage does not exist yet.

Evaluation (including feedback and monitoring):
The aspects which refer to feedback aspects seem to be rather positive. Responsibilities seem to be stated, feedback loops are present in a lot of sites and the reaction to a structural feedback giving to operators and management was also positive. Visual feedback to operators in terms of time between decision and implementation of a measure can be improved. This is important to keep the operators motivated. Operator complaints seem not to occur however.
Evaluation aspects lack totally in most sites. No standard evaluation time and no responsibilities seem to exist. Because of this evaluation lack, variability statements do not make sense. This evaluation part is an aspect of the ISS, which have to be taken care of.

The conclusions concerning the second part of the questionnaire are all very positive. Almost everyone sees the necessity of investigating near misses and is interested in its possibilities. The underlying near misses philosophy is in most cases agreed upon.

6.4 NMMS consequences

The determination of the differences will serve two purposes. Firstly it will determine the question whether a NMMS could fit in the Coatings organization.
The fact that a lot of aspects should improve does not say that the ideal NMMS situation can not be reached. Experience in other organizations proved that. A certain commitment as basis will have to exist in the organization, however. It appeared that this basis exists. The second part of the questionnaire expressed this necessary initial commitment with HSE supervisors. Commitment to the MTS program by BU-managers and by the chairman of the Board of Management to the MTS program also support this basis.
The MTS program will give structure to the safety improvement framework. Concrete practical programs will have to be developed to make the MTS framework practical. The NMMS is a program that can bring the necessary structure and practical aspects within the MTS framework. Also because of the fact that reactions to the NMMS are very positive Akzo Nobel seems to be ready to work with the NMMS. To lower the differences, mentioned in the previous paragraph, to acceptable levels, energy and effort have to be invested. In combination with the MTS program this will be the right

moment to bring that effort. In most cases it will be bringing in the necessary structure of a complete safety program. Some other sites are not far from the ideal situation.
The NMMS will deliver a lot of benefits to a site. It will deliver benefits for sites with a lot of accidents, but also for those sites with less to zero accidents. This means that all 3 goals of the NMMS will take shape: 'Modelling', 'Monitoring' and 'Alertness giving'.

The second purpose of this chapter is to indicate the main problems and places for improvement. These will be discussed in the implementation plan in chapter 8. Because of the fact that already a pilot implementation have taken place which shows the benefits of NMMS, but also the feasibility and extra implementation aspects, this pilot project will be discussed first.

Chapter 7 General NMMS implementation plan and Bergen op Zoom pilot project

7.1 Explanation of relation

Because of the fact that a NMMS will fit in the MTS and the Coatings locations seem to be positive concerning near miss reporting and analyzing, an appropriate implementation plan will be necessary.
This plan will have to consist of 2 main parts. Firstly a general implementation plan and secondly practical implementation aspects concerning the NMMS modules. The general implementation plan is constructed with the experience of ARCO, EXXON and Hoogovens. One of the steps of this plan, the construction of a reference database, has already been worked out in Bergen op Zoom, Akzo Nobel Resins. This pilot project acts as a demonstration of the system, but is also set up to look for problems during the implementation. The next paragraph deals with the general implementation plan. The pilot project and its main results will be discussed in 7.3.

7.2 General implementation plan

The general implementation plan consists of 6 steps.
The 6 steps do not have to be followed in exact order. Step 5 and 6 do have to be executed at the end, however. The reference database, for example, can be constructed as a first step but can also be constructed after the workshop.

step 1 Description safety situation
This refers to the ISS-factors (most revealed by the questionnaire). Instead of making a general Coatings overview, it should be specified for the individual location.
step 2 Workshop
During MTS tours BU- and site-management will get insight in safety management. The NMMS and its accompanying philosophy will have to be clear. The safety supervisors who have to work with it need a more extensive workshop and training. This training will have to deal with methods and techniques of NMMS. This refers to the description, classification and interpretation. The first workshop will take place with the MTS program. The extensive supervisor system training follows at step 4.
step 3 Reference database
A reference database contains data about classifications of incident causesal NMMS implementation and Bergen op Zoom pilotInterviews. The construction of a reference database acts as a demonstration of NMMS practices.
A reference database will have to be constructed just once for comparable sites. Within Coatings almost all sites seem to be comparable in terms of activities. Exceptions are resins and wall-paints production because of a difference in production process.
This step has been performed in Bergen op Zoom. The next paragraph will clarify the construction of a reference database. The benefits will also become clear.

step 4 Organizational factors and training
In this phase the official statement of the 'no blame policy' has to take place. Also the reporting form, responsibilities, procedures and feedback and evaluation channels concerning the near misses have to be determined. The 7 steps of the NMMS have to be completed as far as possible before the practical implementation. Some aspects, the final selection and interpretation criteria will be determined in detail during the implementation. This depends a great deal on the reported near misses.
The training for HSE staff supervisors will have to be given at last in this phase. The techniques (also concerning software) have to be quite clear.
step 5 Practical implementation
In this phase, the introduction to the operators need to be given. The system have to be clear to them, including recognition of near misses. In this phase the elements which have been stated and constructed formally in phase 4 have to become practical. The working of these elements determines the continuation of the system.
step 6 Evaluation
After (each) few months:
- periodic analysis of results, resulting in a package of proposals to management.
- comparison of classification results with reference database (step 3) and, if necessary, correction of reporting biases
- evaluation of NMMS process.

In Bergen op Zoom, the reference database has been constructed as step 1. General aspects of a reference database, specific results and conclusions will be discussed in the next paragraph.

7.3 Reference database and results Bergen op Zoom

A reference database will have to contain information about basic causes of incidents. This information will be revealed by tracing back incidents to their basic causes by means of a causal tree. A general example of a causal tree was shown in chapter 3 with the NMMS introduction.
The causal tree will be constructed during and after a confidential interview with an operator. This is called a Critical Incident Interview, CII and is developed by Flanagan (v. Vuuren, 1993). Preferably the operator who was directly involved will have to be interviewed, but witnesses will do also. After determination of the basic causes, these are classified according to the Eindhoven Classification Model. The resulting range of classified basic causes represents the percentile distribution of causes within the particular organization. The number of necessary interviews depends on task variety and quality of the data.

The benefits of a reference database are:
- it acts as a demonstration of the NMMS and the 'no blame' policy
- it shows data treatment
- it supports acceptation and open communication
- it leads to a first statistical insight into Akzo Nobel safety risks
- construction of the definite form of the classification module, with definitions of the different categories by examples

- the comparison of confidential incident information id. 'openly' reported incidents can be made (possible biased reporting)

The reference database constructed in Bergen op Zoom will mainly act as a demonstration of NMMS, data treatment and deliver first statistical insight for all coatings sites. The interviews were held at a resins production department, which is called BPO.
For time restrictions 15 existing incident reports were used as a basis for the interviews. This is different from other CII-investigations at other organizations. The 15 last reported incidents were chosen out of the file of the safety officer. These incidents took place in the last 3 months before the interview. In this way the operators would remember the circumstances still well. This also appeared in practice. Of all incidents just one referred to a near miss. The other ones concerned incidents with material and/ or personal consequences. This does not interfere with the CII process. During the interviews the causal tree was initiated. After finishing it after the interview, the resulting tree was fed back to the specific operator. After the operator affirmed the data, the basic causes were classified and stored in a database. Just the and-gates of the resulting causal trees have been taken within the quantitative and qualitative results. And-gates refer to those causes which certainly took place.
Just the number of classifications concerning basic causes will be public. Other data concerning the incidents will be confidential and will only be known to the interviewer. The specific numbers of the classifications, and accompanying definitions are enclosed (enclosure 6 and 7). The report which has resulted, including conclusions and recommendations, is stated in Dutch. It is not enclosed but present in Bergen op Zoom (Witteveen, 1994a).

The 15 incident interviews revealed 81 classified root causes. This amount of root causes appears to deliver a lot of information. Former CII-projects have proven that (v. Vuuren, 1993 and Mulder, 1994).
The resulting distribution of the root causes in terms of technical, organizational and human failure types appeared to be as follows (Figure 7.1):

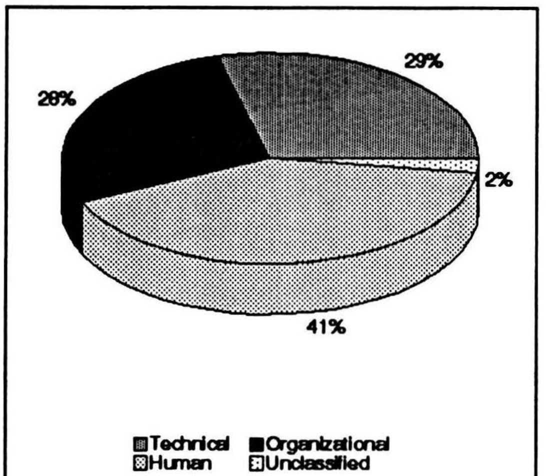

Figure 7.1 Resins failure types

These results are an affirmation of the NMMS philosophy concerning the error type percentile distribution.
The results of the subcategories are given below (figure 7.2). A remark will have to be made concerning the organizational failure types. In Bergen op Zoom, 6 subcategories were used. The ECM only mentions two subcategories. The extensive organizational failure types is based on Hoogovens experience (v. Vuuren, 1992).

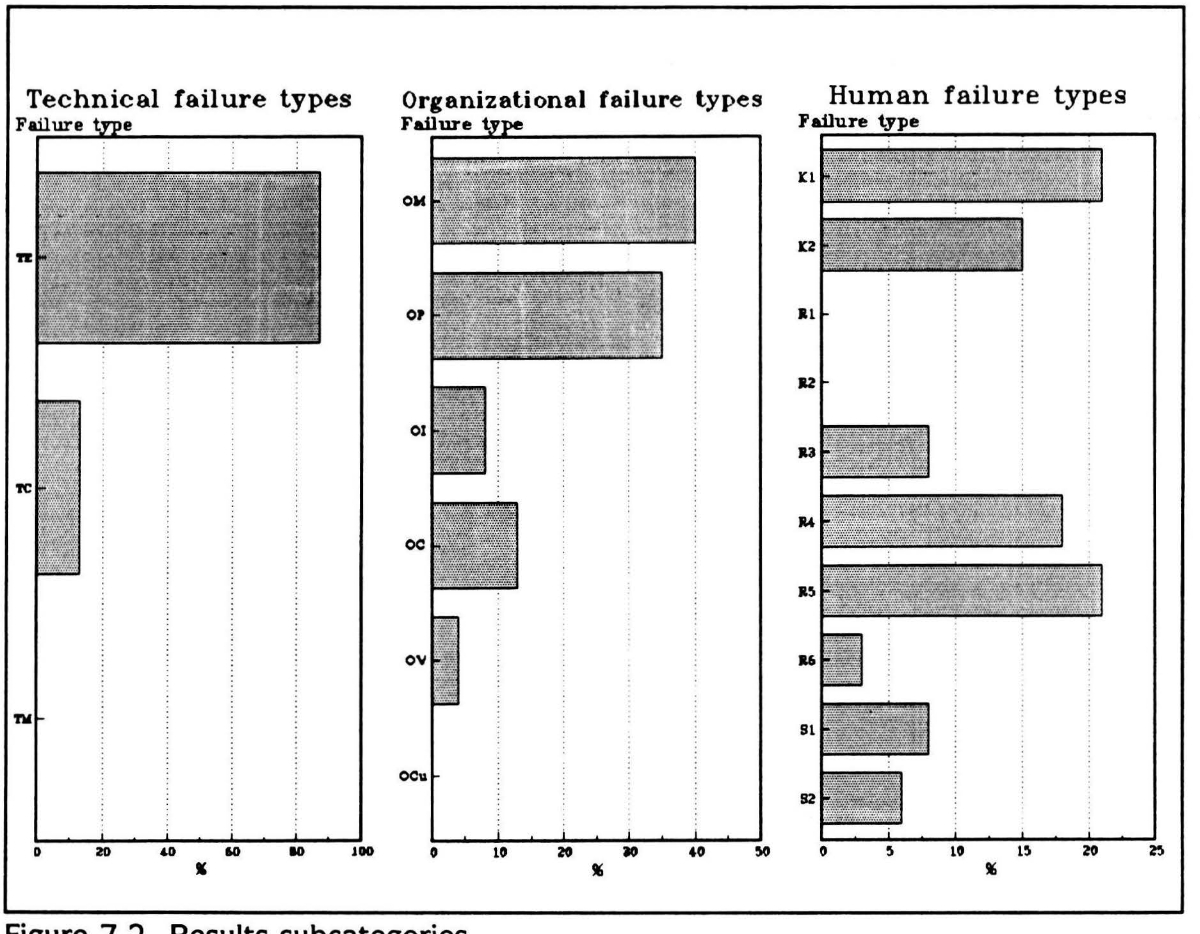

Figure 7.2 Results subcategories

7.4 NMMS consequences

The data which resulted in Bergen op Zoom support the NMMS. It appeared that a lot more information is available in this way of working than in the present way. This concerns not only basic causes, which can be determined and coded in a structured way, it also concerns measures. The advised preventive measures which were mentioned at the incident reports have been compared with the ones that would result with the information concerning the found basic causes.

It appeared that present measures are mainly focused on technical aspects. The measures are very local, focused on the specific department. The organizational learning aspect is not yet in use. Other (less) measures were focused on the interface of the organizational and human field. These were very vague and kind of: discuss

control, treatment in shifttalk. These are again very vague and local.
The advisable actions which resulted after the CIIs were more specific and should be aimed at the total organization. The main problems (percentile distribution), where measures should be aimed at are:

Technical:
At Technical Engineering factors (TE); make the taskfunctions and its workplace more congruent.

Organizational:
At Management priorities (OM); let safety get more priority already in the preventive sphere.

Human:
At Knowledge based factors (HK1): to get more understanding of the dynamic side of the process, and at planning levels (HR5): to do the right tasks in the right order.

Detailed information concerning these aspects is known to the site. This just shows how more specific and comprehensive the NMMS generates measures.

7.5 Other results

The operators who cooperated with the CIIs gave also their opinions about certain general safety aspects at their site. The ones which do have impact on the implementation plan will be discussed in random order.

- The operators did not all understand the purpose of reporting. It seemed that some only reported to get some technical adjustments, so when the action was out of his direct control. They did not understand the learning aspect of reporting. This is of course also due to the fact how reports are treated and communicated.
- Within Akzo Nobel Resins, Du Pont has given its advices and opinions concerning safety. They stated that more than 90% is human failure. The foremen, production chief and safety supervisor could not agree with this, seeing their own site situation. Top management, however, seems to believe fully in this statement. They interpret human failures as operator failures. After the CIIs, the foremen, production chief and safety supervisor told that this was in compliance with their feelings. This refers to a communication problem between the lower and higher management concerning the real production situation in failures.
- After the general safety questions with the operators, the results were presented to the foremen and production chief. On the other hand the results of the questionnaire gave insight how staff thought about the safety situation. It appeared that the higher one enters the organization, the more practical workplace contains secrets. This is a natural process. Staff should however get a realistic picture of the situation. In some cases this is not the present situation. For example with the next element: feedback.
- The feedback part is one of the biggest problems within Bergen op Zoom. This did not result out of the questionnaire, but in practice. The foremen and production chief agreed on this point. A structure concerning feedback lacks. Because of the fact that the questionnaire suggested it would function well, the feedback part will be discussed in the implementation plan. This because the same problem could exist in other sites.

Chapter 8 Implementation techniques

8.1 Implementation level

In the previous chapter a general plan for implementing a NMMS has been presented. The term general refers to the fact that just the mainphases of the implementation are given. Each mainphase itself can be worked out in more detail. This is shown in the previous chapter, where the reference database has been discussed. This chapter will discuss some of the ISS-factors.
The practical implementation advises are directed at site-level.
The advised practice is applicable for all incidents, so not only near misses.

8.2 Method

In determining the right way to deal with certain elements, several sources were studied. The data which has been derived specifically from Akzo Nobel's point of view are based on the MTS program, the pilot project data and the questionnaire. NMMS techniques and data from other (service) organizations were used in addition to this.

8.3 Comprehensiveness

The ISS-factors which will be discussed will be discussed in reasonable detail. This is not synonym for being so comprehensive that the advises will fit to each site situation. It is an indication of the way the factor could be filled in. It is possible and even to be expected that the advises will have to be adapted a little to specific situations. Furthermore, complementary instruction to site management and staff have to be given.

As a second level of comprehensiveness, it should be stated that not all organizational factors which will be necessary will be discussed. The fact that some factors will not be discussed does not say that each site acts in the ideal way. It is site responsibility to notice the differences with the ideal safety situation which are not discussed in this chapter.

The factors which will be discussed are mentioned in table 8.1, in which the relation with the appropriate NMMS module will be given.
Except of the 'operator motivation' and the 'unbiased reporting' all factors are directly related to NMMS modules in terms of appropriate 'tools'. Because of the fact that in the context of NMMS operator motivation and unbiased reporting are very important they will therefore be discussed.

Table 8.1 Factors to be discussed

NMMS module	Chosen ISS factor
Detection	Operator motivation; Unbiased reporting
Selection	Selection method
Description	Analysis method
Classification	Classification Model
Computation	Database availability
Interpretation	Interpretation method (cause-measure linkage)
Evaluation	Feedback and evaluation structure

A responsibility structure will be constructed which refers to all 7 modules.

Reasons for choosing these NMMS-'tools' are:
- The analysis in terms of a causal tree is characteristic for the NMMS. Besides this, 50% of the questionnaire respondents state to lack an analysis procedure and even 75% lack an appropriate analysis training.
- Concerning selection, the questionnaire revealed that the presence of selection criteria is the case in a 44%. 56% of the respondents state to analyze each incident fully. Fully analyzed as mentioned in this answering option will not be necessarily as extensive as meant in the NMMS description phase. In case a lot incidents are reported, the extensive description cannot be executed for all incidents. So in combination with the NMMS description, a selection method is necessary.
- The Eindhoven Classification Model (ECM) is unique and a crucial characteristic of the NMMS. It will be mentioned in this chapter. The model and its appropriate explanation were given in chapter 3.
- Because trend analyses from a database with past incidents lack at most sites this aspect received a lot of attention. A software program has been sought which could perform the necessary analyses.
- The cause-measure linkage as part of the interpretation method will be discussed. This linkage appears to lack in most sites. This resulted out of the questionnaire.
- A major lack in feedback structure does not result out of the questionnaire. This element will be discussed because of the experiences in Bergen op Zoom. This has been explained in chapter 7. This feedback part will be integrated with an evaluation part. Concerning the evaluation aspect, most HSE managers stated to lack this completely.
- Although in most sites clear responsibilities exist (questionnaire), they will be discussed in this chapter. This exception has been made because of the experiences in Bergen op Zoom. This has been explained in chapter 7.
  In giving a comprehensive overview the most important responsibilities concerning all 7 NMMS modules will be given.

8.4 Resulting practical ISS factors

8.4.1 Operator motivation and unbiased reporting

Operator motivation and unbiased reporting are reasonably complex factors in that they are influenced by a lot of elements.
In determining these factors, experiments are being performed now. Most of these experiments take place within Hoogovens.
Data available at Hoogovens, combined with operator opinions of Bergen op Zoom gave some ideas concerning possible influencing aspects already.

Latham and Locke (Moorhead and Griffin, 1992) state that motivation (satisfaction) is being determined by intrinsic and extrinsic rewards after good performance. Good performance is determined by reaching a goal which is set before.
Concerning the NMMS, however, goals can not be specified exactly. The main goal is to report near misses, to learn from them and to improve the safety performance.
This does not say that the reward types can or will not be effective.
The emphasis will have to be laid on intrinsic rewards then. Extrinsic rewards as financial bonuses seem to be ineffective at Hoogovens. Besides this, the operators in Bergen op Zoom also stated not to be interested in extrinsic rewards.
The intrinsic rewards refer to for example top level commitment. Most important however, will be feedback. Feedback plays a central role in the NMMS approach.

In reaching a status of unbiased reporting, training and instruction play an important role. Operators need to recognize the reportable incidents. Besides this they need to know the reasons for reporting. Feedback and evaluation -with the reference database- complete the cycle which have to be taken care of.

8.4.2 Selection method

In case a lot of incidents will be reported, a selection system will have to be in place. This means that the extensive causal tree analysis as will be explained in the next paragraph will only be applied to some incidents. In this way NMMS analysis will not take too much time and can even be planned.
The selection which incident will be analyzed to what detail will have to take place.
A possible solution for this selection is the determination of a Risk Priority Number (RPN) for an incident. This risk figure is already in use within some sites. Besides this are risk figures used in the MTS program.
Because you cannot speak of a risk with accidents, the risk priority number will be determined a little different and called Priority Number (PN).
In this way near misses will get an equal chance in being analyzed as a real accident (or material damage). This is in compliance with the NMMS philosophy.
The selection advice can be adapted to local circumstances. It is only indicative.
To start with an overview, figure 8.1 is shown.

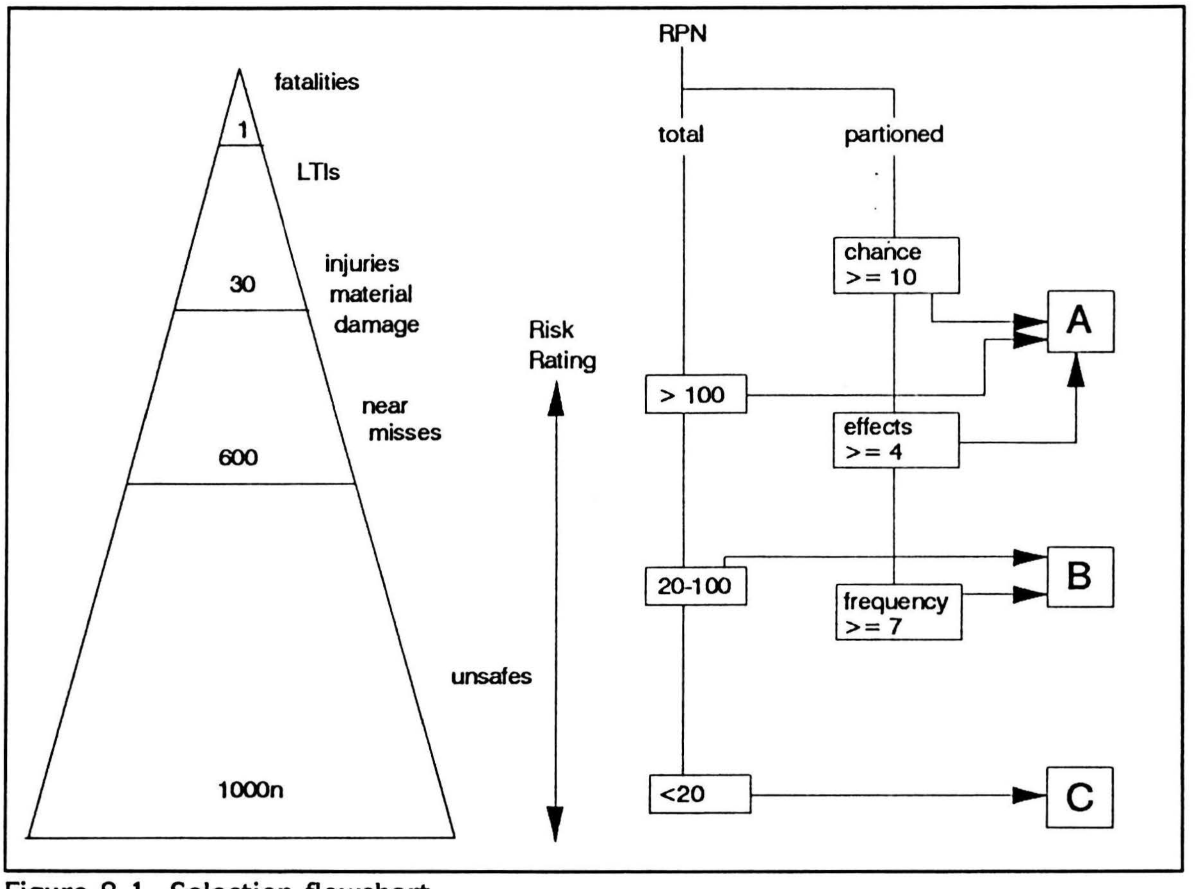

Figure 8.1 Selection flowchart

Explanation of figure 8.1:
The numbers mentioned in the iceberg refer to incident ratio's. This means that the occurrence of one LTI implies that about 30 injuries and/ or material damage cases would have occurred. This is just illustrative information.

The first step is to determine the RPN in case of an unsafe or near miss. To determine the RPN, the following questions will have to be answered:
(numeric answers in accordance with the ones used in MTS, react process[2]):

1 Observation of unsafe/ near miss
  What can go wrong?
2 How likely is it for this situation to turn into an incident?
  quite unlikely 1 —————————— 10 very likely, luck it did not
3 How often does this situation occur?
  once a year 1 —————————— 10 continuously

[2] React stands for REcognition ACTion. The react process is part of MTS and is accompanied by react cards. These cards will be completed on an observation tour. An unsafe will be shortly described on it. The card contains tour tips and observation categories. Aspects of an unsafe which should be described are: short description, main cause, action for prevention and risk figure.

4 What are the effects if the incident shows up?
5 How severe do you think the most probable effects are?
med. treatm./ 1 ———————————————————— 10 death/
little damage > 1 million

The Risk Priority Number RPN is determined by multiplying the resulting figures of question 2, 3 and 5. The appropriate actions in terms of analysis depth depend on this RPN value. The actions are combined with the RPN as a total but also with values of parts of the RPN, so chance, effects or frequency.
A RPN of more than 100 or chance >=10 or effects >=4 represents an important incident. The appropriate action is called A. This stands for: Make a tree like description, classify basic causes, store them in a database, analyze after a range of incidents.
In case of a total RPN of 20 to 100 or a frequency of more than 7, the incident is less severe. The appropriate analysis detail is B. This means: Follow the basic cause checklist, classify the resulting causes and store the classified basic causes in a database.
In case of a RPN of less than 20, the incident refers to a minor unsafe. The appropriate action is C: Mention the most important basic cause and store it in a database.

In case of an accident the PN value has to be determined. This value is the result of the multiplication of the effects and the frequency. The way of dealing with a PN value is similar as the way of dealing with the RPN value except of the fact that the chance value is not taken into account.
Comparable RPN and PN figures are (table 8.2):

Table 8.2 PN-RPN comparison

PN	RPN
>20	>100
10-20	20-100
<10	<20

The transition figures which are stated in figure 8.1 are a personal choice of the author. They refer to a personally stated necessary RPN value concerning various kinds of incidents. The transitions have been indicated at the enclosed react card, with accompanying risk figures (enclosure 8).

To summarize the analysis possibilities (only one possibility per unsafe/incident):
A Make a tree-like description, classify basic causes, store them in a database, analyze after a range of incidents;
B Follow the basic cause checklist and store all classified basic causes in a database;
C Mention the most important basic cause, store them into a database.

The analysis actions until the classification will be explained in the next paragraph.

8.4.3 Analysis method

The analysis description will be divided in three parts, in compliance with the A, B and C actions which result out of the selection.

A Extensive version
Because of the fact that a causal tree is the main characteristic of the extensive analysis, the way to construct it will be explained first.

1. Describe the incident shortly. This is the top of the failure tree. Do not refer to any causes in this description. Referring to possible consequences is allowed.
2. Work in a consequent way, concerning the failure tree structure. A tree for a near miss consists, per definition, of a failure and a recovery part. Report these factors each time the same way, to get a structured overview. A failure tree concerning a real accident or material damage only consists of a failure part.
3. Determine the most direct actions and situations which have induced the incident. The combination of these direct actions/ situations caused the near miss/ accident.
4. Search direct causes for each of the determined direct involved actions/ situations. Do not look for underlying causes before having determined the direct causes fully. Because of the fact that an incident is a conjunction of circumstances, there are always more direct causes.
5. Search for underlying causes. Keep looking for further underlying levels of causes until further information lacks. Do not make up your own things. An other point of stopping the looking at underlying causes is when the factor is not under contol of the own organization.
6. Basic causes are the endcauses of the failure tree. It is advisable to mark them in a certain way. These basic causes are input for the classification model.

Description causal tree construction

The causal tree construction is shown in figure 8.2. In case of causal trees which are much broader or smaller, something will probably be wrong. Figure 8.2 also shows 'and' and 'or'-gates. And-gates refer to actual facts. In case an and-gate lacks or an and-gate will be taken away, the higher dangerous situation will not occur. Or-gates refer to possible facts which could have happened also. This means in case you do not remember the whole story, but also if you want to add important aspects which have not occurred this time. These or-gates certainly are not a goal to determine.
An extensive example of this analysis has been constructed, referring to the Bhopal disaster (Witteveen, 1994b).

B Medium analysis
In case the selection has resulted in analysis B as the appropriate one the following actions will have to be taken.
With this analysis kind, a checklist can be used.
Before going trough the checklist, some questions will have to be answered.

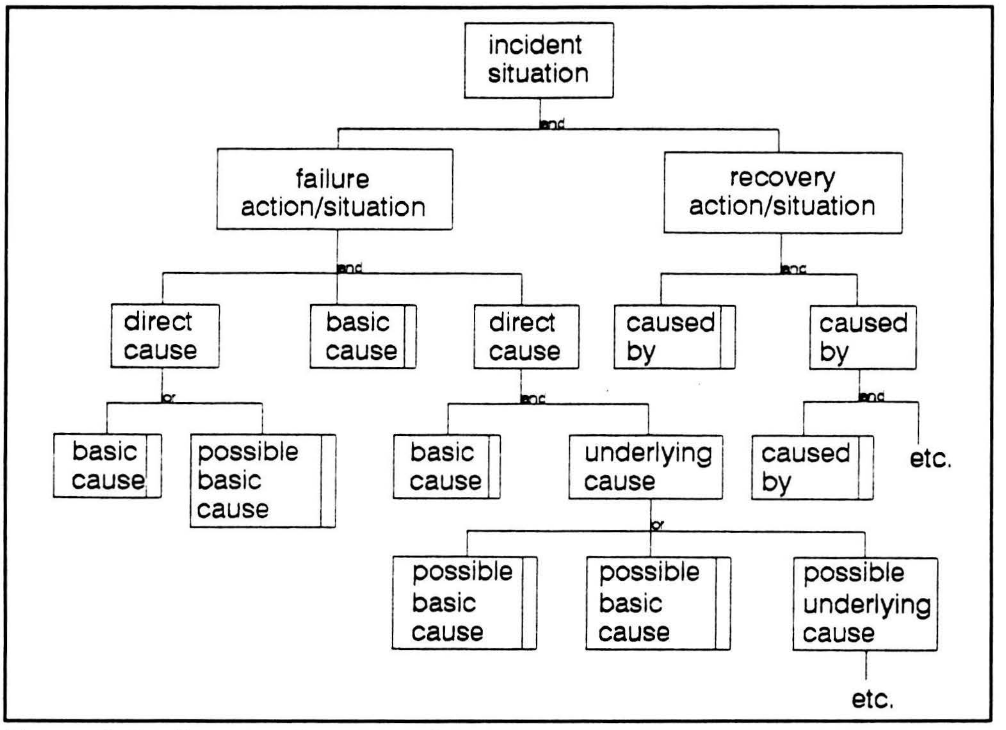

Figure 8.2 Construction causal tree

1. What happened exactly to the process?
2. Which main-action/ movement have been executed by the operator(s)?
3. Which control should have prevented the incident from occurring?

After having answered these questions, the checklist items with direct causes can be filled in. The answers at the questions will have to be taken into account.

The checklist items (direct causes) are:
time related elements; knowledge related elements; interpretation related elements; maintenance related elements; mechanic related elements; tool related elements; material related elements; Personal Protection related elements; communication related elements; responsibility related elements; culture related elements.
Besides these, other elements can also be stated.

In choosing the right option(s), the following questions can be a guide.
- Which factors have been influencing the appropriate control mechanism?
- Were there any failing mechanic parts involved?
- Why is/ are the action(s) by the operator(s) continued, while something was not ok?

After having determined the direct causes on basis of the checklist, the underlying causes will have to be determined. Of each direct cause the technical, organizational and/ or human underlying aspects will have to be determined. To check these aspects, the classification model as described in chapter 3 can be used as a checklist.

C Short analysis
This 'analysis' will be limited to determining the main basic cause(s) in technical, organizational and/ or human terms. The classification model can be used as a checklist. This 'analysis' is the same as asked for at the re-act card of the MTS program.

8.4.4 Classification Model

The Eindhoven Classification Model (ECM) as developed by v.d. Schaaf (1992) is divided in mainphases: technical factors, organizational factors and human factors. Each of these mainphases has been worked out in more detail. The complete model was shown in chapter 3, at the NMMS introduction.

Each basic cause of an incident will have to be classified.
Following the flowchart of the classification, the start is at the technical level. The human factors are mentioned at the end to oppose the inclination to start and stop the analysis at the level of the end-user. In this way one is forced to think about the other factors first.
The most important implication of this model is the fact that different types of errors imply different types of preventive measures.

8.4.5 Computation Model

A database with past incidents and their basic causes is necessary to determine effective measures. The interpretation will have to be based on trends of classified basic causes. An appropriate software package have been found at Classbase software (Classbase, 1994). This decision support system is partly based on the earlier mentioned Eindhoven Classification Model of system failure.

ClassBase serves the purpose to build a large quantitative and qualitative database. Research, scanning and analyzing your data and of course the implementation of modifications in a continuous process will have positive effects on the work environment, hidden dangers, damages and injuries.
Besides this, it will motivate managers and employees to keep alert at all times. ClassBase is a user-friendly and powerful management system with a lot of flexibility. Every wanted selection can be made and directly transported to imaging facilities. In this way a selection will be directly visible in graphics.

The system has been tested at Akzo Nobel Coatings Headquarters.
The tests were except at functionalities' completeness and failures aimed at the level of analysis support. With analysis, the analysis as discussed in paragraph 8.4.4 is meant.
Concerning the extensive analysis version (A): the causal tree will have to be build in a creative manner. One does not have to be given directions of thought. Concerning the classification of basic causes: a part of the software supports the analyst with the classification. This part is constructed in compliance with the Eindhoven Classification Model. In this way, theoretical support has been and will continuously be given.

Concerning the medium analysis (B): the checklist concerning the direct causes can be put as a standard into the software. The classification will be supported as described with version A. Concerning the short analysis, these main causes will have to be put directly into the classification module.

The way checklists are stored within the software is with keywords. This means that in the main screen keywords are being shown. By selecting one of these keywords all underlying options will show up at the screen. The appropriate options can easily be selected. These keywords are taking care of the necessary uniformity concerning the description of an incident. Only in case of uniformity a good trend analysis can take place.

Because of this uniformity, but also because of the necessary system knowledge, the different aspects of the computation phase will have to be performed by the safety-supervisor. These responsibilities will be part of the total responsibility diagram, discussed in the next paragraph.
Bringing a software package to the first line responsibles appeared in Bergen op Zoom not to be the best thing to do. The system would then become more a threat than a useful tool from their point of view. This also supports the idea to keep the analysis concerning the software at staff level.

To put all incident data into the software package, little time will be required. The analysis will have to be performed then already. The structure in description and analysis, however, leading to more effective measures and more efficient use of time, combined with automatic feedback reports generation provide more time than is needed to perform the analysis. Besides this time aspect, safety management will reveal much more effect and will be changed from ad hoc management to structured management.

8.4.6 Interpretation method

In order to develop an actual tool for safety management it does not suffice to stop at the analysis stage of failure classification. The classification results have to be translated into proposals for effective preventive and corrective action. To fulfil this purpose a so called Preliminary Classification/Action Matrix is proposed below (figure 8.3 by v.d. Schaaf, 1992).

Explanation:
The rows of the matrix consist of the final classification codes as stated in the Eindhoven Classification Model. The columns represent the following five classes of actions available to management.

Equipment: redesigning of hardware, software or interface parts of the man-machine system;

Procedures: completing or improving formal and informal procedures for efficient and safe task performance;

	Equipment	Procedures	Information & Communication	Training	Motivation
TE	X				
TC	X				
(TM)					
OP		X			
(OM)					
HK1			X		NO!
HK2			X		NO!
HR1				X	
HR2				X	
HR3				X	
HR4				X	
HR5				X	
HR6				X	
HS1	X				NO!
HS2	X				NO!

Figure 8.3 Classification/action matrix

Information &
Communication: completing or improving available sources of information and of communication structures;
Training: improving (re)training programmes for skills needed;
Motivation: increasing the level of voluntary obedience to generally accepted rules by applying principles of positive behaviour modification.

In the matrix the most preferable action in terms of expected effectiveness for each classification category is indicated by 'x'. The last column's 'no!' refers to particularly ineffective management actions, which are none the less often encountered in practice.

8.4.7 Responsibilities structure

This paragraph will not only deal with responsibilities concerning the interpretation phase, but refers to all 7 NMMS modules. The feedback will be discussed apart from the evaluation, because the responsibilities are different for these two cases. These responsibilities are general in a way that specific site safety committees are not included. There are too much differences concerning the existing safety committees and their tasks.
The analysis part will ideally be performed by line responsibles. This because of the fact that safety is defined as a line responsibility. This will not be the case in most

sites in the beginning because of necessary organizational changes and learning. The start-responsibilities will be given below in table 8.3. A '+' refers to a responsibility concerning that particular aspect.

One person will have to possess the final responsibility concerning a module. For this reason those persons who do not bear final responsibility will get a remark. This remark is stated in terms of the necessary kind of 'performance'.

Table 8.3 Start responsibilities concerning NMMS modules

	first line manager	production manager	safety supervisor	operators	management
reporting	+			+ recognizing	
selection	+		+ consultation		
description	+ cooperation		+	+ cooperation	
classification			+		
computation			+		
interpretation	+ consultation	+	+ consultation		+ consultation
feedback	+ execution	+ execution	+ execution		+
evaluation	+ consultation	+	+ consultation		

A few remarkable elements will be discussed. Firstly, line management as shown in the second column is not responsible for every safety task:
It will be the ideal situation when the first line manager can also perform the classification and computation and can perform the selection and description without help. This is required by the policy statement that safety is a line responsibility. The safety supervisor would then only have to support the system and advise when necessary. The responsibilities concerning the safety supervisor will the be limited to interpretation advises and the giving of feedback. It will possibly take a couple of years to reach this ideal situation. The safety supervisor can delegate more tasks and responsibilities when the line is ready for it. This means also that training in uniformity will have to be given then.

The second remarkable thing concerns the interpretation and feedback rows. These rows include responsibilities at every organization level except operator level. The mentioned organizational levels which are involved with the interpretation do not have to decide these measures within one joint meeting. The eventual measures will

probably be determined in meetings at two different levels. Top management will be the final decider. These decisions will have to be communicated down into the organization. This feedback needs to be given top down and end at operator level. All organizational levels are involved. The structure of feedback will be discussed in the next paragraph.
This paragraph will be concluded with a figure concerning the ideal situation in short term (figure 8.4). This is a compromise between the expected present situation (as explained in table 8.3) and the situation with all tasks delegated to the line.

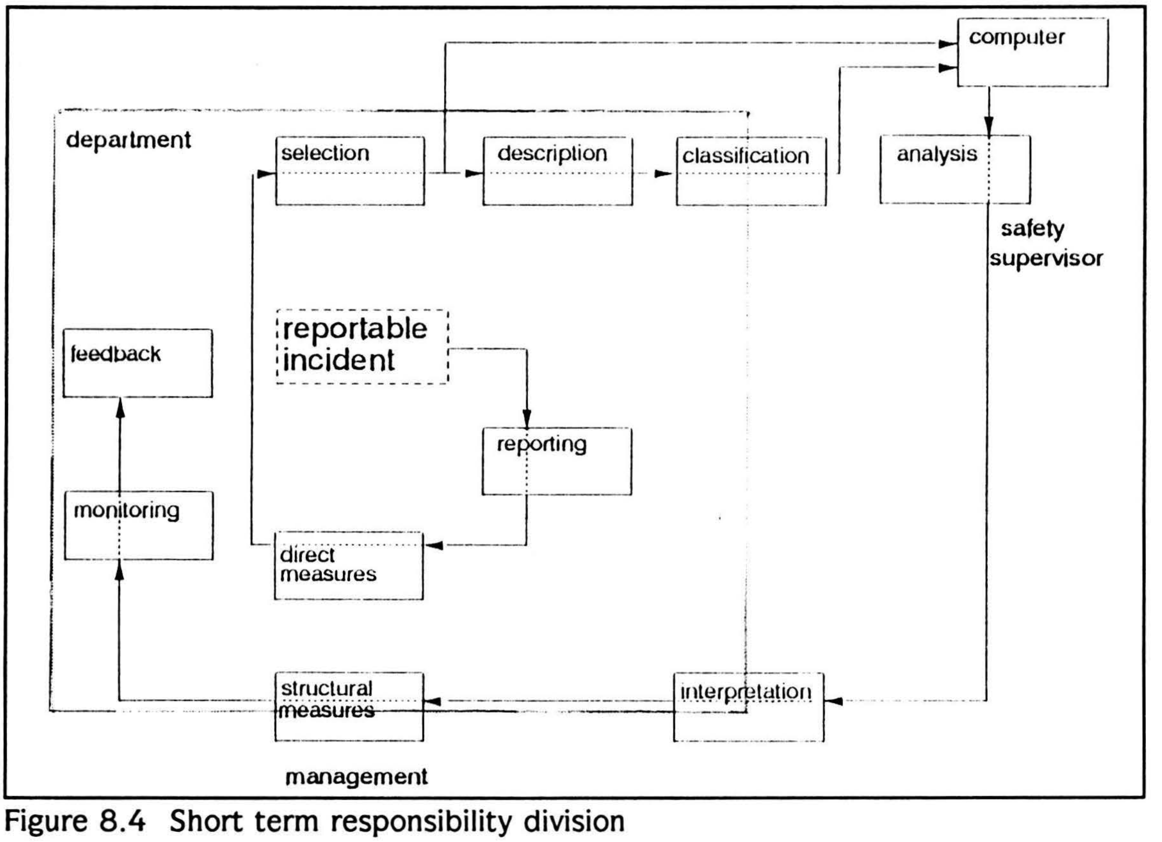

Figure 8.4 Short term responsibility division

Figure 8.4 shows the kind of action combined with the organizational level which has to take care of that action. Most actions will be performed by line management. The safety supervisor can help with the classifications, to keep uniformity. Because of the fact that a software program requires certain techniques and because of uniformity, the safety supervisor stays responsible for the input of incident data in the computer. The analysis will then also be taken care of by him/ her. The interpretation in terms of structural measures involves all organizational levels.

An important difference is that between direct measures and structural measures. After most incidents direct measures as cleaning are necessary. These measures can be taken care of by line management. Structural measures however, for prevention can only be determined after analysis of a range of incidents. These measures influence the total organization and will therefore be taken by top management (with consultation of staff and middle management).

8.4.8 Feedback and evaluation structure

In this paragraph just the communication structures which are at least necessary for this safety system are discussed. The determination of the communication channels is based on the situation in Bergen op Zoom (Witteveen, 1994a) and that of Hoogovens (Mulder, 1994). These official communication channels can be enlarged. Informal channels will be part of this enlargement. The details will have to be determined by site management and depends on the site organizational structure.
The communication channels are shown in figure 8.5 by bows. The global frequency and kind of necessary communication will be discussed after the figure.

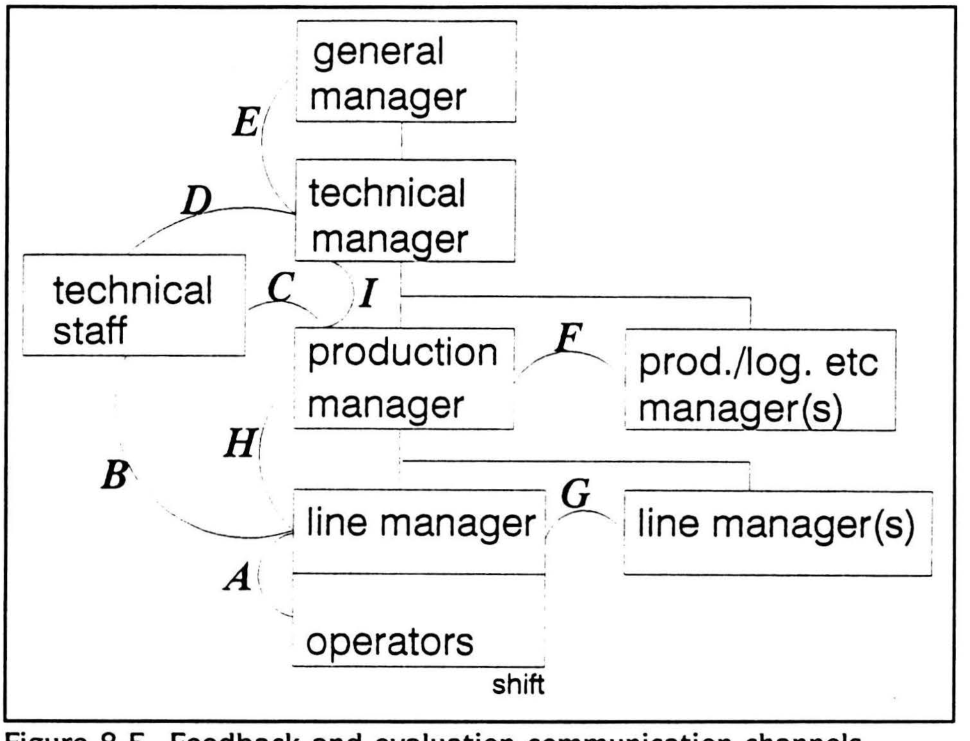

Figure 8.5 Feedback and evaluation communication channels

Explanation:
Figure 8.5 shows the necessary communication channels. The explanation in terms of 'kind of communication', 'global frequency' and 'responsibilities' will be given in table 8.4.

Table 8.4 Communication channels

Bow:	Communication kind	Global frequency (once per)	Responsible person
A	Discussion incident situation (individual); Feedback of analysis results (individual and group); General progress (group); Discussion of teachable incidents (group).	2 weeks (discussion)	Line manager
B	Analysis completion; Discussion react cards; Feedback and discussion analysis results; Discussion of teachable incidents.	2 weeks	Staff
C	Analysis results and progress discussion; Discussion react cards.	month	Staff
D	Progress discussion; Discussion react cards.	2 months	Staff
E	Progress discussion.	3 months	Technical manager
F	Results and progress discussion (group).	month	To be appointed
G	Discussion about experiences concerning reporting, analysis and other system elements (group).	month	To be appointed
H	Discussion about appropriate measures; Experiences exchange (group of production managers and line managers).	3 months	To be appointed
I	Results and progress (more practical)	month	Production manager

Remarks:
The frequency data are indicative. The discussion of the react cards (as a result of the react process in MTS) is part of the NMMS implementation communication channels. This because of the fact that at a react card several aspects have to be determined which are related with the NMMS practices. This refers to the determination of the main cause of an 'unsafe' in terms of technical, organizational or human and to the risk rating of an unsafe. Trends in react cards (completed by managers) can be compared to information which is originated by operators. Any deviations will be important to discuss throughout the organization.

Chapter 9 Review

9.1 NMMS?

Four sources delivered information concerning NMMS possibilities and consequences: the 'Arnhem' database with fixed items, a questionnaire, the IHSE-meeting and a pilot project in Bergen op Zoom (reference database). The database mainly delivered an indication of the underlying error causation model, held at the sites; The questionnaire revealed information concerning factors of the ideal safety situation (ISS). This situation has been determined first and refers to those factors that should be present before a successful implementation can start. This ISS contains the MTS 'corporate basic safety foundation or beliefs that must be shared througout the company', but also more specifically those factors which are essential for a near miss reporting system (NMMS). The IHSE meeting mainly revealed a discussion which delivered more insight in the database results. The pilot project in Bergen op Zoom, Akzo Nobel Resins, showed benefits delivered by the NMMS. This mainly refers to the error type distribution which appeared.

Main conclusions concerning the present safety situation are:
Structure (linkage) will have to be brought into the safety system elements. This structure and uniformity lack in most sites (questionnaire result). Present actions seem to be rather ad hoc and by heart instead of general and structured. Besides this, top level commitment and support is very essential. This top commitment mainly refers to the underlying incident causation model with error types. The present situation indicates that the human component is regarded as being dominant (about 70%, database and questionnaire result).

The reference database showed that the NMMS analysis reveals more, more specified and more comprehensive data concerning incidents and their causes than the present way of working. Most important is the percentile contribution of the human failure component. Human failure contribution appeared to be 41%. This NMMS result is contrary to Du Pont's statement that 90% or more of all failures is due to human acts. The NMMS result corresponded with the operators' and first line managers' feeling.

The attitude of the HSE supervisors concerning a near miss reporting and analysis system seemed to be rather positive. This appeared in the questionnaire, during the HSE meeting and in Bergen op Zoom.

9.2 Practical implementation aspects

Some aspects of the ISS have been chosen to be discussed in more detail. These are: operator motivation, unbiased reporting, selection method, classification model, database availability, responsibilities structure and feedback and evaluation structure. These factors are not yet present in most sites, apart from the feedback

responsibilities and structure. These have been discussed because of the experiences in Bergen op Zoom (paragraph 7.5).
The advises are not prescriptive. They can and will often be adjusted to local circumstances. An exception is the classification model. Definitions concerning the local situation can be added, but the model in itself is prescriptive. In case of data comparison, for example on BU-level, database uniformity is also advised.

9.3 Recommendation

Implementation of the NMMS is recommended. It will deliver a structured and comprehensive safety management program. Most important aspect to be changed at the start is management commitment. This aspect is very diverse at the moment. Management has to accept the underlying philosophy (paragraph 3.5) and has to put enough time in the system. This will act as a catalyst for the other implementation aspects as operator motivation and appropriate techniques.

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ENCLOSURES

NMMS purposes and element consequences — Enclosure 1

<u>Purpose of near miss reporting</u>

	Modelling	Monitoring	Alertness
1. Detection	everything	known problems only	recognising and reporting
2. Selection	new reports only	[not relevant]	convincing, detailed examples of new and old hazards
3. Description	detailed	[not relevant] or very superficial	
4. Classification	flexible: looking for new root causes	routine: standard set of root causes	[not relevant]
5. Computation	[not relevant]: only single events considered	periodic analysis of updated large database	[not relevant]
6. Interpretation and implementation	finding (new) ways of improving prevention and recovery	[not relevant] already prescribed by module 4	near misses as precursors; focus on recovery mechanisms
7. Evaluation	[not relevant]	comparing actual and predicted effects of implemented measures	[not relevant]

ANNEX 2

No:

REPORT OF AN INJURY OR DANGEROUS OCCURRENCE

LOCATION:
Contact:
Date:
To: Akzo NV, P0 Box 9300, 6800 SB Arnhem *
Attn. G.J. Kok – AGCO TQE, Fax (–31).85.665507

A Brief description of accident/incident

B Class		C People involved		D Department	
1. Fatality	O	1. Employee	O	1. Production	O
2. LTI	O	2. Part–timer	O	2. Storage	O
3. N.LTI	O	3. Trainee	O	3. Laboratory	O
4. Material loss	O	4. Third party	O	4. Office	O
5. Other (near misses,....)	O	5. Other	O	5. Other	O

E Primary causes		F Underlying causes	
1. Moving Machinery	O	1. Wrong method	O
2. Handtools	O	2. Procedure not followed	O
3. Handling/Lifting	O	3. Inadequate training/instruction	O
4. Transport/Traffic	O	4. Unauthorised	O
5. Moving object	O	5. Unsatisfactory conditions	O
6. Slip/Trip/Fall	O	6. Inadequate equipment	O
7. Fire/Explosion/Hot surface	O	7. Inadequate personal protection	O
8. Hazardous substance/spill	O	8. Inadequate supervision	O
9. Obstacle	O	9. Carelessness	O
10. Other	O	10. Other	

G Nature of injury		H Part of body affected	
1. Cut/sharp edge	O	1. Eye	O
2. Burn	O	2. Head/face	O
3. Crush injury	O	3. Back/neck	O
4. Strain/Sprain bruise	O	4. Arm/elbow	O
5. Fracture	O	5. Hand/wrist/finger	O
6. Respiratory	O	6. Chest/abdomen/side	O
7. Chemical irritation	O	7. Leg/knee	O
8. Dislocation	O	8. Foot/ankle	O
9. Many–sided	O	9. Many–sided	O
10. Other	O	10. Other	O

I Cost assesment ______

J Recommendation to avoid recurrence

K Investigation report will be available Yes/No

L Remarks: .....

* *For the USA to USR Manager Akzo Coatings Inc., Louisville, KY, fax (502) 459–7394*

Akzo Nobel Underlying causes	Eindhoven Classification Model
wrong method	OP/ HR5/ HR6
procedure not followed	HR5
inadequate training/instruction	O (P + M)
unauthorised	HR1/ HR2
unsatisfactory conditions	T (E + C + M)/ OM
inadequate equipment	T (E + C + M)
inadequate personal protection	HR6
inadequate supervision	OM
carelessness	HS2
other	All categories

The division of underlying causes which do not have one main classification in terms of the ECM has reached its final form after reading the accident descriptions and proposed measures. Not all reports contained such a description. The underlying causes with dubious classifications have then been divided following the same percentile distribution as the underlying causes of reports with a description.

The absolute numbers of classifications and the resulting percentile distribution in terms of technical, organizational and human failure types is as follows:
Technical:
Inadequate equipment: 16; Other: 4.

Organizational:
Unsatisfactory conditions, including maintenance: 18; Inadequate training/ instruction: 3; Inadequate supervision: 2; Wrong method: 8; Other: 3.

Human:
Procedure not followed: 15; Unauthorised: 0; Inadequate personal protection: 10; Carelessness: 43; Wrong method: 20; Other; 7.

Resulting percentile distribution:
Technical: 13%
Organizational: 23%
Human: 64%

Relation questionnaire and ISS   Enclosure 4

The combination of questions and organizational factors which are measured is as follows:
The answering categories are nominal, i.e. functioning just as label.

1: top level goals
2: top level goals
3: top level goals
4: proactive or reactive reaction towards incidents
5: clearness reporting-system to the operators
6: voluntary reporting
7: procedure/ standard form concerning the reporting method
8: training programme for operators concerning recognizing and reporting incidents
9: operator motivation to report incidents
10:top level commitment in terms of available time
11:top level commitment in terms of guilt-question
12:operator awareness concerning incidents and a pro- or reactive reaction
13:selection method concerning whether or not to analyze the incident
14:selection method concerning the detail of incident analysis
15:defined responsibilities concerning this analysis
16:variable quality in the description/ analysis of incidents
17:training programme to perform the analysis
18:classification of causes: mono- or multicause
19:analysis/classification and a possible variability in its quality
20:participation of operators concerning the analysis
21:underlying philosophy about incident causation
22:operator motivation to participate and perform the analysis
23:interpretation method in terms of measures versus incident severity rate
24:decisive style of management in terms of decision time
25:general or individual, ad hoc repair actions
26:defined responsibilities concerning the determining and execution of measures
27:defined responsibilities in terms of the kind of measure decision
28:defined responsibilities in terms of whether or not to take any measures
29:computation method in terms of statistical analysis from a database
30:feedback in visual aspects
31:cause instead of action oriented measures
32:indication of the no blame policy
33:clearness of system in terms of reward or punishment towards the operator
34:defined responsibilities for giving feedback
35:design of feedback loops
36:feedback towards the operator concerning the incident and its results
37:feedback towards management concerning incidents and its results
38:monitoring method in terms of evaluation of measures and feedback
39:defined responsibilities concerning the evaluation
40:monitoring method and variability in quality
41:feedback from operators' point of view and decisive management
42:general or ad hoc measures

Questionnaire and answering percentages **Enclosure 5**

Remark: The first part contains questions with summed percentages of more or less than 100%. This means that more than one answer has been chosen at a question respectively not everyone answered the question.
The percentages of the second part have been determined by only looking at the ones which have been completed.

Just the questions have been enclosed. An accompanying introduction, definitions and NMMS introduction have been part of the questionnaire which has been sent out.

The questions will be shown, starting on the next page.

Questionnaire, PART ONE

A. GENERAL POLICY

Some questions about the general policy concerning safety:

1 Is there a clearly written policy concerning incidents available in the organization?

81 % O yes
19 % O no

2 Are there goals concerning accidents formulated for 1994, and are these expressed in numbers? (in case yes, please fill in the present level and the target level)

81 % O yes, i.e present:____ goal:____
19 % O no

3 With what percentage does the management of your site think it is possible to reduce/prevent the number of accidents in 1994-1995, when the present level is 100%?

44 % O 0%-10%
38 % O 10%-25%
18 % O 25%-50%

B. REPORTING

Some questions about the policy of reporting:

4 Do you think it is always important to internally report data about incidents, other than the incidents mentioned in G & D #1, or is there a certain selection? In this question you can fill up more than one circle.

O except the incidents of G & D #1, no other incidents are necessary to report internally
O injuries with medical treatment or worse
O every injury, it does not matter whether medical treatment is necessary
O near misses (almost incidents with timely recovery) or worse
O dangerous occurrences (static situations) or worse
O it depends on the first impression of the 'type of cause', for example a simple obstacle or a procedural fault
O always in case of material damage
O when the material damage exceeds the amount of $_____

5 When are the employees being informed/instructed about the internal reporting of incidents? (you can fill up more dots)

68 % O when they first enter the organisation
19 % O regularly during their employment, about once a month
19 % O regularly, about twice a year
31 % O regularly, about once a year or less
43 % O each time an incident happened
O never specifically

6 Are there obligations towards the operators to report internally any incidents other then the ones mentioned in G & D #1?

56 % O yes, this concerns all incidents
31 % O yes, but there are some criteria
6 % O no, concerning these incidents the reporting is voluntary

Some questions about procedures, resources concerning reporting:

7 Is there a written/confirmed procedure (inclusive a standard form) for the internal reporting of incidents? In case yes, please enclose it.

88 % O yes
12 % O no

8 How are the employees being informed about the internal reporting of incidents? (you can fill up more circles)

18 % O by visual means, for example slides or video
75 % O by written material with procedures
88 % O by spoken instructions
O irrelevant

Some questions about the execution of reporting:

9 Do the operators have to be stimulated during their employment to report incidents other than the ones mentioned in Coatings G & D #1, because they do not see the necessity of reporting?

81 % O yes
19 % O no

10 Do you think that because of a lack of time not all incidents are reported?

44 % O yes
56 % O no

11 Do you think that because of a possible 'guilt question' not all incidents are reported?

56 % O yes
31 % O no
13 % O there is no 'guilt question'

12 How many incidents, not belonging to the ones mentioned in G & D #1, were reported internally, so at your site, last year? i.e ________

C. ANALYSIS

Some questions about the policy of the (possible) analysis. The term analysis refers to the investigation of incidents in terms of causes:

13 Will a reported incident always be analyzed in terms of its causes, or is there a certain selection? (you can fill up more circles)

56 % O yes, always analyzed
6 % O no, just when there is enough time
19 % O no, it depends on the kind of injury
6 % O no, it depends on the amount of money involved
6 % O no, it depends on the person who makes the analysis
19 % O no, it depends on the first impression of the 'type of cause', for example a simple obstacle or a procedural fault
19 % O no, it depends on the 'uniqueness' of the incident (new, known)

14 Is there a selection in what detail a reported incident will be analyzed in terms of its causes?

44 % O no
50 % O yes, it depends on the kind of injury
25 % O yes, it depends on the amount of money involved
19 % O yes, it depends on the person who makes the analysis
13 % O yes, it depends on the 'type of cause', for example a simple obstacle or a procedural fault

15 Are there clear personal responsibilities stated to perform the analysis?

63 % O yes
23 % O no

Some questions about the procedures and resources concerning the analysis:

16 Is there a written/confirmed procedure for the analysis of incidents?

50 % O yes
6 % O no, because it is not clear how the data has to be interpreted
37 % O no, the analysis is made by intuition/ experience

17 Is there a training model for the analysis?

25 % O yes
75 % O no

18 Is there knowledge about incident causation models?; This means a model which describes a sequence of factors causing the incident, or gives types of possible causes which can be used in the analysis.

19 % O yes, a model which produces one major cause
31 % O yes, we use a multi cause model
50 % O no, the analysis varies, there is not a certain model

19 Are you using checklists of possible causal factors for the analysis?

37 % O yes
56 % O no

Some questions about the execution of the analysis:

20 Who is doing the (possible) analysis, is there a team involved? (you can fill up more circles)

75 % O line manager
88 % O HSE supervisor
19 % O technical engineer
63 % O the operator who reported it
37 % O colleagues of the operator
-- O upper management
25 % O other:____________

21 Can you give a global idea about the percentage of the occurred causes expressed in the following groups? (The sum of the percentages should be 100%):

A management/ procedures
B technical
C operator/ employee ________ +
100%

22 Can you give an idea of the reactions of the operators towards the analysis; How is their dominating reaction?

31 % O they see it as time consuming
19 % O they do not understand the meaning of it
-- O they are very enthusiastic
50 % O they see it as useful
12 % O they see it as a learning system

D. ACTION

Some questions about the policy concerning possible action. The term action refers to measures:

23 On what grounds is decided that an incident has to be followed up by some action? (In case option 3, please give the appropriate FR)

50 % O as the incident is accompanied by serious consequences
94 % O as the incident has a potential risk, although nothing serious happened yet
6 % O when the number of lost time injuries exceeds a certain number, i.e ______/year

24 How long does it take, after an incident is reported, before a decision is made whether to take any action or not?

25 % O 1 day, i.e the same day
37 % O a couple of days
19 % O 1 week
6 % O a couple of weeks
-- O 1 month
-- O 2 months or more
6 % O this varies very much

25 Is this action based on a single incident or is action based on more (comparable in causes) incidents?

56 % O after each incident
-- O after a few comparable incidents
44 % O mostly after a few comparable incidents, sometimes after a single one

One question about procedures concerning the action:

26 Are there written procedures for the responsibilities for determining and execution of measures?

determining 56 %O yes
44 %O no
executing 56 %O yes
44 %O no

Some questions about the execution of the action:

27 Who takes the decision <u>which</u> action will be executed? (You can fill up more circles)

-- O the operator who reported the incident
-- O a group operators (2 or more)
75 % O line management until level of ___________
75 % O HSE supervisor
50 % O upper management
19 % O other, i.e. ______________

28 Who takes the decision <u>whether</u> action will be executed? (You can fill up more circles)

56 % O upper management
44 % O HSE supervisor
63 % O line management until level of ___________
O other, i.e. ______________

29 Are the incidents stored in a database from which statistical analysis is possible?

38 % O yes
56 % O no

30 What is the most common time period between decision and measures being taken?

12 % O < 1 week
25 % O 1 to 2 weeks
44 % O +/- 1 month
19 % O +/- a half year

31 The taken measures; Can you give a global idea of the percentage of the occurred types expressed in the following groups (The sum of the percentages should be 100%):

O procedures/ policy
O technical/ resources
O training
O motivation ________ +
100%

E. FEEDBACK

One question about the policy of feedback. The term feedback refers to the communication concerning taken decisions and measures towards different layers in the organization:

32 After the reporting of an incident, what happens to the person responsible for reporting the incident? (you can fill up more circles)

19 % O name is only known to the first responsible team leader, the report remains anonymous
81 % O name is mentioned to the management
31 % O gets a reprimand, but does not have to pay for the damage
19 % O does get encouragement
6 % O has to pay for the possible material loss one way or the other

Some questions about the procedures and resources concerning feedback:

33 Are the personal consequences, in terms of reward or punishment after an incident, towards the person responsible available in a written statement?

31 % O yes
69 % O no

34 Are there clear responsibilities stated for the giving of feedback concerning:

reporting	75 %	O yes
	25 %	O no
analysis	63 %	O yes
	31 %	O no
measures	69 %	O yes
	31 %	O no

35 Is there a clear/written routing of the communication regarding the results of the incident reporting?

56 % O yes
44 % O no

Some questions about the execution of feedback:

36 Is there a regular form of feedback regarding incidents and the accompanying decisions to the operators?

26 % O no
6 % O no, just when there is time
6 % O no, only after a serious incident
31 % O yes, every few weeks
31 % O yes, quarterly

37 Is there a regular form of feedback regarding incidents to the upper management?

19 % O no
-- O no, just when there is time
-- O no, only after a serious incident
12 % O yes, after every incident
50 % O yes, every few weeks
25 % O yes, quarterly

F. EVALUATION

One question about the policy of the evaluation. The term evaluation refers to the control function, for example whether measures are really executed or feedback is given:

38 Is there a standard period after which an evaluation of the above mentioned system has to be taken care of. This means a) controlling of the fact that measures are implemented, and b) the fact that feedback has been given? (In case yes, please give the appropriate period)

25 % a) O yes, i.e. ________
75 % O no
25 % b) O yes, i.e. ________
75 % O no

Some questions about the procedures, resources concerning evaluation:

39 Are there stated responsibilities for the execution of the evaluation?

25 % O yes
75 % O no

40 Is there a standard/written form available for this evaluation?

19 % O yes
81 % O no

Some questions about the execution of the evaluation:

41 Are there sometimes complaints by operators that they do not hear or see anything about the incidents they reported?

37 % O yes
63 % O no

42 Are there many (comparable in causes) incidents in time sequence, although measures have been taken?

12 % O yes
75 % O no

Please state the time you did spent on this part: __________ minutes.

Questionnaire, PART TWO

NMMS questions

After reading the information about near misses and the Eindhoven near miss management system I would like to get your opinion about some aspects.

First I will give some statements concerning near misses. I would like you to give your opinion whether you agree with it or not.

1 The difference between a near miss and a real accident is only very small.

100 % O agree
0 % O do not agree

2 The actions of operators are often the reason for a developing incident not to turn into an accident (human recovery).

93 % O agree
7 % O do not agree

3 These recovery actions are not always made consciously

86 % O agree
7 % O do not agree

4 Concerning this recovery it is more often build in technical barriers.

57 % O agree
29 % O do not agree

5 Causes for accidents and near misses are the same.

100 % O agree
0 % O do not agree

6 Whether the potential effects are severe or not is not important for the analysis in causes.

71 % O agree
29 % O do not agree

7 Near misses are important for improving the safety performance.

100 % O agree
0 % O do not agree

8 The (Eindhoven) near miss management system will be a useful tool in improving the safety performance at your site.

93 % O agree
0 % O do not agree

9 I am interested in the Eindhoven NMMS and in its specific operation

86 % O agree
0 % O do not agree

After these statements some other questions will follow.

10 Do you already report near misses (according to your own definition)?
In case yes, please give your definition.

72 % O yes ______________________________

____

21 % O no

11 Are you dealing with them in the same way as with accident, concerning:

50 % reporting: O yes
14 % O no
O irrelevant
analyzing: O yes
O no
O irrelevant
actions: O yes
O no
O irrelevant
feedback: O yes
O no
O irrelevant

In case you answered some aspects of question 11 with a 'no', please give the important differences between the dealing with accidents and near misses.

____
____
____
____

Please, indicate the time spent to this second part: __________ minutes.

NAME:____________________ LOCATION:______________________________

Resulting failure types Critical Incident Interviews Bergen op Zoom

Enclosure 6

The 15 interviews revealed 81 classified root causes. The numbers and percentages of the different typifications is given below.

Distribution technical failure types:

	TE	TC	TM	Total	%
No:	21	3	0	24	29
%	87	13	0	100	

Distribution organizational failure types:

	OM	OP	OI	OC	OV	OCu	Total	%
No:	9	8	2	3	1	0	23	28
%	40	35	8	13	4	0	100	

Distribution human failure types:

	K1	K2	R1	R2	R3	R4	R5	R6	S1	S2	Tot.	%
No:	7	5	0	0	3	6	7	1	3	2	34	41
%	21	15	0	0	8	18	21	3	8	6	100	

Summons of the percentages reveals 2% unclassifiable basis causes.

Definitions occurred failure types Bergen op Zoom **Enclosure 7**

<u>Technical:</u>

TE: Wrong design: This concerns the missing of parts in a design, such as detection of failures, but also the total design of processes and their controlling modules.

TC: Correct design which was not followed accurately during the construction phase. When the idea behind a certain construction is ok, but the construction does not work well, it is probably a construction failure.

TM: rest category, for those material defects not classifiable under TE or TC. This is a totally unexpected technical failure, unique in nature.

<u>Organizational:</u>

OP: Wrong procedures: In case procedures or instructions are not present or in a way which is not appropriate for the specific situation, f.e. incomplete or not clear to those who have to work with them, it is a procedural failure. This refers to the quality of the procedures.

OM: Management priorities: This refers to any pressure by top- or middle management to let production or own ideas prevail over safety. This concerns all situations where safety does not get the attention it should get.

OV: Unclear responsibilities: This refers to situations where responsibilities are not formulated in enough detail, when they are to vague. This concerns the quality of responsibility formulation.

OI: Instruction, education lack: This refers to any situation where something went wrong because of the fact that the operator did not receive enough education about the process.

OC: Insufficient communication: This refers to situations where the communication between departments insufficient and leads to failures.

OCu: Culture: This refers to situations where procedures are in place, but which are structurally not followed.

<u>Human:</u> Just the appeared categories will be described.

HK1: Correct status and dynamics must be known to the operator: When in an organization and in a specific situation, checklists and instructions are not present, the organization holds the idea of operators own creativity. The operators should control the situation. Besides this, this also refers to helping to think about consequences concerning new situations as well in reasonable unique situations (f.e. stop).

HK2: Main goal or priorities of goals must be understood by the operator. In its worst form this is sabotage: Concerning their own acts at the process, operators should put safety on top. This is their own responsibility. They have to make the right decision between safety, feasibility etc. This also concerns the lack of motivation to, for example, clean up spillings.

HR3: Informing other operators of the work to be done (coordination) in view of the potential effects on their tasks: This refers to communication, also with contractors when they are at work at the site.

HR4: Local system status should be checked to comply with the expected conditions: Besides the formal, planned checks, regular checks by the operators in order to keep the conditions as they should be are expected. This also implies that operators should ask and pay attention to changes in the officials status after being away for a certain time.

HR5: The job in itself should be planned and executed correctly; correct methods in correct order: The tasks have to be performed in the right way. If procedures exist, these should be followed. Different actions should be finished completely before starting the next one. Within this failure mode you find errors of omission and commission, timing, sequence etc.

HR6: Prescribed tools and information sources for a proper job performance should be present and used.

HS1: Controlled movement: In case of routine, intended, detailed movements.

HS2: Whole body movement: Maintaining the right body position in order to make the controlled movements possible.

React card with risk figures

Enclosure 8

MTS TOUR

(MINIMUM 1 PER WEEK OR AS SEEN)

Tour Tips:

- Observe for Safes, Unsafes and Near Misses in the workplace.
- Use Observation Categories as a systematic guide
- Then Decide, Observe, Act and Report
- Do a 15 minute - 30 minute tour weekly.
- Look for people first and conditions later.
- Consider "What if" the unexpected happened on "How" could injuries be prevented
- Communicate your observations . . . compliment and or council those observed. (The Mirror approach).
- Complete the reverse side of this *RE-ACT* Card for each observation.
- Review *RE-ACT* Card with supervisor who will forward card to Safety Manager/Team.

Observation Categories

1. **Positions/Posture of People**
2. **Rules and Procedures**
3. **Personal Protective Equipment**
4. **Tools and Equipment**
5. **Housekeeping and Maintenance**
6. **Design and Conditions**
7. **Safety Equipment**

Supervisors Risk rating (C x F x E)

Chance of situation evolving into incident:		Frequency of the situation occurrence:		Expected effects:	
•conceivable, but quite unlikely	: 1-3	once a year	: 1	medical treatment/little damage (< 10000)	: 1-3
•conceivable	: 5	few times a year	: 3	LTI/serious damage (10.000 - 300.000)	: 4-6
•quite possible	: 7	once a month	: 5	incapacity for work/disasterous damage (300.000 -1 million)	: 7-9
•very likely	: 10	once a week	: 7	death (> 1 million)	:100
		once a day	: 9		
		continuously	: 10		

Risk Rating

Supervisors Risk Rating [ ] X [ ] X [ ] = [ ]

Name observer: ______________

Recognition/observation

____

____

____

____

____

____

____

____

____

____

AKZO NOBEL

RE-ACT CARD

FOR EACH

SAFE, UNSAFE, NEAR MISS

Basic Cause Check the main cause of unsafe, near miss

Human: ______________ ☐

____

Organizational: ______________ ☐

____

Technical: ______________ ☐

Date: ______________

Action for prevention

____

____

____

____

____

____

____

____

____

____