Lund University,
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Tetra Pak

Developing and Using a Health & Safety Reporting System at Tetra Pak

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Title

Developing and Using a Health & Safety Reporting System at Tetra Pak

Titel

Utveckling och användning av ett olycksrapporteringssystem på Tetra Pak

By / Av

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Abstract

Over a long period of time Tetra Pak has made great efforts, on local levels of their organization, to improve their Health & Safety (H&S) conditions. However, on corporate level, Tetra Pak has little information about its performance within this area. Tetra Pak Converting's sites have already started to develop a common structure for their H&S Management Systems. This structure has served as a role model in this thesis.

The main objective of this master's thesis has been to develop an accident reporting system. The developed reporting system, which in this report will be referred to as the Corporate Accident Reporting System (CARS), should thereafter be used to measure the H&S performance on corporate level at Tetra Pak. In this master's thesis, this was done in an H&S survey, where information about the accidents that happened during 2007 within the organization was collected.

The vision of the CARS is to create a personnel safety event reporting system, on corporate level at Tetra Pak that catalyzes the organizational learning and contributes to create a learning organization, within H&S.

The methods used in this master's thesis included interviews, an external benchmarking study and usability tests of the developed reporting prototype. Accident Frequency Rate (AFR) and Accident Severity Rate (ASR) were chosen as indicators, to measure the H&S performance in the conducted survey.

It was concluded that there is a need to implement an accident reporting system on corporate level at Tetra Pak, provided that it can replace some already reporting structures. The top management's commitment and a high willingness to report were found as two important factors for establishing and running the reporting system. It is suggested that the willingness to report can be increased, at Tetra Pak, by visualizing the effects of increased reporting of personnel safety events and by increased education in H&S-related issues.

During the H&S survey extraordinary and serious accidents were reported into the CARS. During 2008, minor accidents will be added as an additional reportable accident type in the system. In the system's implementation phase, it was recommended to perform the reporting monthly and that one person per site / cluster shall report into the CARS. However, the aim is a personnel safety event reporting system with continuous reporting, where every employee has read and write access.

The AFR at Tetra Pak was, according to the H&S survey, on the same level as the mean, with this indicator, at six international companies. The spread of the recorded indicators was found to be high. This can partly be explained by the fact that the true accident rates differ a lot between the different parts of Tetra Pak. It was also found likely that the respondents did not have a common opinion regarding how to classify the personnel safety events.

The safety culture, in all parts of the organization, seemed to be high enough to establish the CARS, considering how the H&S survey was received by the organization. However, Tetra Pak must put much effort on improving their safety culture in the future. My recommendation is to achieve this by engaging all Tetra Pak's employees in the H&S work and by starting H&S projects that are focusing on the organizational factors.

The following recommendations, on how Tetra Pak should use CARS, were given in this master's thesis:

- It is important to use the CARS for proactive purposes. Therefore, the consolidated material in the system should be used to identify areas of weaknesses to improve, in the work environmental conditions at Tetra Pak.
- Comparisons of the recorded indicators can be used to establish priorities between the sites / clusters and to allocate central H&S recourses.
- The CARS will be able to involve its respondents and probably also some managerial persons at Tetra Pak in H&S-related issues. This could increase the awareness of H&S-related issues at Tetra Pak.

A basic condition for enabling high reliable internal benchmarking studies of the root causes of the accidents at Tetra Pak is to create a standardized method of performing Root Causes Analyses (RCAs). A suggested development of the CARS is to integrate the future standardized RCA into the system. Another recommendation on future development, within H&S at Tetra Pak, is that they should set specific goals, regarding the development of their indicators AFR and the ASR, on corporate level.

Sammanfattning

Tetra Pak har under lång tid lagt mycket resurser, på lokala nivåer av sin organisation, på att förbättra sina arbetsmiljömässiga förhållanden. På koncernnivå har dock Tetra Pak begränsad kunskap och data om sin nuvarande situation och utveckling inom detta område. Tetra Pak Convertings fabriker har redan börjat utveckla en gemensam struktur för deras Hälsa och Säkerhets (H & S)-ledningssystem. Denna struktur har fungerat som förebild i detta arbete.

Syftet med examensarbetet har varit att utveckla ett koncernövergripande rapporteringssystem, som skall användas för att rapportera arbetsolyckor inom Tetra Pak. Det utvecklade rapporteringssystemet, som i denna rapport har benämnts Corporate Accident Reporting System (CARS), ska därefter användas för att mäta den koncernövergripande utvecklingen inom H & S på Tetra Pak. Inom ramen för examensarbetet gjordes det i en H & S-undersökning, där data om de arbetsolyckor som har hänt i koncernen under 2007 samlades in.

CARSs vision är att skapa ett koncernövergripande olycks- och tillbudsrapporteringssystem på Tetra Pak, som kan katalysera det organisatoriska lärandet och bidra till att skapa en lärande organisation inom H & S.

Metodiken, som har använts i examensarbetet, bestod av intervjuer, en extern jämförelsestudie och användbarhetstester. Accident Frequency Rate (AFR) och Accident Severity Rate (ASR) valdes som indikatorer för att avspegla H & S-utvecklingen i ovan nämnda undersökning.

Det bedömdes att det finns ett behov av att implementera ett koncernövergripande olycksrapporteringssystem på Tetra Pak, förutsatt att det skulle kunna ersätta viss befintlig rapporteringsstruktur. Koncernledningens engagemang och en hög rapporteringsvilja identifierades som två viktiga faktorer för att lyckas med att etablera och driva rapporteringssystemet. Att visualisera effekterna av ökad olycksrapportering samt att intensifiera utbildning av Tetra Paks anställda inom H & S föreslogs som två åtgärder för att öka rapporteringsviljan.

Under H & S-undersökningen rapporterades extraordinära och allvarliga arbetsolyckor till CARS. Under 2008 kommer även lindrigare olyckor att vara rapporterbara i systemet. I arbetet föreslogs en månadsvis inrapportering, under systemets implementeringsfas, samt att en person i varje fabrik/kluster ska rapportera till CARS. Dock är målsättningen ett olycksrapporteringssystem med kontinuerlig rapportering, där alla Tetra Paks anställda har läs- och skrivbehörighet.

Tetra Paks AFR uppmättes, i H & S-undersökningen, som genomsnittlig i jämförelse med samma indikator på 6 internationella företag. Spridningen av de uppmätta indikatorerna var hög. Detta ansågs delvis bero på att de verkliga olycksfrekvenserna skiljer sig starkt mellan de olika delarna av Tetra Pak. Det ansågs även bero på att respondenterna klassificerade olyckorna olika. Med tanke på hur H & S-undersökningen mottogs av organisationen, bedömdes säkerhetskulturen, i alla delar av koncernen, vara tillräckligt

god för att implementera CARS. Emellertid måste Tetra Pak lägga mycket energi på att förbättra sin säkerhetskultur. Det rekommenderas att man uppnår detta genom att involvera alla Tetra Paks anställda i det framtida H & S-arbetet samt genom att driva H & S-projekt som fokuserar på de organisatoriska faktorerna.

I examensarbetet gavs följande rekommendationer till Tetra Pak, angående hur de ska använda CARS på ett effektivt sätt:

- Det är viktigt att använda CARS i förebyggande syften. Det konsoliderade materialet i systemet bör därför användas för att identifiera arbetsmiljömässiga förbättringsområdena inom Tetra Pak;
- Jämförelser av de uppmätta indikatorerna bör användas som bas för prioriteringar mellan fabrikerna/klustren och för att allokera centrala H & S-resurser.
- CARS har potential att involvera sina respondenter och några av Tetra Paks chefer i H & S relaterade frågeställningar. Detta skulle innebära en ökad medvetenhet inom detta område, på Tetra Pak

En förutsättning för att kunna göra interna jämförelsestudier, med hög tillförlitlighet, av orsakerna till arbetsolyckorna på Tetra Pak, är att skapa en standardiserad metod för att genomföra olycksanalyser. En föreslagen utveckling av CARS är att integrera den framtida standardiserade olycksanalysen i systemet. Ytterligare en rekommendation till Tetra Pak, inom H & S- området, är att de ska införa konkreta koncernövergripande mål, för utvecklingen av indikatorerna AFR och ASR.

Acknowledgements

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I would also like to thank all of the 16 interviewees, for taking your time to provide this master's thesis with highly relevant information. I am also grateful for the feedback I received from the participants in the usability tests. Furthermore, I owe a big gratitude to all the 57 respondents of the H&S survey, who submitted information about the accidents that have happened at their sites and clusters. I would also like to thank Edson Minawa and Paul Lindau for helping me to appoint the respondents and for promoting the use of the reporting system.

Finally I would like to show my appreciation for Dow Chemical Company, for letting Anders Larsson and me come to their site in Stade and for sharing their experiences with us.

Lund, February 2008

Fredrik Gratte

Table of Contents

Abbreviations

This section presents the abbreviations that are used in this master's thesis.

Accident Frequency Rate	AFR
Accident Severity Rate	ASR
Corporate Accident Reporting System	CARS
Central Occupational Safety & Health Committee	COSHC
Double-Loop Learning	DLL
Field Service Engineer	FSE
Global Accident Report	GAR
Goal Equivalence Model	GEM
Group Leadership Team	GLT
General Failures Types	GTFs
Human Resources	HR
Human Resources Management	HRM
Health & Safety	H&S
Health & Safety Management System	H&S MS
Injury and Illness Severity Rate	IISR
Key Performance Indicator	KPI
Learning Accident Report	LER
Occupational Health and Safety Assessment Series	OHSAS
Participant	P
Plan-Do-Check-Act	PDCA
Performance Indicators	PI
Process Kaizen Engineering	PKE
Personal Protective Equipment	PPE
Tetra Pak Development & Engineering	Tetra Pak D&E
Tetra Pak European Council	TPEC
Tetra Pak Occupational Health Safety	Tetra Pak OHS
Tetra Pak Processing Systems	TPPS
Root Causes Analysis	RCA
Relevance Efficiency Attitude Learnability	REAL
Supply Chain Operations	SCO
Single-Loop Learning	SLL
Safety Master Pillar	SMP
World Class Manufacturing	WCM

1. Introduction

This chapter aims to explain the background and the purpose of the master's thesis. The chapter also contains delimitations and a brief introduction to the reporting system and to the used nomenclature.

1.1 Background of the project

According to a statement in their Code of Business Conduct, Tetra Pak is committed to provide safe and healthy working conditions for their employees all over the world. Over a long period of time Tetra Pak has made great efforts, on local levels of their organization, to improve their Health & Safety (H&S) conditions, e.g. through education and Personal Protective Equipments (PPEs). However, on corporate level, Tetra Pak has little knowledge and data about its performance within this area. Therefore, a common accident reporting system throughout the company is, by the initiator of this project, seen as an important factor in order to assess and further improve the situation, within H&S.

During 2006 and 2007 meetings were held to determine how to best handle this issue. A member of the Group Leadership Team (GLT) and employees from the middle management at Tetra Pak were participating in these meetings. Since the project was anchored with the GLT, the project is considered to have the top management's commitment. In these meetings, it was also concluded that Human Resources (HR) initially shall own and drive the issue. During the summer of 2007 the Human Resources Management (HRM) at Tetra Pak settled that the issue shall be more deeply investigated in this master's thesis. During the HRM meetings, the importance of involving the frontline staff in the reporting system was stressed. It was also agreed on that preferably a web-based reporting tool should be used to collect information about the personnel safety events that have been caused in some or all of the following ways:

- A Tetra Pak employee who is involved in an accident or near miss at Tetra Pak's production facilities;
- Any of Tetra Pak's employees who is involved in a personnel safety event, when working at Tetra Pak's customers' sites;
- Tetra Pak's customers' employees, who get injured using Tetra Pak's equipment;
- Personnel safety events occurring at Tetra Pak's Office sites.

Tetra Pak Converting has already started to develop a common structure for their H&S Management Systems (H&S MSs), including e.g. a common accident reporting system. Therefore, it was decided that this structure should serve as a role model in this master's thesis. However, extensive adjustments, in order to fulfil corporate needs, were needed.

Initially it was found that Tetra Pak could gain the following benefits from the implementation of an accident reporting system on corporate level:

- The creation of corporate uniform statistics within the H&S area. These can be used to compare similar sites within Tetra Pak and to perform external benchmarking studies. This would also ease the identification of areas of

improvements and can be used as a basis for the allocation of central H&S recourses.
- The establishment of measurements on a corporate level for personnel safety events can result in an increased awareness of H&S issues. This will mean that the importance of these issues will be increased in the future at Tetra Pak.
- The implementation of an accident reporting system on a corporate level, will be preceded by mapping of some, internal and external, already existing accident report systems. This mapping could have an intrinsic value for Tetra Pak.
- An accident reporting system on a corporate level will enable the implementation of a standardized procedure that efficiently handles the personnel safety event reporting at Tetra Pak.
- The system analyses of the gathered personnel safety event reports will enable the detecting of patterns in the occurrence and in the severity of accidents that happen at all parts of Tetra Pak.

1.2 Purpose

The main objective of this master's thesis was to develop a reporting system to be used to report personnel safety events on corporate level at Tetra Pak. This reporting system was thereafter used, in order to measure their H&S performance and to test the system by collecting information about accidents that have happened during 2007.

In order to give a proposal for the design of an accident reporting system on corporate level, the following research questions were identified:

- *Is there a need, within Tetra Pak, to implement a personnel safety event reporting system on corporate level?*
- *How can a model that combines accident reporting with productivity and work environmental conditions be designed?*
- *What factors are most important to secure a successful implementation and running of a reporting system at Tetra Pak?*
- *What questions should be asked in the reporting prototype?*
- *How should the classification of the personnel safety events be made? What types of events should be reportable?*
- *Which subgroups at Tetra Pak should report into the system?*
- *Which entities at Tetra Pak could own the reporting system? What advantages and disadvantages exist by putting the ownership on the different entities?*
- *What further central H&S efforts can be made at Tetra Pak to reduce the accident rates?*
- *Can a web-based reporting prototype fulfill Tetra Pak's needs, regarding collecting information about personnel safety events, on corporate level?*
- *How could a future reporting flow scheme be designed at Tetra Pak? When and by whom should the reporting be done?*

To be able to measure the current performance within H&S at Tetra Pak, by gathering data about the accidents that have occurred during 2007, the following research questions were identified:

- *Which Performance Indicators (PIs) should be used to measure the H&S performance within Tetra Pak?*
- *How was the H&S performance, within Tetra Pak, during 2007? How was their performance in comparison to other companies'?*
- *What conclusions can be drawn from the collected material?*

1.3 Delimitations

This master's thesis focuses on how to design a reporting system for H&S events that are caused by physical work environmental conditions.

In the framework of this master's thesis, the following types of work-related, personnel safety events were therefore chosen to be excluded from the reporting system:

- Occupational diseases;
- Security events like fires and data trespassing;
- Environmental accidents, e.g. emissions and pollutions.

1.4 The Reporting system

The reporting system that will be developed consists of two parts; these will in the master's thesis be referred to as the *Reporting prototype* and the *Reporting model*, see Figure 1.1 for visualization of the nomenclature. The Reporting system, to be developed in the master's thesis, will be referred to as the Corporate Accident Reporting System (CARS). The Reporting prototype is the actual reporting tool that will be used to collect and to file information about the personnel safety events at Tetra Pak. The second part of the reporting system is the Reporting model. This model includes information on how, when and by whom the reporting shall be done. The structuring of the flow of the reports, from the point of time that the respondents submit their reports to the system analyses and the feedback phase is also described. Furthermore, the model contains information about what tasks the owner of the system, and the person who is responsible for the operative running of the CARS, have to fulfill.

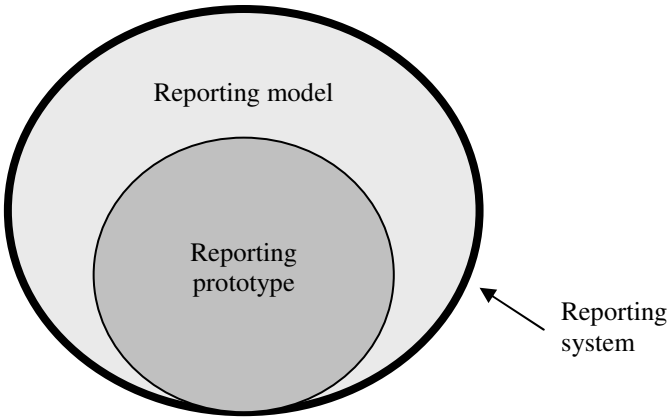


Figure 1.1. Nomenclature for the reporting system

1.5 Overview of the report and the conducted work

1.5.1 The chronological outline of the work

The chronological disposition of the work is a bit different from the structuring of the report. Literature studies have been made throughout the process, whenever it was considered as needed. The first step of the work was to conduct interviews concerning Tetra Pak's H&S efforts and the content in the reporting prototype; Chapter 4 describes how all the different steps were made. Thereafter a first draft of the reporting prototype, including the choice of a classification system for the personnel safety events, was made. Then feedback-interviews, with the interviewees were held, to confirm that the consolidation of their interview was correct and to get their opinion about the first draft of the reporting prototype. To get further external ideas about how reporting tools at a Best Practice company are designed, external Benchmarking at Dow Chemical Company's site in Stade was the next step in the development process. Thereafter, usability tests of the current reporting prototype were made. The reporting prototype was modified after the experiences gained from the external benchmarking, the feedback interviews and the usability tests. The reporting model was created at the same time as the reporting prototype was launched. The aim with the H&S survey was that all 49 production facilities and 11 clusters at Tetra Pak should use the reporting prototype to report the serious and extraordinary accidents that had happened at their sites / clusters during 2007. After the results from the survey were gathered, the 6th chapter, which contains the analyses, was written. A procedure, regulating the use of the reporting prototype was also written in this phase of the work. The last stage of the work was to write the discussion and the summarized conclusions.

1.5.2 The structure of the report

The first chapter of the master's thesis aims at giving the reader a brief background of the work. Thereafter, the purpose and the delimitations of the master's thesis are specified.

The work concerns Tetra Pak and is therefore influenced by their possibilities and constrains. Therefore, Tetra Pak's organization and its entities, as well as its current work within H&S are described in detail in the second chapter. This chapter also contains background information about the benchmarking partner Dow Chemical Company.

The 3rd chapter was written with the purpose of providing the reader with the theoretical framework that is used in the later parts of the report. Information about H&S MSs, personnel safety event reporting to reduce accident rates, safety culture and accident causation is given in this chapter.

The 4th chapter describes the methodologies that were used in this master's thesis. Different methods have been used at the different stages and parts of the work.

16 persons, within Tetra Pak, were interviewed in this master's thesis. The outcomes from these interviews, as well as the outcomes from the usability tests, the external Benchmarking and the results of the H&S survey are described in the 5th chapter.

The 6th chapter starts with identifying methods to decrease the accident rates at Tetra Pak. Thereafter, it is analyzed how an accident reporting model at Tetra Pak can be designed and what factors that influence the system's establishment. In the last part of the chapter the information, gathered with the reporting prototype, is analyzed.

In the 7th chapter a suggestion for how a procedure for the CARS could be designed, is made.

The 8th chapter consists of the discussion with corresponding conclusions. Overlaps between the CARS and existing accident reporting structures at Tetra Pak are included in the chapter as well as my thoughts about the reporting system and the H&S survey. In the last part of the chapter it is suggested how the system could be used and further developed.

2. Background

This master's thesis was written with the aim to give a proposal for how to design a Health & Safety reporting prototype that can be used at Tetra Pak. To enable the reader to understand the needs and the constraints at Tetra Pak, this chapter describes Tetra Pak and their current Health & Safety efforts. The information in this chapter was gathered through electronically sources, interviews and written material.

2.1 The history of Tetra Pak

Leander (1995) stated that Tetra Pak was founded in Lund 1951, by Ruben Rausing and Erik Wallenberg, as a subsidiary to the packaging company Åkerlund & Rausing. One year later the first packaging system, for production of the tetrahedron-shaped carton Tetra Classic, was delivered to a Swedish dairy. In 1954 Tetra Pak sold their first machine to a foreign customer. In 1961 the first aseptic filling machine, for bacteria-free milk, was introduced. Today most of the packaging systems at Tetra Pak are also available in aseptic versions. The Tetra Brik package system was introduced in 1963. The carton had a rectangular shape and a large number of openings could be attached. Since the early 1990's Tetra Pak is also offering food processing equipment. Nowadays Tetra Pak offers packaging materials and packaging machines for 10 packaging systems. However, they are still producing traditional systems like Tetra Classic Aseptic and Tetra Brik.

Tetra Pak Group stated on their homepage that they, in 2006, had about 20 000 employees. Their net sales were 8533 million Euros. Tetra Pak is present in more than 165 countries.

2.2 Tetra Laval Group

In 1991 Tetra Pak acquired Alfa-Laval and two years later the industry group Tetra Laval was founded. After the acquisition Tetra Laval was, according to their homepage, one of the largest suppliers of equipment and packaging material, to the food and processing industries, in the world. Although Tetra Pak sold big parts of the former Alfa Laval in 2002, the entity De Laval remained in the Tetra Laval Group. De Laval stated on their homepage that they are mainly producing equipment for milk production. In 2005 also the Sidel group was bought. This company is, according to their homepage, producing packaging equipment and materials for glass bottles, plastic and drink cans.

Today Tetra Laval Group consists of these three independent industry groups, see Figure 2.1 for Tetra Laval Group's organization chart. Tetra Laval Group has, according to their homepage, altogether more than 30 000 employees and they had in 2006 10 562 million euros in net sales. Tetra Pak is the biggest company in the group, with about 65 % of the employees and about 80% of the net sales.

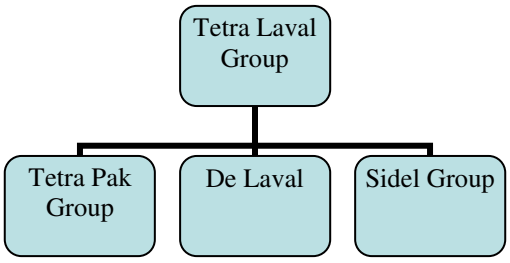


Figure 2.1. Organization chart for Tetra Laval Group

2.3 Mission and vision

On their homepage, Tetra Pak stated that they have the following vision:
"We commit to making food safe and available, everywhere"

Tetra Pak complemented their vision with the following mission
"We work for and with our customers to provide preferred processing and packaging solutions for food.

We apply our commitment to innovation, our understanding of consumer needs and our relationships with suppliers to deliver these solutions, wherever and whenever food is consumed.

We believe in responsible industry leadership, creating profitable growth in harmony with environmental sustainability and good corporate citizenship"

2.4 Tetra Pak Group's organization

According to Tetra Pak (2007), they are structured in a matrix organization, see Figure 2.2. The upper blue box, in the figure, includes the business strategy and development functions, which can be divided in two parts; Tetra Pak Processing Solutions and Tetra Pak Packaging Solutions. The latter can be subdivided into Commercial Operations, Development and Engineering and Supply Chain Operations. Commercial Operations is working strategically and complements the operative sales function in the market companies in the clusters. The other entities are different types of production sites. These entities are potential users of the CARS and will therefore be described more in detail in Section 2.4.1-2.4.3.

The clusters are Tetra Pak's geographical structuring of their activities; there are 11 clusters. A number of market companies are operating in each cluster. The market companies are operatively responsible for sales and technical service in one specific

country or in a bigger region. In 2007 Tetra Pak had 48 market companies and 68 sales offices spread around the world. These parts of the organization have most of the contact with Tetra Pak's customers. The entity Technical Service stated on their homepage that the majority of their employees, 1600 of 3000, are working as Field Service Engineers (FSEs). They are mainly performing their work at Tetra Pak's customers' sites; installing, starting-up and maintaining units delivered from Tetra Pak Packaging Solutions or Tetra Pak Processing Solutions.

The Corporate Functions are more centralized staff functions that are supporting the business strategy and development activities with specialized competences in Human Resources, Legal and Tax, Finance and Business Transformation and Corporate Communications.

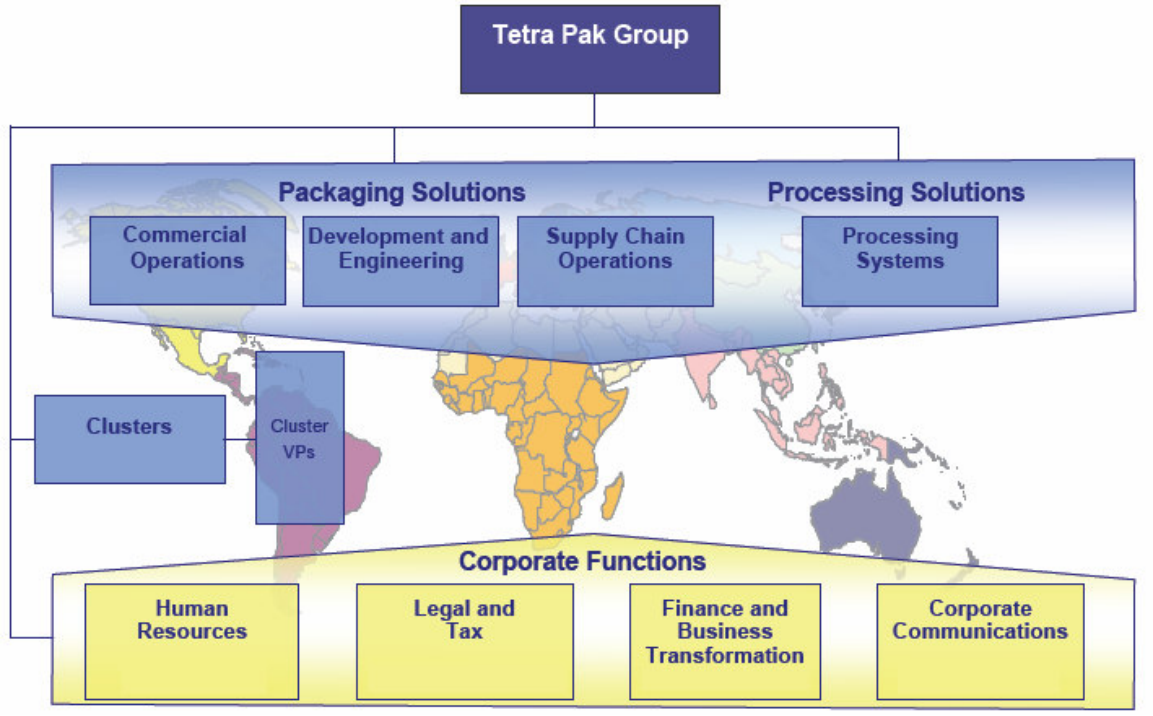


Figure 2.2. The organization chart of Tetra Pak Group

2.4.1 Tetra Pak Development & Engineering

Tetra Pak Development & Engineering (D&E) is responsible for the development and the testing of filling- and packaging machines. They are also executing Packaging platform plans. Tetra Pak D&E has the mission to maintain the machines over their life cycle, meaning that they also do maintenance work at Tetra Pak's customers' sites together with the local FSEs. Tetra Pak D&E has testing facilities in Lund and in Modena, Italy. They will be called "Equipment Manufacturing site (Packaging)" in the reporting prototype, which can be found in Appendix 2. Tetra Pak D&E has about 1500 employees. As stated on Tetra Pak's homepage, Tetra Pak D&E delivered 664 packaging machines during 2006 and altogether 8793 machines were running at customers' sites in 2007.

2.4.2 Supply Chain Operations

This operating unit is responsible for providing Supply Management expertise and to ensure consistent Supply Management strategies to all parts of Tetra Pak. In order to do this the Supply Chain Operations (SCO) develops and executes supply chain strategies for all types of material and capital equipment.

The biggest part of SCO is the Converting factories. These factories are producing packaging materials. According to Tetra Pak Converting (2007), there were 37 active production facilities in November 2007, which were spread all over the world. As stated on Tetra Pak's homepage, packaging materials for 129 725 thousand packages were produced at Tetra Pak Converting's sites during 2006. SCO is also assembling the filling and packaging machines. This is done in Lund and in Modena. These sites will be referred to as "Equipment Manufacturing site (Packaging), Capital Equipment" in the reporting prototype. Supply Chain Operations, including the Converting factories, has about 6900 employees, and is in this aspect the biggest part of Tetra Pak.

2.4.3 Tetra Pak Processing Systems

Tetra Pak Processing Systems (2007) stated that they are developing and producing process equipment. Their products can be divided into five core categories; Dairy, Cheese, Ice Cream, Prepared Food and Beverage. The biggest sector is Dairy; about half of the sales were in 2006 generated there. Tetra Pak Processing Systems (TPPS) has about 3500 employees and is in this aspect much smaller than Tetra Pak Packaging Solutions. TPPS has 19 core units and their production facilities are located at 11 sites. TPPS are called "Equipment Manufacturing site (Processing)" in the reporting prototype. Although it is much more compromised, TPPS has a similar structure as Tetra Pak Packaging Solutions with Technical Service and Development & Engineering. As stated on Tetra Pak's homepage, TPPS delivered 2137 Processing units during 2006 and in 2007, there were 25 950 units in operation at Tetra Pak's customers' sites.

2.5 The Central Occupational Safety & Health Committee

Ekman (2006) stated that the Central Occupational Safety & Health Committee (COSHC) is a specialized function, working with policies and follow-ups regarding work environmental issues. This function was, according to the interviewed Industrial Safety Engineer, founded to be able to maintain a high work environmental standard after a major conversion, into independent subsidiary companies, was made at Tetra Pak Sweden. COSHC serves all Tetra Pak's entities, which are situated in Sweden. The organization is advisory, since the responsibility for the work environmental in Sweden lies within the line organization in each local company.

2.6 World Class Manufacturing

The Operations Director at Tetra Pak Dairy & Beverage Systems AB stated that World Class Manufacturing (WCM) is a production philosophy that was derived from Toyota

Production System and from lean production. The WCM is also the used methodology to audit the implementation of lean production at Tetra Pak's sites. Lean production has the goal to minimize all kinds of losses and to continuously improve all performances. Although the framework is on corporate level, it is mainly being used at Tetra Pak Converting. WCM is built up by a large number of functional Pillars; e.g. Cost Pillar, Logistic Pillar and Safety Pillar. According to the interviewed Safety Master Pillar Leader, all Pillars have Key Performance Indicators (KPIs) which are specified metrics, used for a fast and continuous evaluation of the Pillars.

Each factory also has a WCM Leader, who is responsible for the WCM efforts at its site. Every factory can do its own prioritizing, regarding which Pillars they want to implement and in which sequence. WCM is preferably gradually implemented. Usually the implementation of all the requested Pillars takes many years. The WCM champions are, at least yearly, auditing all implemented Pillars in every Converting factory, in order to assess the Pillars and visualize areas of improvements to the management.

2.7 The Health & Safety Management Systems at Tetra Pak Converting

In 2000, the work with harmonizing the Health and Safety Management Systems (H&S MSs) within Tetra Pak Brazil was started. This project was the first one with the aim to harmonize the H&S MSs within Tetra Pak Converting. The Safety Master Pillar Leader stated that this was done through the creation of the first Safety Pillars. Nowadays, the ultimate aim with the project, which now is on a global level, is to implement a uniform H&S MS in all of the Tetra Pak Converting factories. This should be done by receiving Health and Safety Assessment Series (OHSAS) 18001 certificates at all Tetra Pak Converting sites before the end of 2010. Tetra Pak Converting has set an ambition to have zero accidents. The intended route to reach the OHSAS 18001 standards is described in Figure 2.3.

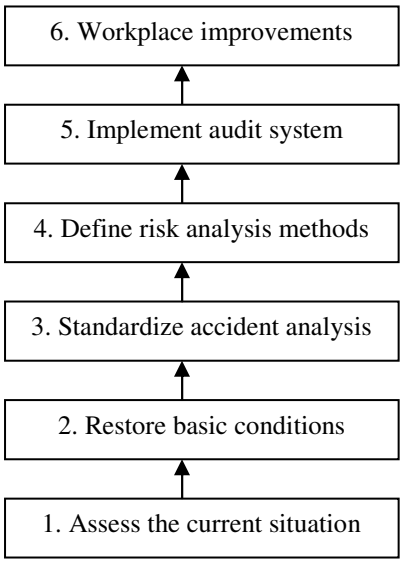


Figure 2.3. The route to implement an H&S MS at Tetra Pak Converting

2.7.1 The Safety Pillars and the Safety Master Pillar

For the coordination of the work between the Safety Pillars at the Tetra Pak Converting sites, there is a Safety Master Pillar (SMP). When this master's thesis was written in 2007, Edson Minawa was the leader of this group. The SMP creates, selects and implements Best Practices. The SMP is established to fulfill a need of standardizing and harmonizing the used H&S tools at Tetra Pak Converting. According to the SMP Leader, they have the responsibility to provide the factories with materials and safety tools that made it possible for them to meet the requirements that are needed for the OHSAS certificate. There is one Local Safety Pillar Leader in every factory that has implemented the Safety Pillar. The Local Safety Pillar Leaders are responsible for using the tools and for preparing the H&S MS at their site for the WCM audits. The audits are also a way for the SMP to identify the Converting factories with H&S MS with high potential of improvements and to assist these factories more in the future. Accident Frequency Rate (AFR) is chosen as the only KPI for the Safety Pillar. The SMP Leader argued that the advantages of this indicator are that it is a relative measurement that can be used for internal and external Benchmarking. Tetra Pak Converting has only one KPI within H&S, since they are still in an initial phase of harmonizing their H&S efforts. Additional KPI for the Safety Pillar will probably be implemented. The SMP shares the tools, developed within the H&S MSs on site-level, in Safety Process Kaizen Engineerings (PKEs), to all the Local Safety Pillar Leaders. The purpose of the Safety PKEs is to educate these people further in H&S and to secure that all factories are using the selected Best Practices and Standards. The SMP Members are responsible for supporting the implementation and the rollout of the Best Practices to the Local Safety Pillar Leaders. Each SMP Member also has responsibility for a specific H&S field. To secure the top management commitment and that sufficient resources are allocated and to give strategic directions, the SMP also has a Sponsor in the top management. In Figure 2.4, the SMP's virtual organization is described.

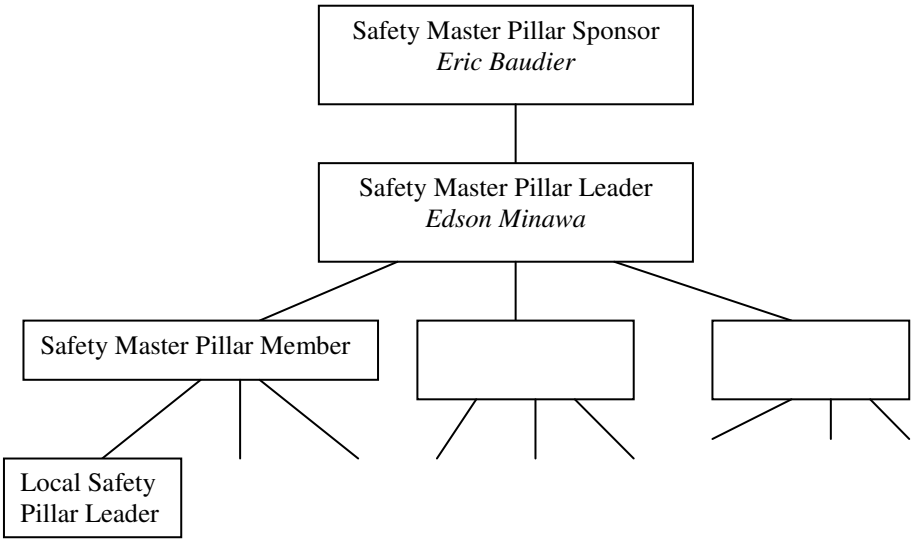


Figure 2.4. Safety Master Pillar virtual organization at Tetra Pak Converting

According to the SMP Leader, the following actions take place, when a serious or extraordinary accident has occurred at a Converting site:

- Taking care of the injured persons;
- Internal information to HRM and to the Cluster Management. This information should be spread maximum 24 hours after the accident. The purpose is to enable these departments to handle later external requirements;
- The Local Safety Pillar Leader shall inform his SMP Member through the Global Accident Report (GAR).

2.7.3 Tools spread by the Safety Master Pillar

There are a number of Best Practices that are spread by the SMP. The SMP uses the WCM Knowledge Center to spread these Best Practices. WCM Knowledge Center is a database, where everyone can get access to every relevant, within Tetra Pak Converting existing method to make H&S improvements. Below two, for this master's thesis, relevant H&S tools are listed.

- *The GAR* was initiated by the SMP in 2005 and was implemented in the beginning of 2007. It is mandatory for the Local Safety Pillar Leaders to send information about serious and extraordinary accidents that have happened at their site. Information about the accidents together with corresponding Root Causes Analysis (RCA) and countermeasures are monthly consolidated in an Excel-sheet. The GAR is a part of the first step in the safety route, which is described in Figure 2.3. The SMP Leader stated that the purpose of the tool is to spread information about the accidents and countermeasures between all Tetra Pak Converting sites and to raise the awareness of H&S-related issues. This information is spread via WCM Knowledge Center and e-mail. In the period January 2007 to July 2007, Minawa (2007b) stated that 8 serious and 1 extraordinary accidents were reported in the system. The GAR had problems with a low willingness to report. The SMP Leader argued that this was mainly due to the high turnover rate of the Local Safety Pillar Leaders.

- *PODAR* is a proactive safety tool, provided by the SMP. The idea is to involve everyone in the safety work by changing Tetra Pak Converting's employees' attitudes against H&S issues. This should be done through education and practical training in H&S. This will, according to Almeida (2007b), give as a result that unsafe acts, unsafe conditions and near misses will be identified and reported to a larger extent. Once these events are known, corrective actions can be taken. If adequate corrective actions have been taken, a personnel safety event, with the same set of root causes, will not reoccur. According to the Safety Iceberg assumption a decrease of the near misses will result in a decrease of the accidents. For the steps in the PODAR, look at Figure 2.5. PODAR works with the principle of continuous work environmental improvements.

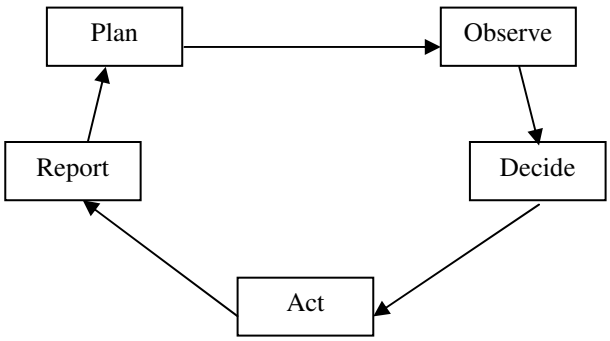


Figure 2.5. The steps in the PODAR

2.7.4 Accident reporting within the World Class Manufacturing framework

The KPI-Guidelines (2007) settles and defines KPIs within all functions of Tetra Pak Converting. The WCM Leaders in every Converting factory are responsible for reporting the data needed to calculate the KPIs. To calculate the AFR, information about the number of serious and extraordinary accidents and the total exposure hours is needed. It is therefore mandatory for the WCM Leaders to report the serious and extraordinary accidents that have occurred at their site. According to Dahl (2007), 45 serious and 1 extraordinary accidents were reported in the period January 2007 to July 2007.

2.8 The Health & Safety work at Tetra Pak Processing within the World Class Manufacturing

Tetra Pak Processing Systems (TPPS) does not have the same virtual organization, with Master Pillars who are transferring Best Practices to the Local Pillars, as Tetra Pak Converting. The Operations Director at Tetra Pak Dairy & Beverage Systems AB explained that the main reason is that the Tetra Pak Converting sites are much more similar to each other, compared to the TPPS sites. Furthermore, TPPS has fewer sites and just some of them have started to implement the WCM. However, TPPS has Global Pillars serving the same purpose as the Master Pillars. The Global Pillars will only be introduced for those Pillars that are implemented in most of the TPPS' sites and presumably not for Safety.

2.9 Dow Chemical Company - External benchmarking partner

Dow Chemical Company's production facility in Stade, Germany was chosen to be the external Benchmarking partner in the master's thesis. This section aims at briefly introducing the reader to Dow and to their production site in Stade.

Dow is a diversified company that operates in many industries. Nettersheim (2007) stated in our interview that Dow has a broad product spectrum that can be divided into plastics, chemical and agricultural products. Dow is an international company, with about 200 production facilities and about 43 000 employees. Dow has bundled their H&S function with the Environment function. This will be referred to as EH&S. The main reason for the bundling is that an environmental event, at Dow, is also likely to result in a personnel safety event.

Dow's production site in Stade, Germany has about 1500 employees and is producing chemical substances like chlorine, polycarbonate and hydrogen.

3. Literature background

This chapter was written with the aim to provide the master's thesis with useful definitions, as well as relevant theory, e.g. within the areas: Health & Safety Management Systems, personnel safety event reporting as a method to reduce accidents, safety culture and accident causation.

3.1 Definitions

In this section commonly used expressions in the master's thesis will be defined and clarified.

3.1.1 Accident

Although there is not any world-wide accepted definition of an *accident*, most of the definitions are similar to each other. The classification society Det Norske Veritas (1999) used the following definition of an accident:
"An undesired event which results in harm to people, damage to property, loss of process and / or harm to the environment. The result of an accident is loss"

This definition will also be used in this master's thesis. But since this master's thesis is focusing on personnel, work-related safety events; accidents will be understood as any undesired event that is causing harm to people.

3.1.2 Near miss

A *near miss* is in most literature defined as an undesired event, but without any, or with limited, consequences. Some authors used instead the word incident for this purpose. Jacobson (1998) defined near misses as:
"Events without the consequences of an accident but which, under other circumstances or left to continue, may have developed into accidents"

This definition will also be used in this master's thesis.

A major near miss will be defined as:
"Events without the consequences of an accident but which, under other circumstances or left to continue, may have developed into an accident that would have resulted in more than one lost working day"

3.1.3 Personnel Safety Event

Personnel Safety Events will, in this master's thesis, be used as a concept, which includes accidents and near-misses.

3.1.4 Root causes

Jones et al. (1999) defined the root causes of a personnel safety event as the factors that allow the direct causes of the event to occur. The direct causes are the immediate reason why a personnel safety event occurs. If the root causes of the personnel safety event are removed, a near miss or an accident, with the same set of root causes, will not reoccur.

3.1.5 Corporate Level

Whenever the expression *"on corporate level"* is used in this master's thesis, it is meant as the Tetra Pak Group level. Section 2.4 describes Tetra Pak Group and its entities.

3.1.6 Response rate

The response rate will be defined as in Formula 3.1:

$$\text{Response rate} = \frac{\text{The number of respondents who have submitted reports}}{\text{The total number of potential respondents}} \qquad (3.1)$$

3.2 Existing classification of accidents

This section starts with describing within Tetra Pak existing classification systems of personnel safety events, as well as how a Best Practice company has classified their accidents. Thereafter, a decision on how to classify accidents in this master's thesis is made.

3.2.1 Internal classification system at Tetra Pak

A within Tetra Pak existing classification system of accidents was made in the KPI Guidelines (2007) and is used at Tetra Pak Converting. This system will be referred to as System A. *Total Accidents* are defined as any injury that occurs at the workplace. The term can, depending on the actual severity of the accidents, be subdivided into 3 groups:

*Minor Accidents***:** Injuries that can be treated on site or that do not require medical advice / attention or loss of time less than 1 working day, e.g. minor cuts, bruises, contusions, scrapes, temporary dizziness and nausea.

Serious Accidents: Injuries that cannot be treated on site or that require medical advice / treatment or loss of time amounting to more than 1 working day. Examples of serious accidents are cuts requiring sutures, broken bones and fractures.

Extraordinary Accidents: Any injury causing death, loss of a body part or total or partial disability. Injuries included in this group could be loss of fingers or hands, injuries of such a nature that the employee will never be able to perform her / his regular job function again or will not be able to perform her / his regular job without additional aid.

Another classification of accidents is made by the group at Tetra Pak Development & Engineering, who is developing a reporting system for any accidents caused by equipment or packages that are produced by Tetra Pak; for further details about the project, see Section 5.1.6. The classification system will be referred to as System B and the project will be referred to as Project B. According to Larsson (2007a), the classification is done immediately after an accident has occurred, in order to assess their required involvement level and to determine who is going to be informed about the accident. The events are categorized with a classification tool that consists of about 15 yes-or-no-questions. System B can be used for many types of undesired events and the classification is not only depending on the actual severity of the safety event. The questions are either related to the facts and the consequences of the accident or to the business and customer impact of the accident. Depending on how the questions were answered, the event will be classified in one of the three following levels:

- *Incident level*
- *Emergency level*
- *Crisis level*

3.2.2 External classification system

According to Nettersheim (2007), Dow is using the following terms to classify their personnel safety events:

- *Incidents that require medical treatment.* (The individual can, immediately after the medical treatment, perform more than 95 % of her / his normal work tasks.)
- *Restricted working case.* (The individual is not able to perform, immediately after the medical treatment, 95 % of her / his normal work tasks.)
- *Accidents resulting in minimum one lost working day.* (Equivalent to a serious accident in System A.)
- *Fatalities.* (An accident at work causing death.)

3.2.3 The chosen classification system

During the interviews, many of the interviewees stressed the importance of using an objective within Tetra Pak already existing and frequently used accident classification system. During the investigation of such systems two realistic alternatives became visible; System A and System B. The following two major differences between the systems were identified:

- There are different purposes of the systems. System B has the purpose to determine to which level of the organization the accident investigations need to be escalated. The classification procedure is quite time-consuming and the user needs to have much information about the event and its consequences. System A is easy for everyone to use and the classification can easily be done by any Tetra Pak employee. The purpose is to inform the Local Safety Pillar Leader about the occurred accidents.
- System A is only used to classify personnel safety events and takes only the actual severity of the accidents into consideration. System B is used to classify many

types of undesired events. This classification depends on a number of variables and not just the actual severity of the accidents.

It was chosen that System A should be used to classify the accidents in this master's thesis. The main advantages of this system are that it is fast and easy to use. One of the aims with the CARS, just like in System A, is to only classify personnel safety events. Therefore, variables that are not related to the severity of the accidents would in my opinion only increase the complexity. Hence, using System A is a basic condition to be able to use the AFR. The interviewees were in the feedback interviews asked about their opinions regarding using System A; everyone thought that this was a good solution. A risk of using System A is that two different classification systems will be used when a FSE gets injured at a Customer site. Another advantage with using System B is that it is more precisely, since it, for instance, also takes the potential severity of the personnel safety events into consideration.

3.3 Reporting system

Persson (1998) made a survey on existing personnel safety event reporting systems. A universal near miss and accident reporting system that fits the needs of every user in every organization does probably not exist. However, the following structure was found to be common for all systems:

- Many reporting units;
- An administrative and analyzing unit that receives, files and analyzes the personnel safety event reports;
- A central database where the reports, the procedure for the reporting and system analyses are stored.

3.4 Health and Safety Management Systems

An H&S Management system (MS) is an organization's formal way of guaranteeing a high standard within H&S. This includes the organizational structure, planning of activities and securing of resources for developing, achieving and reviewing the H&S aims. The purpose of implementing these kinds of systems is, according to Det Norske Veritas (1999), to identify, assess and control the H&S risks that the employees are being exposed to. It is also used in order to assure itself and external stakeholders like authorities that the operations correspond with the company's H&S policy and the work environmental legislation. Akselsson (2007) stated that some of the following components could be included in an H&S MS:

- An H&S policy that meets legal requirements and Best Practice. It is important that the policy is continuously revised;
- Procedures regulating the structures and the responsibilities within H&S;
- The handling and the investigation of personnel safety events;
- An accident and near miss reporting system;
- Communication and documentation of H&S issues;
- Training programs and education.

3.4.1 OHSAS 18001

A company can choose whether they want to certify their H&S MS. Mårtensson et al. (2005) stated that OHSAS 18001 was developed by a number of standardizing and certification associations, with the purpose of creating one international standard for H&S MSs. It can be used in all types of businesses. Zeng et al. (2007) stated that OHSAS 18001 aims at creating and maintaining a safe work environment by continuously improve the H&S MSs. Det Norske Veritas (1999) stated that OHSAS 18001 has given requirements in many areas, which the companies must reach in order to get their H&S MS certified. However, there are not any detailed specifications on how to design the H&S MS. OHSAS 18002 is guidance for how to implement the standard. According to the SMP Leader, three Converting factories had an OHSAS 18001 certified H&S MS in October 2007. OHSAS is fully compatible with the Quality Management System ISO 9000 and the Environmental Management System ISO 14000. Two Converting factories have certified integrated MSs, which include ISO 9000, ISO 14000 and OHSAS 18001. An organization can, according to Bureau Veritas Certification (2007), gain the following advantages if they certify their H&S MS:

- A reduce of costs, since proactive efforts are cheaper than reactive ones;
- Less lost working time, which results in increasing productivity and employee satisfaction;
- Better corporate image;
- A systemized method to continuously improve the work environmental conditions.

3.5 Measurements within Health & Safety

This section describes purposes of performing H&S measurements and the potential problems by only using reactive Performance Indicators (PIs).

3.5.1 Purposes of measuring Health & Safety performance

The Health & Safety Executive (2001) stated that the primary reason for measuring the H&S performance is to meet an organization's internal needs. Ljungberg et al. (2001) stressed that the purpose with measuring is not to create diagrams, but to provide knowledge. The same study found the following general purposes and advantages with H&S measurements:

- Detect patterns in the occurrence and the severity of the accidents. This leads to the result that the areas with the biggest needs of improvements can be found;
- If measurements within H&S on corporate level are introduced, these questions will have a bigger focus in the future. This will lead to an increased awareness of H&S issues;
- Measuring enables internal and external Benchmarking;
- You cannot manage what you cannot measure. Therefore, the Health & Safety Executive stated that measuring H&S performance is a basic condition for efficient H&S MSs;
- Measuring harmonizes the definitions of specific terms between the entities in a company;

- Measuring provides arguments for changes and is a basic condition for continuous improvements within H&S.

3.5.2 Problems with only using injury statistics to measure Health & Safety

A common feature of measurements, in most areas, is that they measure something positive like Return on Investments or market share. However, within H&S, there are often negative measures like injury and failure rates. Health & Safety Executive (2001) stated that within H&S, the absence of reports is often seen as a success; in most areas it is the other way around. It is further stated that many different measures are needed within H&S, in order to provide a differentiated picture of the performance. Due to the following risks with only using reactive PIs to measure the H&S performance, the Health & Safety Executive proposed to also introduce proactive PIs:

- Injury rates do not reflect the potential severity of the personnel safety events, but only the actual consequences;
- The number of lost working days does not fully reflect the severity of a personnel safety event;
- If the statistics are related to reward systems, there is a major risk that personnel safety events are not reported, in order to record a successful performance;
- The relationship between low accident rates and a high level of control of the major accident hazards is not proven.

The needed information to calculate the proactive indicators should be easy to gather and they should reflect something positive. Activities for reduction of accidents, like the number of training courses and the number of inspections are suggested as possible proactive PIs.

3.6 Performance indicators within Health & Safety

To be able to measure, it is necessary to have some kinds of indicators. The Health & Safety Executive (2001) stated that an adequate PI, within Health & Safety, should provide information for answering some of the following questions:

- How is the current situation compared to the company's aims?
- How does the company score in an external Benchmarking?
- How is the development over time, within H&S? What are the reasons for this development?

It is important to calculate the PIs not only on a corporate level. If it is also done on site-level, a more covering and differentiated picture of the H&S performance will be provided.

3.6.1 Accident Frequency Rate

Tetra Pak Converting is the only part of Tetra Pak that is using an indicator to measure their H&S performance. Their KPI Accident Frequency Rate (AFR) was established in 2007. The purpose with introducing the indicator was to visualize to which extent the taken corrective actions have resulted in improved work environmental conditions.

According to the KPI Guidelines (2007), the AFR is defined as in Formula 3.2; note that minor accidents are not included in the measure.

$$AFR = \frac{(\eta_e + \eta_s) * 1000000}{t} \tag{3.2}$$

Where

η_e is the total number of extraordinary accidents that have occurred during the last 12 months;

η_s is the total number of serious accidents that have occurred during the last 12 months;

t is the total exposure hours during the last 12 months.

3.6.2 The Injury and Illness Severity Rate

In Dow's Progress Report (2007) it was stated that Dow has many PIs, for measuring how their situation within EH&S is developing. Within the personnel safety area, Dow has two indicators. Goering (2007) stated that the Injury and Illness Rate counts all near misses and accidents that have occurred at Dow. Although the measure also includes less severe safety events, this indicator is comparable with the AFR. Dow has set goals for all their PIs. As for the Injury and Illness Rate the goal is to reduce the size of this indicator, from 2005 until 2015, with 75%.

According to Nettersheim (2007), the Injury and Illness Severity Rate (IISR) is the second key indicator and it is defined as in Formula 3.3. This indicator is principally different from the AFR since it weights the personnel safety events depending on their actual severity.

$$IISR = \frac{(\eta_m + 3 * \eta_r + 9 * \eta_o + 27 * n_f) * 200000}{t} \tag{3.3}$$

Where

η_m is the total number of times when medical treatment has been needed;

η_r is the total number of restricted working cases;

η_o is the total number of accidents that have resulted in minimum one lost working day;

η_f is the total number of fatalities;

t is the total exposure hours.

If the same PI would be used in this master's thesis, the measure would have needed some modification in order to suit the in Section 3.2.3 chosen classification system. Formula 3.4 shows the principal design of the modified PI that can be used at Tetra Pak; it will be referred to as Accident Severity Rate (ASR).

$$ASR = \frac{(k_1 * \eta_e + k_2 * \eta_s) * 1000000}{t} \tag{3.4}$$

To complete Formula 3.4, it is necessary to determine the two coefficients k_1 and k_2. In Section 3.9.1 it is stated that according to the Safety Iceberg assumption, a serious accident happens ten times as often as an extraordinary accident. In order to have the

same incentives for reducing the number of extraordinary accidents as the number of serious accidents, the sum of the severity of the two types of accidents must be equal. Given that the proportions in the Safety Iceberg assumption are correct, k_1 needs to be 10 times bigger than k_2. With this argumentation, the following two coefficients are recommended:
$k_1 = 10;\ k_2 = 1$

3.7 Personnel safety event causation

In order for an accident or a near miss to occur, the danger needs to, according to Reason (1997), penetrate a defense-in-depth. The defense-in-depth is a number of barriers that prevent an accident from occurring, see Figure 3.1. One example could be a tool for reducing the source of the danger combined with physical barriers between the source and the target and Personal Protective Equipments (PPEs), to cover the target if the other defense functions fail.

According to Reason (1997), most of the personnel safety events are caused by an unsafe act together with local workplace factors and organizational factors, see the lower part of Figure 3.1 for their connection. The root causes of an accident can be found in all these groups. The accident causation chain starts with the organizational factors. This could for instance be a strategic decision regarding the planning and managing of different processes or the allocation of recourses. It is important to identify and eliminate the organizational factors, since they are causing the other types of failures. The consequences of the organizational factors become visible in the local workplace factors. These factors raise the risk for unsafe acts. Typical factors in this group are time pressure, inadequate tools and material, inadequate PPEs, insufficient training and education and poor communications. The local workplace factors together with the human nature of making faults create unsafe acts. An unsafe act is not a sufficient condition for an accident and far from all unsafe acts result in accidents. However, unsafe acts weaken the defense-in-depth. This could at a danger result in penetration of these barriers, which means that an accident is caused. An unsafe act could either be an error or a violation. Reason found that the different kinds of unsafe acts require different kinds of countermeasures.

Although unsafe acts contribute to cause most accidents, they are not necessary in order to cause an accident. Some accidents are caused when organizational- and local workforce factors together create latent conditions that weaken the defense-in-depth. This

scenario is also described by the red, dashed, arrow in Figure 3.1.

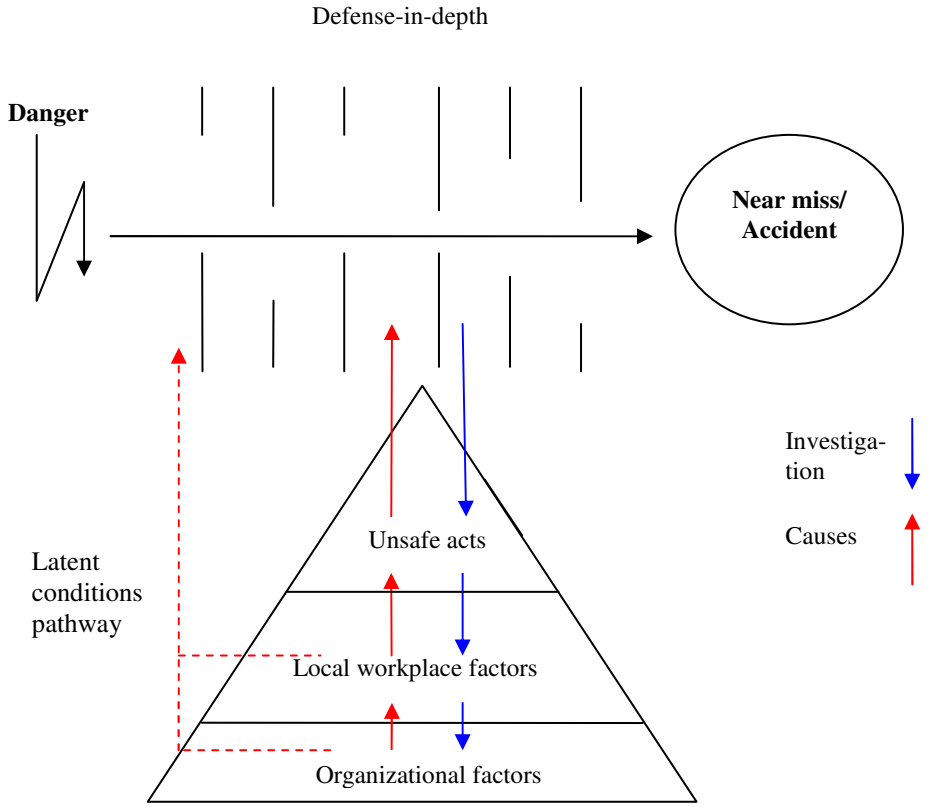


Figure 3.1. Accident and near miss causation model combined with the defense-in-depth

3.8 Root Causes Analysis

However, if a danger penetrates the defense-in-depth and an accident or a near miss occurs, it is important to do a Root Causes Analysis (RCA). According to Reason (1997), the RCA starts with investigating the unsafe acts and thereafter the local workplace factors. The last stage is to identify the organizational factors. The sequence is visualized by the blue arrows in Figure 3.1. Minawa (2007a) found the following purposes for doing an RCA:

- If the root causes of the personnel safety event are found and adequate corrective actions have been taken a personnel safety event, with the same set of root causes, will not reoccur;
- Establish a standardized accident investigation methodology;
- Meet legal requirements.

3.8.1 5-Whys method

According to the SMP Leader, the 5-Whys method is the recommended tool to use in order to perform an RCA at Tetra Pak Converting. As stated by iSixSigma (2007), the following steps are made when the method is used:

1. A complete description of the personnel safety event;
2. The investigator answers the question “Why did the event occur?”;

3. If the answer, retrieved in the second step, does not provide the root causes of the accident / the near miss, return to step 2;
4. The root causes of the personnel safety event have been found.

The question "Why did the accident occur" is asked until the root causes have been found. This does not necessarily have to be five times. iSixSigma further stated that the main advantage of the 5-Whys method is that it is an easy tool to use, because no statistical analyses are needed.

3.8.2 Categorization systems of root causes

The root causes of personnel safety events can be divided into many categories. This section describes two methods of categorizing the root causes. The General Failures Types (GTFs) were in a number of companies found after accident reports have been analyzed. The second categorization is used at Tetra Pak Converting. These two categorizations will be combined and, after major modifications, be used to categorize the root causes in this master's thesis. Nielsen et al. (2006) stated that 85% of all accidents are caused by unsafe acts and 15% of the accidents are caused by unsafe conditions.

3.8.2.1 General Failure Types

According to Reason (1997), near misses and accidents are consequences of GFTs, combined with local triggering factors. Of these two, only the GFTs are knowable and potentially corrected before they have caused personnel safety events. The GFTs were termed when Tripod Delta, a proactive error management tool that mainly is used by the oil exploration and the production industry, was developed. The following GFTs were found as the factors that most likely create conditions that promote unsafe acts and result in accidents:

- Hardware failures (quality and availability of tools and equipment);
- Design failures;
- Poor management of the maintenance;
- Poor procedures;
- Error-enforcing conditions;
- Poor housekeeping (a problem that has been present for a long time);
- Incompatible goals;
- Poor communications;
- Organizational deficiencies;
- Poor defenses (failures in warning systems and PPEs).

3.8.2.1 4M

The Local Safety Pillar Leader at Tetra Pak Converting in Lund stated that they are using the following 4Ms, to categorize their root causes:

- Machine;
- Man;
- Material;
- Method.

3.9 Personnel safety event reporting to reduce accidents

3.9.1 Two underlying assumptions

Nielsen et al. (2006) stated that the effectiveness of using personnel safety event reporting systems to reduce accidents is built on two basic assumptions.

The *Safety Iceberg assumption* was established after a massive investigation of accident and near miss reports. The assumption claims that there is a constant proportionality between the numbers of occurred personnel safety events in the categories that are given in Figure 3.2. If an organization has many near misses, there will also be a high accident frequency. It was found that the number of near misses, within an organization, is high in comparison to the number of actual accidents.

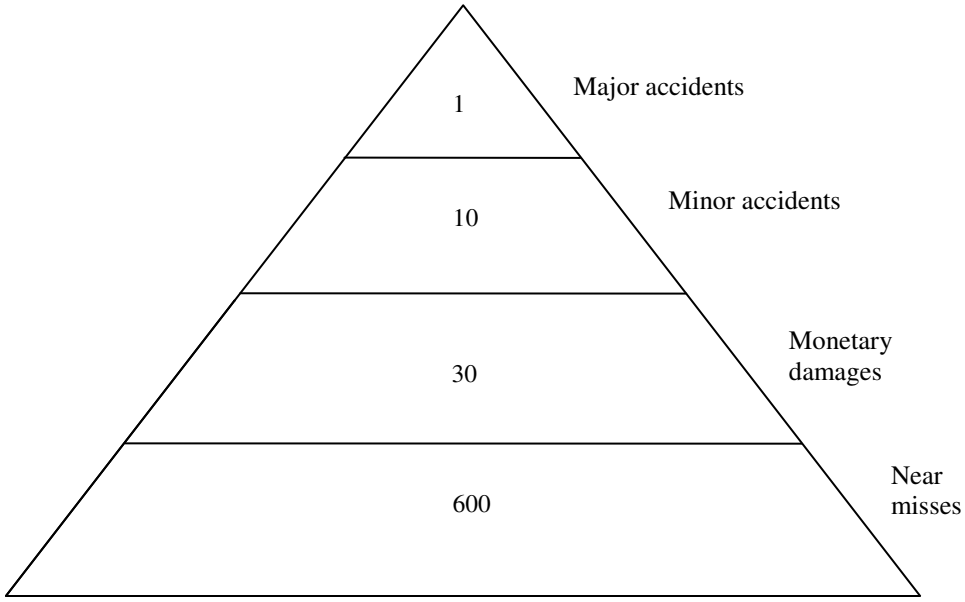


Figure 3.2. The proportions in the Safety Iceberg assumption

The second assumption is the *identical causation*. This assumption states that the large number of near misses has the same set of root causes as the accidents.

The first assumption is widely accepted, the second one has received some criticism.

3.9.2 Potential effects of implementing a reporting system

Once a near miss and accident reporting system is successfully implemented, Persson (1998) found that it could contribute to increased safety in the following ways:

- An accident reporting system can contribute to increased knowledge about how accidents occur and how future accidents can be avoided. In a study, made by Nielsen et al. (2006), a short term effect of the implementation of a reporting system was an increase of the AFR. This was probably a consequence of the

increased willingness to report. However, two years after the implementation the AFR was 50% lower than at the time of the implementation.
- The visualization of statistics and PIs, within H&S, can serve as an incentive for further H&S efforts.
- To spread information about deficiencies and taken corrective actions between similar entities.

3.9.3 A system's potential of using personnel safety event information to increase safety

An accident reporting system can be more or less capable of utilizing the potential advantages mentioned in Section 3.9.2. Persson (1998) identified a number of parameters that influenced the capability of these systems:

- The system's capability to react on hazards and deficiencies. The operator of the system has major influence on this parameter.
- To which extent the system operator can analyze the information in the gathered personnel safety events reports. The reliability of the conclusions drawn from the statistics is strongly positive correlated with the size of the database.
- The system's capability of distributing safety related information, e.g. feedback about the results from the analyses to the reporting unit and information about the hazards to the other reporting units.

3.10 Near miss reporting to reduce the accidents

According to the Safety Iceberg assumption, the number of near misses is high in proportion to the number of accidents. Therefore, the Safety Iceberg needs to be attacked from the bottom, in order to make an organization fast and efficiently learn from personnel safety events and to enable prevention of future accidents. An efficient method of decreasing the number of accidents is therefore to decrease the number of near misses, see Figure 3.3.

Jones et al. (1999) also justified this in a mathematical argumentation, derived from Formula 3.5.

$$\Phi_{real,a} = \sum_{n} \lambda_n * k_n \tag{3.5}$$

Where

$\Phi_{real,a}$ is the total number of accidents;

λ_k is the frequency of a near miss, type n;

k_n is the probability that a personnel safety event, type n, results in an accident.

Given that the Safety Iceberg assumption is correct, k_n are constants and cannot be changed. The only way to decrease $\Phi_{real,a}$, according to Formula 3.5, would then be to decrease the λ_k.

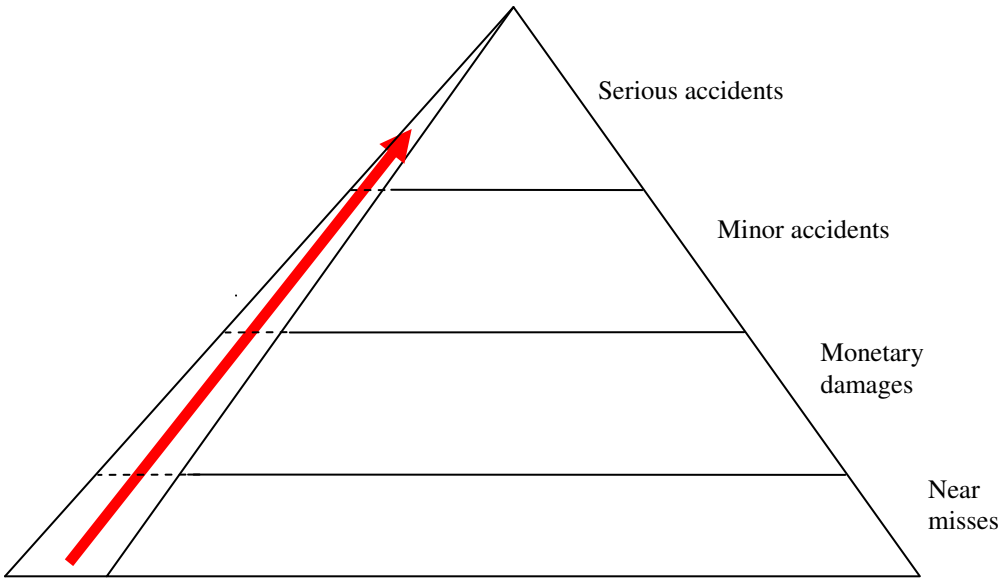


Figure 3.3. Decrease the number of accidents by decreasing the number of near misses

A basic condition for using near miss reporting as a method to decrease the number of accidents, is that the employees have a high willingness to report near misses; α in Formula 3.6. If the near misses are not reported, there will not be any organizational learning and the actual number of accidents will not decrease.

$$\Phi_{rep} = \Phi_{real} * \alpha \tag{3.6}$$

Where

Φ_{rep} is the total number of reported personnel safety events;

Φ_{real} is the actual number of occurred personnel safety events;

α is the share of the personnel safety events that are reported.

To stress that near miss reporting can be an efficient method to decrease the number of accidents and to further stimulate the reporting; Norsk Hydro has introduced the number of reported near misses as a PI in their H&S MS. A high number of reported near misses are positive, since Jones et al. (1999) found an inverse proportionality between the number of reported near misses and the actual number of accidents in a study of two Norsk Hydro's sites. Nielsen et al. (2006) found the same pattern in a Danish study.

3.11 Organizational Learning

Learning can only be done if a solution already exists. This means that discovering problems and inventing new solutions are a necessary, but not a sufficient condition, for learning. According to Koornneef (2000), the learning process is triggered respectively finished by the following two events:

- The learning process starts when a mismatch between the intentions and the outcomes is created and detected.
- The learning process ends when the organization achieves what it intended. That means that there is a match between the purposes of an operation and the outcomes.

Organizations do not perform the learning themselves. This is done by the employees in the organization; they are acting as agents for the organization. Organizational learning is made if the entire organization can learn from experiences gained by one employee. Organizational learning is always interplay between the individuals and the organization. Argyris (1999) stated that organizations can create conditions that influence the individuals when they are defining problems and designing solutions. Koornneef found the following components to be important, if an organization wants to catalyze the organizational learning, within H&S:

- A reporting system that enables the agents to report easy and efficiently;
- An H&S learning process that is catalyzed by an organizational inquiry agency;
- A database with personnel safety event reports.

3.11.1 Singe-loop- and Double-loop learning

Koornneef (2000) distinguished between individual Single-Loop Learning (SLL), organizational SLL and organizational Double-Loop Learning (DLL), see Figure 3.4. The organization must visualize that its employees benefit from the organizational learning, in order to motivate them to report mismatches.

- Individual SLL means that an individual has identified a mismatch and changes her / his actions in order to stop the reoccurrence of the error.
- To achieve organizational SLL it is necessary that the organization has learned to take the actions that are needed to prevent the same error in the future. This means that also other employees are able to perform the required actions. To make this work, it is necessary for the individuals to report the mismatches to an agency in the organization. The agency investigates the deviations and spreads information about adequate actions to the employees concerned.
- Organizational DLL takes place when a mismatch leads to a change of the governing variables. First thereafter, the corrective actions are executed. Argyris (1999) defined governing variables as states that the individuals try to achieve when they are acting. These variables can be changed by observing the actions of individuals acting as agents for the organization.

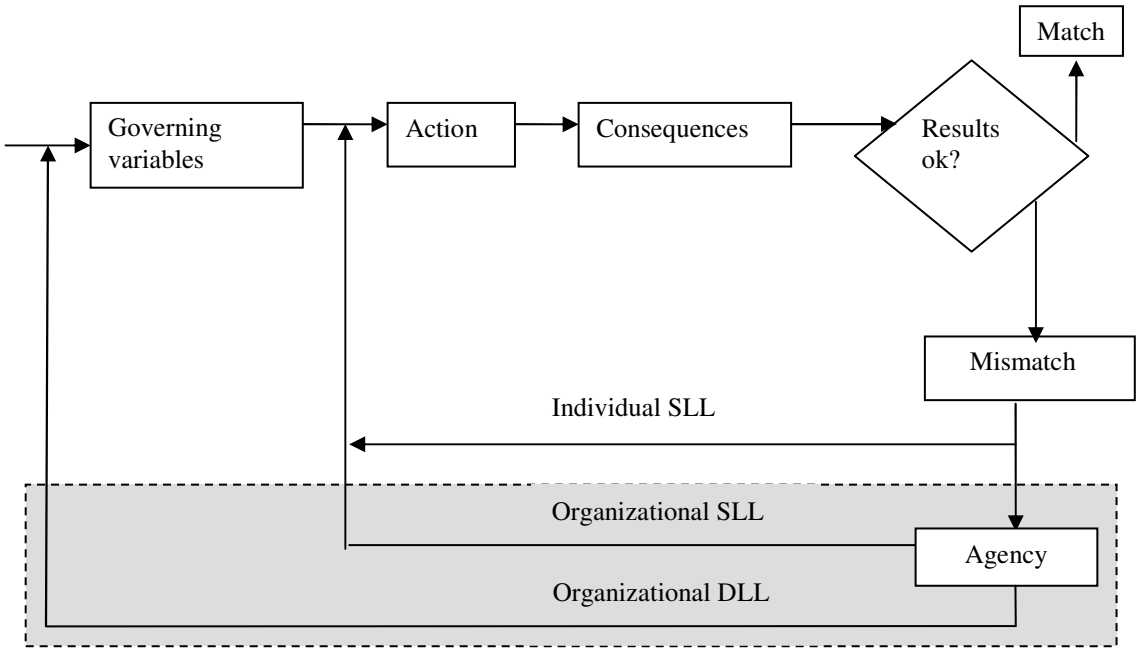


Figure 3.4. Single- and Double-loop learning

Argyris stated that both SLL and DLL are required in all organizations.

- SLL is best suited for easy routine tasks. It is needed to efficiently do the everyday job. According to Koorneef, SLL leads to an improvement of the organizational task performance.
- DLL is needed for complex problems, where individuals need to think out of the box. The double-loop actions determine the long term effectiveness of the organization. DLL are required to enable organizations to adapt to a fast changing environment.

To learn the solution of a relatively new problem, DLL is often needed. However, in the long term, it is necessary to transfer double-loop issues to single-loop issues, since these are more easily programmable and manageable.

3.11.2 Factors, influencing the establishing and running of a reporting system

Nielsen et al. (2006) made a study, where it was investigated what factors influenced the implementations of H&S reporting systems at two sites. Two factors were found to be most important for a successful implementation of reporting systems. The same factors were also stressed by Akselsson (2007) as critical factors when it comes to using a reporting system to catalyze the organizational learning. Figure 3.5 visualizes the problems in the learning process, when the following two factors are not satisfactory:

Top management commitment was found to be the single most important factor in order to change the employees' attitude to H&S-related issues and their behavior. Akselsson stated that a basic condition for a functioning organizational learning process is the top management commitment in all stages of the process.

Furthermore, the effectiveness of the reporting system is also highly depending on the *willingness,* among the employees, *to report* personnel safety events. Nielsen et al. found that the willingness to report personnel events is highly correlated with the severity of the events. The willingness to report serious accidents is much higher than the willingness, within the same organization, to report near misses. Nielsen et al. also studied how the willingness to report was influenced by the implementation of personnel safety event reporting systems. Two years after the implementations, it was found that the willingness to report had increased significantly compared to prior the implementations. Akselsson found that education in how to write reports is an efficient method for increasing the quality of the reports. The quantity of the submitted personnel safety event reports is highly depending on the reporting culture within the organization. Reason (1997) found that the following actions were important in order to secure that many near misses and accident reports, with high quality, are submitted:

- Do not punish the respondents unless she / he has been extremely culpable;
- De-identify the involved person's identity once the report is received;
- Make it easy to report;
- Secure a fast and useful feedback to the respondents;
- Separate the department that collects and analyses the reports from those that are imposing sanctions.

Provided that the agency is working according to the Plan-Do-Check-Act (PDCA) methodology, the framework in Figure 3.5 can be used to describe the learning process, from input to organizational learning. When the system analyses of a personnel safety event have been made, this information should be used as input in the PDCA cycle to improve the future H&S performance. Akselsson stated that this step, with feedback to the respondents and proposing corrective actions, is critical.

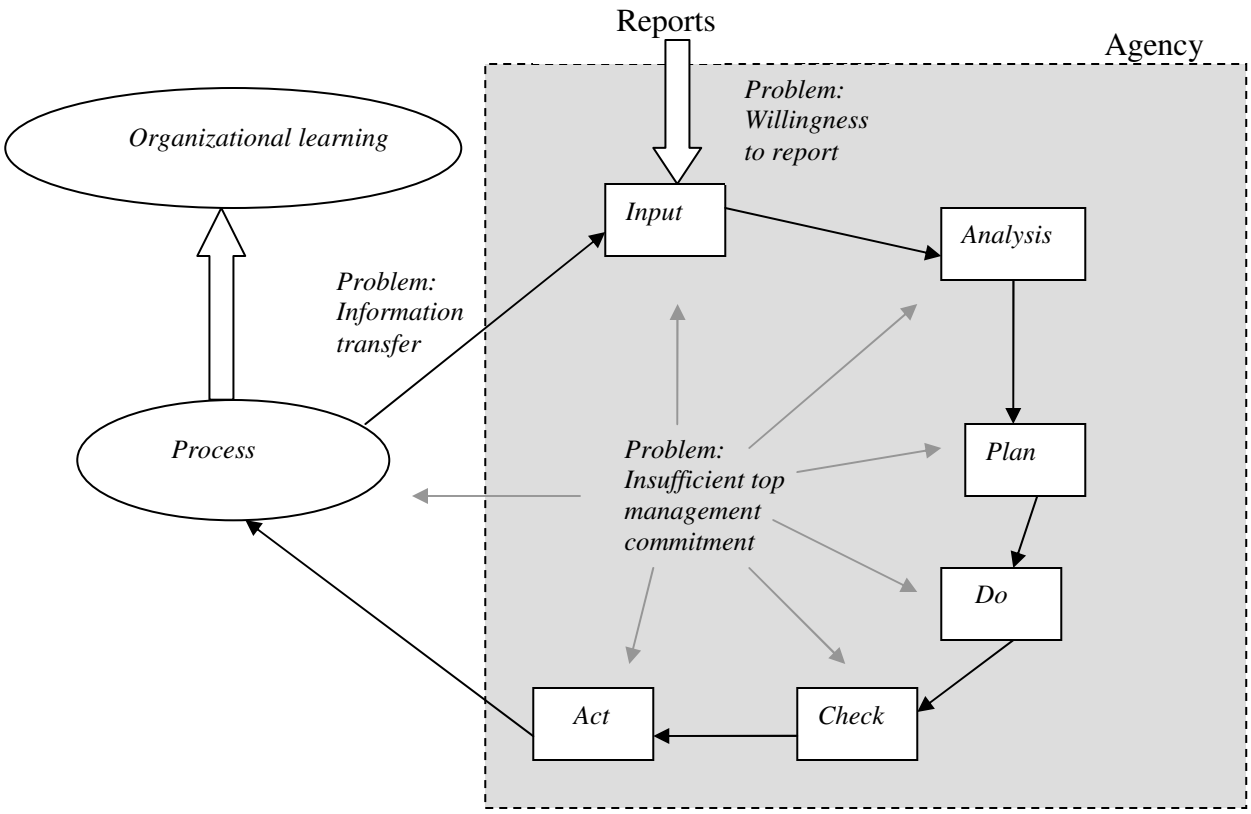


Figure 3.5. Framework for H&S learning processes and potential problems

3.12 Learning organization

Albinsson (1998) found some central aspects that frequently reappeared, when authors define a learning organization. A learning organization promotes and stresses both the individual and the organizational learning. The organization is seen as an open system and must handle a constantly changing environment. Furthermore, the learning is a continuous, always ongoing, process. Everyone's involvement in the learning process is also stressed in a learning organization. Thurbin (1994) argued that organizational learning is a basic condition for the existence of a learning organization. Albinsson also stressed the importance of rewarding learning, in order to encourage the employees to learn. Furthermore, it was found important that the management shows that the learning really results in improvements.

3.13 Goal Equivalence Model

Improved work environmental conditions and more effective and efficient production system are highly correlated. Akselsson (2007) designed the Goal Equivalence Model (GEM), with the purpose of visualizing the interplay between the conditions in the work environment and the efficiency and the effectiveness of the production system. See Figure 3.6, for the GEM-framework.

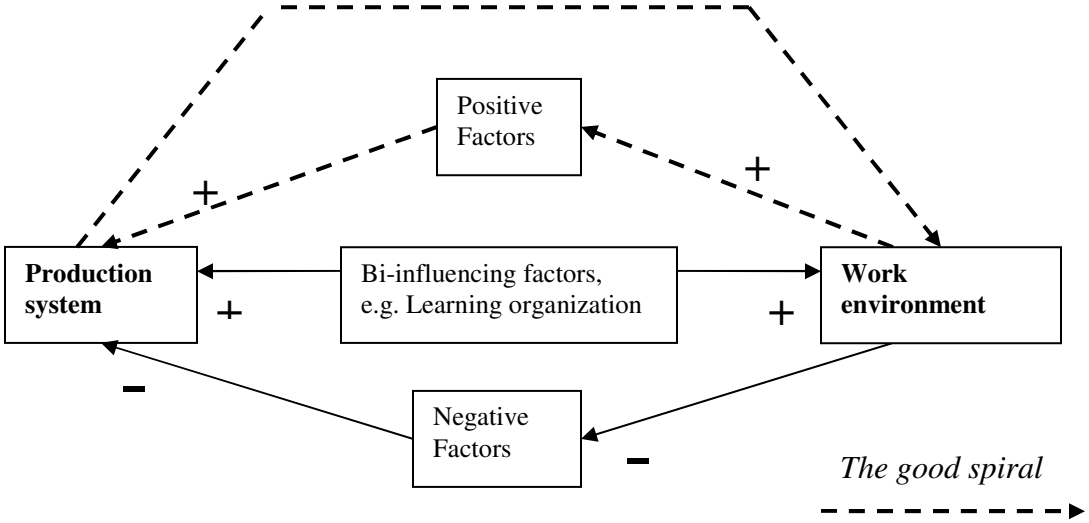


Figure3.6. The GEM-Model

Akselsson exemplified motivated, committed and competent employees as positive factors in a company's work environment. These positive factors can contribute to a better production system. The improved production system can improve the work environmental conditions further, which means that the good spiral, visualized in Figure 3.6, has been created. Factors, derived from the work environmental conditions, which reduce the productivity and the quality, are a high employee turnover and a high sick-leave rate. A high work environmental standard, within an organization, improves its production system, since it contributes to increasing the positive factors in the GEM-model and to decreasing the negative ones.

However, there are also bi-influencing factors. These factors improve the work environmental conditions at the same time as they improve the productivity. A learning organization is such a factor. Akselsson stated that a learning organization provides conditions for a production system that is continuously improved and that is more flexible. On the other hand, the employees in a learning organization are continuously developing new capabilities and gaining more knowledge. This is usually positively perceived by the employees and contributes to create a better work environment.

3.14 Safety culture

Reason (1997) stated that an ideal safety culture can improve the effectiveness of H&S Management Systems (MSs). A basic condition for acquiring and sustaining an effective safety culture is the existence of organizational learning within H&S. Reason argued that improving the safety culture is an efficient method for decreasing the number of organizational accidents. There are many definitions of a safety culture. Lee (1996) used the following definition of the concept:

"The safety culture of an organization is the product of individual and group values, attitudes, perceptions, competencies, and patterns of behaviour that determine the commitment to, and the style and proficiency of, and organization's health and safety management"

Nielsen et al. (2006) found that the safety culture seems to be highly correlated with the top management's commitment to H&S issues. The best way to engineer a safety culture is to develop an H&S MS that collects and analyses data from near-misses and accidents. A successful implementation and running of an H&S MS depends, according to Reason, highly on the capability to stress the importance of a high safety culture level within the organization. To create a safety culture a Reporting culture, a Just culture, a Flexible culture and a Learning culture is needed.

Firstly, it is important to create a *Reporting Culture* where the employees are willing to report near misses and accidents; see Section 3.11.2 for more details.

A basic condition for developing a Reporting Culture is the existence of a *Just Culture*. It is important to clearly state what behaviors that are seen as acceptable and what behaviors that are not. It is also important to create an atmosphere, within the organization, where the employees are encouraged, perhaps even rewarded, for submitting personnel safety event reports.

The third component that is needed to engineer a safety culture is the organizational capability of adapting effectively to changing demands; Reason defines this as a *Flexible Culture*. When an accident occurs, the existence of such a culture is often characterized by the shifting from a conventional, standard-procedure-based, hierarchical structure to a structure where task experts at the site have the control. Once the emergency has passed, the organizational structure shifts back to its normal form.

To be able to analyze and to use the information gained from the H&S MS and to have the capability to make corrective actions when it is needed, it is necessary to create a *Learning Culture*. According to Reason, a Learning Culture is the easiest subcomponent to engineer, but the most difficult one to really make work.

3.14.1 Safety culture maturity model

Fleming (2001) designed a model with five levels of safety culture maturity, see Figure 3.7. An organization must go through all the levels to reach the highest level of safety culture maturity. According to Fleming, the safety culture maturity model has been developed in order to assess an organization's current safety culture maturity level and thereafter to identify the needed actions to improve their safety culture. The actions that are required to improve the safety culture depend on the currently assessed safety culture maturity level. Fleming's suggested actions are described in Figure 3.7.

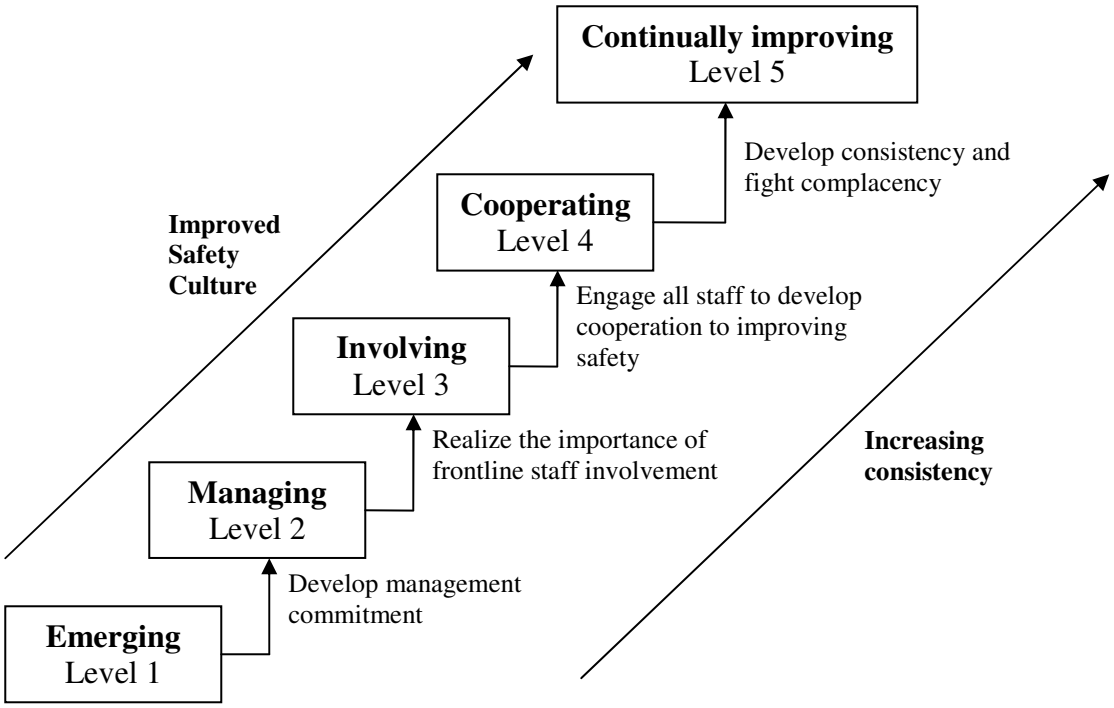


Figure 3.7. Fleming's safety culture maturity model

The safety culture maturity levels have, according to Fleming (2001), different characteristics. In the first level an H&S MS is running and safety procedures have been established. However, H&S is only a major concern for the H&S departments. Neither the frontline staff nor the management is involved, to a high degree, in H&S issues.

The second level is characterized by the top management's commitment to safety issues. However, H&S is still measured with reactive Performance Indicators (PIs), like AFR, and safety incentives are based on reducing these rates.

On the third level the accident rates are relatively low, but they have reached a plateau. A considerable proportion of the frontline staff is willing to work with the management to improve the H&S conditions. PIs are actively monitored and effectively used.

On the fourth level, a majority of the staff is convinced that H&S issues are important, both for moral and economic reasons. The management and the frontline staff have accepted their responsibility for their own and others safety.

The fifth and highest safety culture maturity level is characterized by the fact that the prevention of all accidents is seen as a core company value. The organization's work environmental conditions are constantly improving and many types of PIs, for monitoring the H&S progresses, are used.

3.15 Usability tests

Wärneryd (1998) stressed the importance of performing usability tests on reporting prototypes, before they are launched. There are many methods to define the general usability of a system. Löwgren (1993) used the REAL model to measure how usable a system is for a specific purpose. The REAL model has the following dimensions:

- The *Relevance* describes to which extent the system can fulfill the needs of its users. It is also taken into consideration if the users are missing any function or if it, in their opinions, exist unnecessary functions.
- The *Efficiency* indicates how fast the users can perform their tasks and how high the error frequency is.
- The *Attitude* reflects the users´ subjective opinions against the system.
- The *Learnability* indicates how easy it is to learn to use the system and how well the users remember how to use the tool.

Usability tests can be conducted in many ways but, according to Dumas and Redish (1999), they all share the same five characteristics:

- The primary goal is to improve the usability of the system;
- The participants in the tests represent the real users;
- The participants perform real tasks;
- It is observed and recorded what the participants do and say;
- The data in the usability tests is analyzed and used as an input to overcome the identified problems.

4. Method

This chapter describes how the different parts of the work were conducted.

4.1 The interviews

The purpose of the interviews was to collect information about what specific demands and needs the different parts of Tetra Pak have on an accident reporting system on corporate level. The fulfillment of these needs is crucial, in order to design a reporting system that can create a buy-in from the organization. It was desired that the input from the interviews should influence the output of the master's thesis as much as possible; therefore the interviews were conducted in an early phase of the project. The interviews were made during 5 weeks. 16 people were interviewed in altogether 26 interviews, including the feedback interviews.

4.1.1 The material

To get a picture that covers as exhaustively as possible, people from many functions at Tetra Pak were interviewed. In order to involve the top management, the Director of Corporate Governance & Business Structure was interviewed. To get a legal perspective a Legal Council at Tetra Pak Development & Engineering and a Legal Council at Tetra Pak Processing Systems were interviewed. Since the Field Service Engineers (FSEs) are one of the potential target groups for the reporting system, the Director for Service Operations and the Technical Service Director for the Middle East Cluster were interviewed. Two members of the Tetra Pak European Council (TPEC) were also interviewed. The members stated that TPEC is an internal association within Tetra Pak, which has representatives from labor unions in the European Union member states where Tetra Pak is represented. It was said that Tetra Pak Converting's H&S structure should serve as a role model; therefore the Safety Master Pillar Leader and the Local Safety Pillar Leader at Tetra Pak Converting in Lund were interviewed. Tetra Pak Processing Systems in Lund was one of the first Processing sites that have started to implement the WCM framework. Therefore, the Operations Director at Tetra Pak Dairy & Beverage Systems AB was chosen as an interviewee. Tetra Pak Converting in Wrexham has developed an advanced H&S MS, on site-level. To get further knowledge about this system, the Health and Safety Manager at the site was interviewed. Internal Benchmarking was also the purpose of interviewing the Leader for Project B. The Industrial Safety Engineer for Sweden, the Security Manager at Tetra Pak Sweden and the Industry Physician were also interviewed since them, as members in the COSHC, play central roles in the H&S efforts at Tetra Pak Sweden. Human Resources is the initiator of this project, therefore the Personnel Director of the North European Cluster at Tetra Pak was interviewed.

4.1.2 The characteristics of the interviews

The interviews were semi-structured and a majority of them were held face-to-face. According to Wärneryd (1988), this interview method provides the smallest risk for

misunderstandings and enables many types of questions to be asked. However, when it was impossible to meet; phone interviews were conducted. The duration of the interviews was about an hour.

To get as much information from the interviewed people as possible, the intentional topics for the interviews were sent to the interviewees some days before the interviews. In the beginning of each interview a shorter presentation of the master's thesis and the project was held. In order to get as many opinions as possible, the same basic topics were discussed with all interviewees; for details about the common questions, see Appendix 1. However, some specific questions that were adapted to fit the interviewees' working tasks and competences were also asked. The interviews were recorded on tape. According to Andersson (2001), tape recordings enable a two way-communication during the interviews and reduce the risk of forgetting important details. After the interviews, I listened to the tape and wrote summaries. This was done as soon after the interview as possible.

In the feedback interviews, the interviewees were asked for their opinions about the first draft of the reporting prototype and about the chosen classification system. They were also asked follow-up questions, if something in their first interviews was unclear. The information gained from the feedback interviews resulted in modifications of the reporting prototype.

4.2 Written sources

The literature studies have been done to gather adequate theory; e.g. about accident causation, personnel safety event reporting to reduce accident rates and organizational learning. Literature studies were also used to design the reporting prototype and the usability tests. To provide the master's thesis with useful definitions and to find information about H&S measurements literature studies were also the major source.

Studies of written sources have been done throughout the entire working process, whenever it was considered as needed. About half of the literature was electronically articles that were found on the internet, the other literature was books that have been found through the database Lovisa and borrowed in libraries. The literature was complemented with information on homepages and internal material from Tetra Pak. Most of the internal material was found on Tetra Pak's intranet ORBIS and was, for example, used to get the needed quantitative information about Tetra Pak and its operations. Altogether 63 sources were used in the master's thesis.

4.3 External Benchmarking

The Health and Safety Executive (1999) found five stages important, in order to perform a Benchmarking study:

Deciding what to benchmark. The first step in the Benchmarking study was to choose a suitable object for the Benchmarking. In this master's thesis, it was said that the

benchmarking object would be H&S MS in general and that personnel safety event reporting systems are particularly interesting.

Analyzing the current situation, at Tetra Pak, has been made throughout the work process. This step mainly includes the interviews and the gathering of information about the accidents that have happened at Tetra Pak during 2007.

The third step is to *select a suitable benchmarking partne*r. According to Goering (2007), the Dow Chemical Company's accident rates are considerably lower than the average in the German chemical industry. Dow's production site in Stade is one of their safest sites, with an Injury and Illness Severity Rate that during the last 5 years, was about 50% lower than the average at Dow. Therefore, Dow's site in Stade was chosen to be used in the external Benchmarking. Choosing a benchmarking partner in another industry can, according to the Health and Safety Executive, lead to innovations and new ideas, and there is no competitor problems.

The best way, in my view, *to work with your partner* is to meet the benchmarking partner face-to-face. Therefore, the benchmarking study was conducted in the production facilities in Stade, Germany. First, a shorter presentation about Tetra Pak and how they are working with H&S issues was held. Thereafter, the representatives from Stade presented Dow Chemicals, their H&S MS and some of the tools that they were using. In the end we were given the opportunity to ask further questions. During our 5 hour long visit we also took part in a safety inspection at a Chlorine production facility.

The last step is to *learn and act on lessons learned.* The design of Dow's LER program, Dow's methodology to reduce the accident rates and how they are measuring their H&S performance made all foundation to some of the recommendations that were given in this master's thesis.

In order to get an opinion whether Tetra Pak's accident rates are high or low, their average Accident Frequency Rate (AFR) was compared to the same measure at other companies. To be able to make relevant comparisons, some of the Benchmarking companies' measures needed to be converted. The average AFR in 2006 at manufacturing companies operating in Sweden served as benchmarking partners, since these companies have operations similar to those at Tetra Pak. To get a global perspective, the average AFR during 2006 in the following six international companies, in different industries, also served as benchmarking partners: Astra Zeneca, Atlas Copco, BP, Sandvik, SCA and SKF.

4.4 The Reporting prototype

Tetra Pak wanted to investigate whether a web-based reporting prototype could be an efficient tool to use in order to collect information about the accidents that have happened at Tetra Pak. Two slightly different templates were made to be used in the reporting prototype.

The first reporting template was used to gather information about the extraordinary and serious accidents that have happened at Tetra Pak during the first 11 months of 2007. A second template will be used to collect information, about accidents that happen at Tetra Pak during 2008. In the second template minor, serious and extraordinary accidents are reportable. The questions in the second template, except some minor modifications, were identical with the ones in the first reporting template. The information gained from the interviews, the feedback interviews, the usability tests and the literature research made up the foundation when the reporting prototype was developed.

4.4.1 Plan-Do-Check-Act methodology to develop the reporting prototype

This master's thesis was written according to the Plan-Do-Check-Act (PDCA) cycle, as it was described by Lindemann (2006); see Figure 4.1. This methodology was especially used when the reporting prototype was developed. Firstly, the prototype was planned by examining similar, already existing reporting templates and by asking the interviewees how they would design the prototype. Thereafter, a first draft of the reporting prototype was released. The Check-step is represented by the usability tests of the reporting prototype, where it was controlled whether the reporting prototype could meet the demands from the different parts of Tetra Pak. The feedback interviews were also an important part of this step. The launching of the reporting prototype, in order to record the current H&S performance at Tetra Pak represents the Act stage. However, the reporting prototype needs to be continuously improved and revised, in order to fulfill corporate future needs. This is represented by the cycle, meaning that the work with the development of the prototype is never finished.

In a long term perspective, the gathering of the information about the accidents that have happened during 2007 can be seen as a check-step in the PDCA cycle. This means that the conclusions that were drawn from the results in the H&S survey also can be used to further improve the reporting prototype. As mentioned in Section 1.2 a purpose with performing the H&S survey is therefore also to test and to improve the reporting prototype.

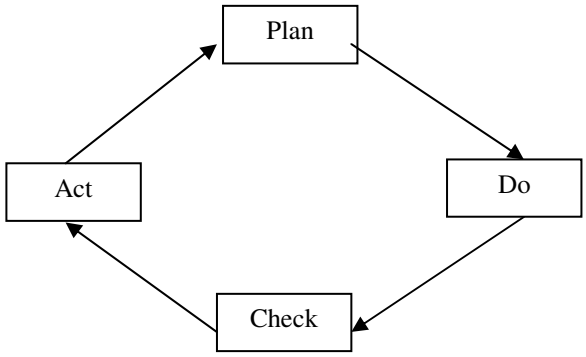


Figure 4.1. The PDCA cycle

4.5 Usability tests

As stated in Section 3.15, the key to designing a successful test group is to involve persons who represent the real users of the future tool. Therefore, the test group was chosen with this ambition. Virzi (1992) found that 80% of the usability problems can be found by a test group with four participants. It was also found that if the test group expanded further, the increase of the error discovery rate would decline. Therefore, it was decided that four persons should conduct the usability tests. Participant 1 (P1) was, since one year, Local Safety Pillar Leader at Converting in Lund. P2 was Local Safety Pillar Leader at the Converting site in Wrexham, England and since two years also an SMP Member. P3 had been working as FSE, for the last ten years. P4 was Chairman in the Work Environmental Committee, for the entities with production facilities at the TPPS site in Lund. P4 have had this position for 20 years. By choosing these participants, all three user groups of the CARS were participating in the usability tests. The test group consisted of three males and one female. Three Swedes, in order for me to be physically present at the usability tests, and one Englishmen, to focus at the linguistics, were participating.

The test users were first asked questions about her / his working tasks and if she / he thought that she / he was a potential user of the tool; for details about the asked questions, see Appendix 3.1. Thereafter, the participants were given the same descriptions of three accidents that to my mind could occur at Tetra Pak. The first one was a typical accident that can occur at a Converting site, the second accident could happen to a FSE and the last case described an accident that could occur at a TPPS site. The given tasks can be found in Appendix 3.2. After the tasks were performed, the participant was asked if she / he liked the reporting prototype and whether the person thought that there is a need to implement the CARS at Tetra Pak; see Appendix 3.3 for the Post-test questionnaire.

According to the REAL model, described in Section 3.15, the following measures and questions were chosen, to determine the usability of the reporting prototype:

Relevance **-** Do you think that there is a need for implementing the CARS?
- Would you like to have more or less questions in the reporting tool?

Efficiency **-** The average time for the users to complete one accident report;
- The number of errors per accident report;

Attitude - Did you like the tool?

Learnability **-** Did you think that it was easy to use the reporting prototype?

The following goals were set, in order for the reporting prototype to fulfill Tetra Pak's needs and demands:

- The average input time, for filling in one accident report, shall be less than 10 minutes;
- The average number of errors per accident report shall be less than 1;
- The participants should have positive feelings towards the reporting prototype.

The average input time recorded in the usability tests, is surrounded by uncertainties. This is due to that the input time is depending on how much text the participants are

writing and how fast they type it. There are also some situational deviations compared to a real reporting situation. The following things could affect the input time:

- The participants do not know the accidents as well as they would, if it had been a real accident at their sites. This will lead to an overestimation of the true input time.
- The accident descriptions were written in English and not, as usual, in the respondents' native languages. In a real situation, the respondents would probably need to look up some English terms. This would lead to occasions where the true input time gets underestimated.

However, it was still found important to do the usability tests, in order the get an opinion whether the reporting prototype could meet Tetra Pak's needs of being fast and easy to use.

5. Results

This chapter describes the results gained in the interviews, in the external Benchmarking and in the usability tests. It also presents results from a Health & Safety survey, in which information about the accidents that have happened at Tetra Pak during 2007 was collected with the developed reporting prototype.

5.1 The interviews

5.1.1 Responsibilities for the work environment

According to the interviewees, Tetra Pak Converting's sites earlier had centralized and specialized functions that were responsible for operative work environmental issues. However, this has changed and this responsibility is now delegated to a local level of the line organization. This has resulted in a procedure where every group leader now is responsible for well defined, tangible work environmental tasks. The reorganization enabled the corrective H&S actions to be done on the organizational level at Tetra Pak Converting, with the best knowledge about the local conditions. The same pattern was also found at Technical Service, where the responsibilities for the work environmental conditions are, according to the Technical Service Director for the Middle East Cluster, delegated to the operative units of the market companies.

5.1.2 The user groups of the accident reporting system

In order to propose a design of an effective reporting system, it is first necessary to define the user groups. As stated in Section 1.1, the following groups at Tetra Pak could use the Corporate Accident Reporting System (CARS):

- A Tetra Pak employee who is involved in an accident or near miss at Tetra Pak's production facilities;
- Any of Tetra Pak's employees who is involved in a personnel safety event, when working at Tetra Pak's customers' sites;
- Tetra Pak's customers' employees, who get injured using Tetra Pak's equipment;
- Personnel safety events occurring at Tetra Pak's Office sites.

The interviewees considered it as natural to include the first potential user group. Almost all of the interviewees thought that the second category should also use the CARS. It was argued that there is a big potential to improve the work environment for these employees. A small majority thought that the third group should be excluded from the reporting system. The Legal Councils argued that Project B is already covering that aspect. The Industry Physician feared that the including of this group would only conceal the real trends, since the statistics also would depend on the safety culture of Tetra Pak's customers. The TPEC members, on the other hand, argued that this user group should be included. A majority of the interviewees stated that they would also like to exclude near misses and accidents occurring at Office sites from the CARS. The Legal Councils argued that these events are already covered by reporting systems on site level and local

regulations. The Industrial Safety Engineer claimed that this type of events almost always is minor accidents that cannot contribute to the organizational learning, within H&S at Tetra Pak. The Industry Physician, on the other hand, did not think that the Office sites should be treated differently from the plants, although corrective actions could be more difficult to find.

5.1.3 Main target group of the accident reporting system

The Technical Service Director for the Middle East Cluster and the Personnel Director of the North European Cluster argued that the Field Service Engineers (FSEs) are exposed to the biggest work environmental risks and they are not included in an existing, fully covering, near misses and accident reporting system. Therefore, they will probably gain the most of the implementation of such a system. The Legal Councils and the TPEC members also considered the FSEs to be the main target group of the CARS.

5.1.4 The need of a global accident reporting system

All of the 16 interviewees thought that there is a need within the organization, to implement some kind of reporting system for near misses and accidents on a corporate level. The interviewees found that such a system could have the following purposes and advantages:

- The Legal Councils pointed on the fact that similar reporting systems are being implemented in other companies, supports the statement that a near miss and accident reporting system on a corporate level at Tetra Pak is needed.
- The Director for Service Operations stated that implementing a reporting system is a way of making the organization understands that safety issues are important. If Tetra Pak starts to record their performance within H&S, more focus will automatically be put on these issues. Once the H&S performance is recorded, this could be used for internal Benchmarking between similar parts of Tetra Pak.
- As stated in Section 5.1.1, the work environmental conditions at Tetra Pak's sites are highly relying on local responsibilities. At the sites where this does not work to a satisfactory extent the conditions could, according to the Legal Councils, be improved if a personnel safety event reporting system on a corporate level and more corporate minimum standards were implemented.
- The Technical Service Director for the Middle East Cluster stressed the importance of the reporting system being a part of a bigger initiative within H&S and not just a detached system. In this way the system can more easily be appreciated and anchored in the organization.
- The Security Manager at Tetra Pak Sweden argued that if a procedure flow is included in the reporting system, a more efficient and standardized flow of the near miss and accident reports can be created.
- The Director of Corporate Governance & Business Structure stated that Tetra Pak is a member in an association hosted by the UN. This association orders that Tetra Pak reports their accident rates on corporate level. Implementing a reporting system on corporate level could ease this reporting as well as other, similar external requirements.

- The TPEC members argued that a successful implementation of an accident reporting system could improve the work environment at the same time as it improves the productivity. The implementation could therefore benefit both the employees and the employer.
- When the CARS is working satisfactorily, the Health and Safety Manager at Tetra Pak Converting in Wrexham thought that Tetra Pak could create a buy-in from their customers, to also use the system.
- The TPEC members stated that it is good internal and external marketing for Tetra Pak to show that they are doing follow-ups and making corrective actions when accidents have occurred.

Two of the interviewees did not think that there was any urgent need of implementing a corporate reporting system, since they stated that the accident rates at Tetra Pak already is low. However, they thought that such a system will be needed in the future. The Local Safety Pillar Leader at Tetra Pak Converting in Lund argued that there is a need for such a system only if it is good enough to replace some existing reporting tools, on site-level at Tetra Pak, with similar purposes as the CARS. If replacements cannot be made, the implementation would only result in an increased bureaucracy. The Safety Local Pillar Leader at Tetra Pak Converting in Lund further stated that the SMP decides a lot of the methods and tools that are being used at the Safety Pillars. To secure that the system can replace some current reporting tools, a close cooperation with the SMP is crucial.

The Technical Service Director for the Middle East Cluster thought that the implementation in less developed countries will probably be more difficult, since these countries are more likely to have a lower safety culture level. He stated that this can result in a lower willingness to report near misses and accidents.

5.1.5 Classification of the accidents

To make an adequate consolidation of the information about the accidents and to enable relevant benchmarking studies between the entities at Tetra Pak, some kind of classification of the accidents is necessary. The first step of the implementation route of the CARS must therefore be to introduce a, throughout the company, common classification of their accidents. Many of the interviewees mentioned the problem that the constructor of this classification system inevitably gets influenced by his local environment. This is a problem since the safety culture differs a lot between different parts of the world. Therefore, the classification needs to fulfill the needs both in the developed and in the less developed countries. The Personnel Director of the North European Cluster stressed the importance of using an objective, within Tetra Pak frequently used, classification system. The Industrial Safety Engineer once had the task to introduce a near miss and accident reporting system on a corporate level, but without succeeding. He stated that the main reason for the failure was that the classification of the accidents was not sharp enough. The Director for Service Operations also stressed the importance of a clear decision regarding what types of safety events that shall be reportable. The Leader for Project B suggested that all safety events resulting in minimum one lost working day should be reportable.

A big obstacle against the implementation of a corporate uniform classification of personnel safety events is, according to the Industry Physician, the fact that *accident at work* is defined differently in the national work environmental legislations in the countries where Tetra Pak is present. According to the Industry Physician, commuting accidents are included in the concept in the Swedish and Brazilian work environmental legislations, but are excluded in most of the other countries' legislations. The SMP Leader did not think that commuting accidents should be reportable, since this is an area that Tetra Pak cannot influence.

5.1.6 Within Tetra Pak existing accident report systems

During the interviews three, in principle different, already existing systems for reporting personnel safety events at Tetra Pak became visible. These systems are developed for different levels of the organization.

- There is a number of well developed H&S MSs on site-level. These systems are highly adapted to the local conditions and to the national work environmental legislations. Therefore, they cannot be replaced, only complemented, by a near miss and accident reporting system on corporate level at Tetra Pak. However, these systems can be used for internal Benchmarking. The aim with this section is to give the reader an idea how these site-specific systems work, by describing the Safety Health Environment Management Administration System (SHEMAS) at Tetra Pak Converting in Wrexham. The SHEMAS was implemented at the plant in 1998 and has ever since been improved. According to the Health and Safety Manager at Tetra Pak Converting in Wrexham, the main reason for the implementation was the increasing need for efficient exchange of information, due to a changeover to a five-shift-system. This was fulfilled by the SHEMAS. The system classifies personnel safety events in three groups; major accidents, minor accidents and near misses. These are also the indicators that are used to measure the H&S performance at the site. The safety responsible in each shift reports into the system. In order to ease the reporting, everyone has 1st level access to the SHEMAS. This means that everyone can report into the system and read all the reports. The system is accessible at every work station of the plant. The RCAs at Tetra Pak Converting in Wrexham are standardized and the 5-Whys method is used. The RCAs are integrated into the SHEMAS. The SHEMAS contains much information and it covers many aspects and areas. For instance, the system contains information for external requirements like inspections.
- Efforts are made to harmonize the H&S MSs at all Tetra Pak Converting sites that have implemented the Safety Pillar. This common management system is on Tetra Pak Converting-level and consists of many tools that the plants can, if they wish, integrate into their site-specific systems; see Section 2.7 for more details. The GAR is developed for reporting serious and extraordinary accidents to the SMP. The tool has the same purpose as the CARS. However, according to the SMP Leader, this tool cannot directly be used on a corporate level, because it is adapted for the heterogeneous and well defined activities at Tetra Pak Converting.

- Project B is an ongoing project where a global handling is developed for personnel safety events caused by packages or their content, and equipment produced by Tetra Pak. The personnel safety events can either take place at Tetra Pak's customers' sites or by the end consumers. Project B started at the beginning of 2007 at Tetra Pak D&E and will, according to Larsson (2007b), be rolled out and implemented during the first quarter of 2008. The project involves four persons in a core team and eight additional employees in an extended team. The reporting tool is an Excel sheet. The standardized reporting procedure is differentiated depending on the classification of the personnel safety event; see Section 3.3.1 for details concerning the classification. The analyses of the emergencies and crises are made by an interdisciplinary core team, which is differently created depending on the needed competences of the specific event. According to the Leader of Project B, the centralizing of the RCAs enables a standardized assessment by co-workers with much competence about the equipment and much experience from similar investigations. The information from the RCAs is sent back to the developers of the process equipment, so they can take corrective actions that can prevent the reoccurrence of the same type of accidents in the future.

5.1.7 The technical solution of collecting the information

All 16 interviewees would prefer a technical solution with a web-based reporting prototype. The following advantages were found by the interviewees:

- A web-based reporting prototype is easy to administrate and easy to revise;
- It is easy to distribute the reporting tool to a global organization;
- A web-based tool would be accessible for almost all of Tetra Pak's employees;
- A web-based system would simplify the processes of consolidating and visualizing the gathered material.

Some of the interviewees, however, stressed the need of also having the templates available in paper form, to fulfill the need when no internet connection is available. The Security Manager at Tetra Pak Sweden would prefer, from a computer security point of view, to integrate the reporting prototype into Tetra Pak's intranet ORBIS.

5.1.8 The reporting prototype

As for what questions that should be asked in the reporting prototype, there was a big consensus among the interviewees. The following questions were proposed:

- Which type of accident has occurred?
- Where did the accident occur?
- In which cluster did the accident happen?
- Time and date of the accident?
- How did the accident occur?
- Were there, in your opinion, any aggravating circumstances in the physical environment at the time of the accident?
- What were, in your opinion, the causes of the accident?

- What actions have been taken, in order to stop the reoccurrence of an accident with the same set of root causes

Many of the interviewees emphasized the need of keeping the templates as simple as possible, since a short input time and an easy reporting procedure would, in their views, increase the willingness to report. A solution with multiple-choice answer options to as many of the questions as possible was preferred by the interviewees. Many of the interviewees would prefer a conditional question tree, where the appearing questions are depending on the respondents' previous answers. The interviewees found it also important to keep the language in the reporting prototype clean and objective and to test the tool in a usability test. The Industrial Safety Engineer stated that a high quality of the submitted reports is crucial in order to get useful outputs from the analyses of the gathered material. A user-friendly design of the reporting prototype can ease the creation of good reports, but never secure it. He also thought, contrary to many of the other interviewees that the respondents should get a shorter education, regarding how to write reports. The Technical Service Director for the Middle East Cluster thought that the reporting prototype could be built in many levels. He proposed an elementary prototype in less developed countries and a more advanced version in countries with a higher level of safety culture. The Legal Councils argued that it would probably be difficult to build a multi-answer tree to cover all possible root causes.

5.1.9 Responsibilities for the input to the Corporate Accident Reporting System

The interviewees had different opinions regarding who should report into the CARS, when an accident occurs at Tetra Pak's sites. However, the Industrial Safety Engineer stressed that it is more important that someone is responsible for the reporting, than exactly who has the responsibility. Most of the interviewees found it ideal if the reporting was done on local levels of Tetra Pak. Some of the interviewees wanted that the managers in the line organization who are work environmental responsible, should be responsible for reporting into the CARS. Some of the interviewees suggested that the persons who were involved in the accidents and her / his manager should report in together.

The interviewees were more agreed in their opinions about the reporting procedure when accidents have happened to Tetra Pak employees at Customer sites. The FSEs need to fill in a form regarding their conducted work; one tab in this form could be personnel safety event reporting. However, the TPEC members stressed the importance of the FSEs being reminded about this responsibility.

A majority of the interviewees would prefer if the reporting was done as soon as possible after the personnel safety events have occurred. It was stated that an event-triggered reporting would probably increase the quality of the reports, since details are easier to remember if the reporting is done immediately after the accidents. The Director of Corporate Governance & Business Structure, on the other hand, argued that the reporting initially should be done on a monthly basis. The stated reason was that an event-triggered reporting would build up unreasonable expectations among the employees that corrective

actions should be taken immediately for all submitted reports. A reporting on a monthly basis would also be easier to implement, since it would faster create a routine and increase the discipline to do the reporting. Once the routines are rooted it could, to his mind, be changed to event-triggered reporting. The Leader for Project B would also prefer the later solution, on the condition that extraordinary accidents are continuously reported.

Most of the interviewees would prefer that it should be mandatory for the respondents to reveal the identity of the injured person. The Operations Director at Tetra Pak Dairy & Beverage Systems AB stated that it is often legislated that an external investigation shall be made when an accident at work has occurred. This would make it impossible for the injured person to stay anonymous. However, the names should only be included in the raw data and will therefore only be accessible to a small and carefully chosen group of people. The Security Manager at Tetra Pak Sweden suggested that the CARS should be designed with a multi-level-password system in order to achieve this. To obtain the advantages both with reports where the involved persons' names are written and anonymous reports, the Industry Physician argued that typing in the injured persons name should be optional.

The interviewees argued that it should also be mandatory for the respondents to reveal their own identities when they are using the CARS. In order to analyze the information, the Industrial Safety Engineer stated that it is almost always necessary to ask the respondents for additional information about the personnel safety events. This would not be possible if the reporting was done anonymously. Furthermore, according to the Legal Councils, an anonymous reporting can lower the quality of the input and give a feeling of distrust against the respondents.

5.1.10 Responsibilities for Root Causes Analyses

To enable for Tetra Pak to learn from previous near misses and accidents, in order to stop the reoccurrence of an accident with the same set of root causes, Root Causes Analyses (RCAs) of the events are necessary. All of the interviewees thought that the RCAs shall be made on local levels of Tetra Pak. A common mentioned main reason was that the knowledge about local work environmental conditions only exists on these levels of the organization. Two common opinions among the interviewees, on the issue where in the organization the responsibilities for the RCAs of the near misses and accidents should be made, could be traced.

- It should lie on a person as local in the line organization as possible, but who still has the mandate to execute the needed corrective actions. This design has the advantage that the RCAs of personnel safety events and the later corrective actions are made by the same person.
- A specialized function, e.g. the Industrial Safety Engineer, should have the responsibility to do the RCAs of a near miss or accident, since she / he has the adequate knowledge and still knows the local conditions.

The Operations Director at Tetra Pak Dairy & Beverage Systems AB thought that the RCAs of the personnel safety events solely should be made on a local level. The Industry Physician contradicted this; he argued that analyses on a central level also are necessary, in order to secure a corporate uniform assessment and to be able to do relevant comparisons between the plants. The Technical Service Director for the Middle East Cluster argued that the RCAs of the personnel safety events that have happened at the Customer sites must, in general, be analyzed on a more central level than those that have happened in Tetra Pak's productions facilities.

5.1.11 Responsibilities for the corrective actions

It was a common opinion among the interviewees that the corrective actions that are taken after the personnel safety events have occurred, must take place on a local level of Tetra Pak. It was considered as ideal by the interviewees, if the RCAs and the corrective actions were made by the same entities at Tetra Pak.

5.1.12 Factors that could influence the willingness to report

In Section 3.11.2, it was found that a high willingness to report, among the respondents, is a basic condition in order to establish and run a near miss and accident reporting system at a company. The interviewees had, to some degree, divergent opinions how this could be achieved.

The following actions were suggested by the interviewees, in order to stimulate the willingness to report personnel safety events:

- Education in H&S-related questions was pointed out by many of the interviewees as an important factor. The Local Safety Pillar Leader at Tetra Pak Converting in Lund, for instance, had very positive experiences concerning the effects from safety campaigns and education. The SMP Leader argued that the effects of education are not always visible in the short term, but once the actual change is achieved it is often sustainable. It is crucial to make the employees understand that a high willingness to report contributes to a better work environment. The Director of Corporate Governance & Business Structure, on the other hand, thought that education has a good intention, but pointed on the difficulties with really achieving a change of behaviors. The Director for Service Operations stressed the importance of creating a true and balanced picture and not to exaggerate the work environmental risks in order to increase the number of submitted reports.
- Visualize the short- and long term effects of an increasing reporting. When the employees can see the effects that the increasing reporting has, their willingness to report will increase further and a positive spiral has been created. The Health and Safety Manager in Wrexham first had difficulties to motivate the employees to report into the SHEMAS. But, once the employees could see the effects that the personnel safety event reporting had on the H&S performance, their willingness to report increased. He stated that Wrexham nowadays has a positive reporting culture and a high willingness to report.

- The Director for Service Operations argued that feedback to the people who reported is very important. It must be made as fast as possible after the reports were submitted in order to maintain a high willingness to report. The Local Safety Pillar Leader at Tetra Pak Converting in Lund thought that the best feedback would be information about corrective actions that have been taken after serious and extraordinary accidents at other, similar plants.
- The Industrial Safety Engineer had experiences with a reporting system that was not frequently used. He argued that it was due to the management that did not implement any methods for stimulating the employees to increase their reporting.
- Near misses and accidents are often caused by human errors. Therefore it is, according to the Industry Physician, crucial that the employees know that they will not be punished for their mistakes, unless they have been extremely culpable.
- The Director of Corporate Governance & Business Structure stressed the importance of writing a procedure, where it is stated that it is mandatory for the respondents, to report their reportable personnel safety events into the CARS.
- The TPEC members thought that you can motivate the employees to report further if they are able to, whenever they like, see the current status of their reports and which corrective actions that have been taken. It is especially important to visualize the corrective actions, since this can help to assure the employees that an accident with the same set of root causes cannot happen again.
- The Industry Physician stressed the importance of the top management's commitment to the issue.

Some of the interviewees thought that smaller economic incentives, if the other mentioned actions did not have the desired effect, could be efficient in order to raise the short-term willingness to report accidents. The Legal Councils proposed that the indicators, measuring the H&S performance in the implementing phase of the CARS, should not affect the salaries, since this could decrease the report frequency. However, once the reporting system is working satisfactorily the Legal Council would like to implement PIs that are influencing the salaries. Many of the interviewees, on the other hand, stressed the difficulties of designing such incentives. They claimed that is very difficult to find PIs that stimulate the requested behavior and nothing else.

The Legal Councils thought that many parts of Tetra Pak need to collaborate in order to create a reporting culture. The Operations Director at Tetra Pak Dairy & Beverage Systems AB pointed at the possibility, provided that a personnel safety event reporting system on corporate level was implemented, to identify the entities with a low willingness to report and focus the actions to these sites.

5.1.13 The handling of the raw data from the accident reporting system

The near miss and accident reports are highly sensitive and uncertain information. All of the interviewees therefore thought that this raw data only should be accessible to the involved persons and to some relevant persons. Some examples, given by the interviewees, were:

- The local H&S-responsible;
- The Industrial Safety Engineers;
- Auditors;
- Human Resources Management (HRM).

5.1.14 System analysis

The information gathered with the reporting prototype also needs to be analyzed, in order to measure the H&S performance at Tetra Pak. Furthermore, general patterns can be sought and relevant comparisons between the plants can be made in these analyses. These actions will be referred to as system analyses in this master's thesis.

The consolidation of the gathered material and the system analyses must be made on corporate level at Tetra Pak. This would, according to the Security Manager at Tetra Pak Sweden, enable uniform analyses of the gathered information, as well as internal Benchmarking with common measurements. However, the Operations Director at Tetra Pak Dairy & Beverage Systems AB argued that there is no reason to transfer the gathered information in the CARS between the Equipment Manufacturing sites, the Tetra Pak Converting sites and the Customers' sites. This organizational level will in this master's thesis be referred to as type of site-level. The stated reason was that the local conditions at the different types of sites differ too much.

Most of the interviewees thought that all employees at Tetra Pak should have access to all for them relevant results from the system analyses. This includes the statistics for their plant, statistics on a corporate level and general drawn conclusions. The Operations Director at Tetra Pak Dairy & Beverage Systems AB considered this to correspond with the visualization principle in WCM. The Legal Councils and the Leader for Project B, on the other hand, thought that it is for Communication, on site-level, to decide how the statistics are spread and displayed. The statistics should only be shown together with the other indicators in WCM. It was argued that it becomes out of context just to show these H&S-related statistics at the sites that have not implemented a Safety Pillar.

The Director of Corporate Governance & Business Structure thought that the system analysis should be made on a monthly basis at Converting's sites and at the Equipment Manufacturing sites. The personnel safety events at Customer sites should, in his view, be analyzed every 6 months.

5.1.15 Ownership of the accident reporting system

Before the implementation of a reporting system it is necessary to settle the ownership of the reports and the reporting system. The Personnel Director of the North European Cluster and the Director of Corporate Governance & Business Structure argued that HRM should take the ownership. The Industrial Safety Engineer disagreed and argued that HRM cannot see the value of the CARS and that their function is now facing a major, time-consuming reorganization. The Industrial Safety Engineer suggested that

Tetra Pak Occupational Health Safety (OHS) should take the ownership of the accident reporting system. He stated that they could see the benefits of the CARS and that they could act when central corrective actions will be needed. The Industry Physician agreed and argued that Tetra Pak OHS is an independent part of the organization that has a global perspective. He further stated that the entity has adequate competences within H&S-related issues.

The Personnel Director of the North European Cluster would prefer if the COSHC was responsible for the operative running of the system. The Director of Corporate Governance & Business Structure, on the other hand, would like to put that task on Operations.

5.1.16 National work environmental legislations

The Legal Councils did not think that a near miss and accident reporting system on corporate level can take national work environmental legislation into account. Such a system would, to their minds, be far too complex and such issues are handled more efficiently on national- or site level. I share this opinion. National work environmental legislation will therefore neither be taken into consideration in this master's thesis nor in the CARS.

5.1.17 Requested additional features

During the interviews many of the interviewees asked for specific additional features in a coming reporting system. The most frequent of them were:

- Possibility to do searching, e.g. for corrective actions at specific sites, within the reporting system;
- A standardized process that regulates the procedure when an employee gets injured;
- Graphical visualization of the development of the PIs over time;
- A database with personnel safety events on corporate level, that everyone can access;
- A document regulating the use of the system, including responsibilities and procedures.

5.2 External Benchmarking

The external Benchmarking was made with the purpose of investigating how Best Practice companies have organized their H&S functions and which tools they are using.

5.2.1 Dow Chemical Company

Within the EH&S framework at Dow Chemical Company there is, according to the interviewed Nettersheim (2007), 10-15 safety modules. The most important ones are:

- Environmental safety;
- Personnel safety;
- Process safety;

- Quality safety.

Figure 5.1 describes Dow's methodology to reduce accidents, as stated by Goering (2007). Depending on the current accident rates and the time an organization has worked actively with reducing the number of accidents, different methods are efficient to reduce the number of accidents further. Within an organization that just has started to systematically work with reduction of accidents, the accident rates tend to be high. In this phase it is efficient to improve the design and engineering of the sites. Once this is done, according to Dow's methodology, it is necessary to focus on the organizational factors, to reduce the accident rates further. The next step is to try to involve all employees in the accident reduction process; one way of doing is the Learning Accident Report (LER) program. As for organizations with very low accident rates, it is important to focus on changing the employees' behavior.

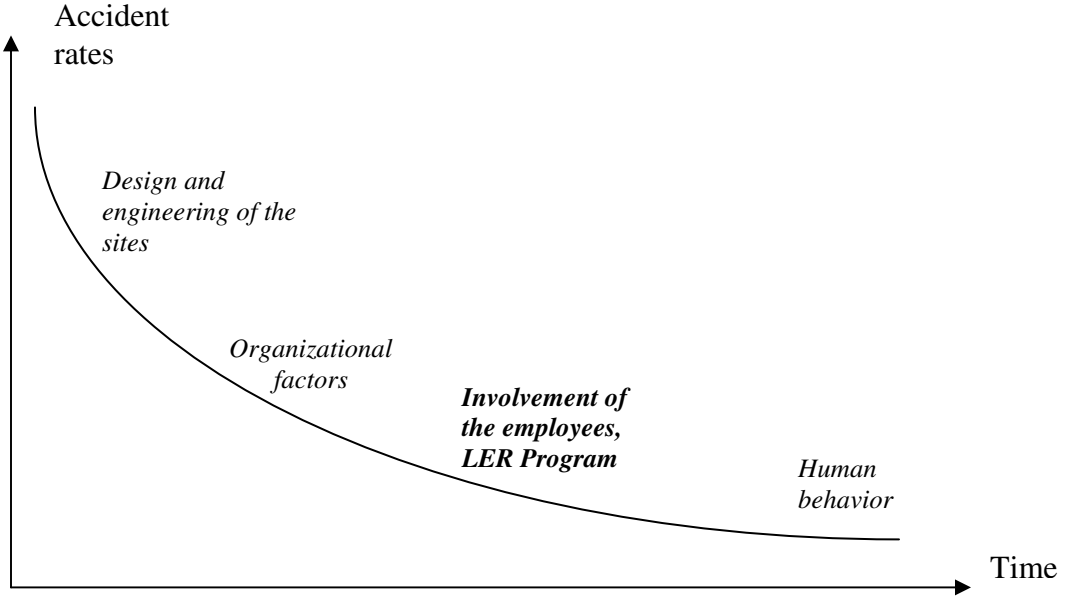


Figure 5.1.The LER program as a part of Dow's "reduction of accidents" curve

Dow has many H&S tools. Some are site-specific and some are spread throughout the company as Best Practices. The tool that seemed to have the highest relevance for this master's thesis was the LER.

5.2.2 The LER tool

According to Nettersheim (2007), LER is a web-based awareness and communication tool. It has existed for about 20 years and it was paper-based for a long time. The tool is specific for the Stade plant, although it is now being rolled out as a Best Practice to all Dow's sites. The tool is seen as a success and is frequently used; 6500 Learning Experience Reports have been submitted during the first nine months of 2007. The LER should be used when any employee at Dow discovers an unsafe situation. This could for example be:

- Technical deficiencies in a system;
- Inadequate or missing equipment;

- Missing or insufficient emergency equipment.

According to Nettersheim, there are three main reasons for the success of the tool:
- Everyone has read and write access to the system;
- About 80% of the LERs lead to some kind of corrective actions. Feedback about these corrective actions is always given to the author;
- The reporting is not done anonymously.

5.2.3 Further benchmarking studies

Smerdzinske (2002) made a study with the purpose of investigating the current trends within H&S. The following features were demonstrated in many of the Best Practice companies:
- Best Practice companies coordinate their H&S objectives, expertise and indicators through a central H&S function;
- The H&S awareness is technology-driven, including e.g. personnel safety event databases and computerized Best Practices;
- They are setting specific H&S goals, regarding e.g. H&S-related PIs and local regulation compliance, on a corporate level.

5.3 The reporting prototype

A justification of the choice of the questions and the corresponding answer options in the developed reporting prototype will follow in this section; see Appendix 2, for the full version of the reporting prototype.

It was decided that the reporting prototype should be written in English. The prototype could have been translated into several other languages. However, this would have had the consequence that the respondents would have submitted accident reports in these languages. This would mean that the administrator of the CARS would have an almost impossible task in translating all reports into English.

It was found to be most important to determine what type of accidents that have occurred. Therefore, this question was put first in the reporting prototype. The answer options were made according to the chosen classification system in Section 3.2.3.

Thereafter some questions, with the purpose of investigating where the accidents have happened followed. As for accidents in Tetra Pak's production facilities, it was asked for the cluster and the site. Regarding the accidents at Customer sites, it was asked in which country the site was located. All these questions were given multiple-choice answer options. According to Wärneryd (1998), this design of the questions would ease the statistical consolidation of the material and ease the overcoming of language barriers. Using multiple-choice answer options can also decrease the time to report.

It was decided that the reporting should not be made anonymously and that the injured person's identity also should be revealed in the reporting prototype. Therefore, the respondents were asked to type in information about the injured person and her / his

closest manager in the line organization. For follow-up purposes, it was considered important to ask whether the accidents were reportable, according to the national legislations. It was also asked for the time and date of the accidents.

To be able to analyze the gathered material in the system analysis, it was asked what type of accident that had occurred. A classification book for accidents from Socialstyrelsen (1997) and benchmarking from similar reporting tools were sources in order to design adequate answer options. For the same purposes, the respondents were also asked to state whether there were any aggravating circumstances at the time of the accidents. Multiple-choice answer options were attached to both these questions. Akselsson et al. (2005) was used, in order to find feasible aggravating circumstances in the physical work environment.

It is important to get information about how the accidents have occurred. Finding full covering multiple-choice answer options to this question was considered as impossible; therefore a free-text answer was attached. To help the respondents to remember the different aspects of the accidents, a help text was written.

This master's thesis has stressed the importance of investigating the root causes of the accidents. To get a more holistic view of which factors, in the respondents' opinions, that causes the accidents at Tetra Pak, a question about this was asked. The answer options were designed by choosing the alternatives, which were considered as most relevant, in Section 3.8.2.

Corrective actions to prevent an accident with the same set of root causes from reoccurring are also important. Therefore, questions about which corrective actions that have been, and will be, taken were asked as the last questions in the reporting prototype. This was done with the purpose of spreading this information to the other relevant stakeholders, e.g. those responsible for a site where a similar accident could happen. Asking these questions is also a way to enable the owner of the system to follow-up which actions that are taken after the accidents at Tetra Pak.

5.4 Usability tests

This section aims at investigating in usability tests whether the developed reporting prototype can meet Tetra Pak's needs of being fast and easy to use.

5.4.1 The interviewees' subjective opinions about the reporting prototype

The pre- and post-test interviews concluded that all the participants in the usability tests saw themselves as potential users of the CARS. This means that the results from the tests can be used to come to some general conclusions.

Three of the participants thought that there is a need, within Tetra Pak to implement the CARS. The Local Safety Pillar Leader at Tetra Pak Converting in Wrexham thought that the tool fulfilled the same need as the Global Accident Report (GAR), however on a corporate level. Therefore, he thought that the CARS should be combined with the GAR.

The Local Safety Pillar Leader at Tetra Pak Converting in Lund had a more ambivalent opinion and argued that even though the CARS replaces the GAR it will increase the working load at her site. The reason is that it cannot replace any existing local reporting structure at Tetra Pak Converting in Lund.

An overall opinion, among the participants was that the reporting prototype was easy to use. However, two of the participants felt that they had some difficulties in understanding the questions and describing the accident in a linguistically correct way. All of the interviewees liked the tool and its design with many multiple-choice questions.

Two of the participants thought that the amount of questions was satisfactory. The Local Safety Pillar Leaders, on the other hand, wanted some more questions in order to get more detailed information about the reported events. The following modifications of the questions were proposed:

- To introduce the question "*Was the accident legally reportable?";*
- Expand the question "*What actions have been taken, in order to stop the reoccurrence of an accident with the same set of root causes*" to the following three questions: "*What actions have already been taken, in order to stop the reoccurrence of an accident with the same set of root causes?*", "*Which corrective actions are planned to be taken?*" and "*When is the deadline for the implementation of these actions?".*

Two of the participants asked explicitly for the possibility to attach photos or other files to the accident reports. The Chairman in the Work Environmental Committee at the TPPS plants in Lund also wanted to make major near misses to a reportable personnel safety event. However, he thought that it should be done at a later stage when the CARS is well established.

5.4.2 Objective measures in the usability tests

Two of the participants in the usability tests named the involved person when they wrote the accident reports; the others chose not to reveal the involved persons' identities. Table 5.1 shows how much time the participants needed to do the input. The average time for the users to complete one accident report was 7 minutes and 13 seconds. This was faster than the goal, which was set to 10 minutes. The set target time was only exceeded in one out of 11 times where the accident reports were completed. See Table 5.1 for all the details.

Table 5.1. Task times for the participants

Task	P1	P2	P3	P4	Mean
Task 1	7 min 24 s	7 min 50 s	7 min 47 s	12 min 35 s	8 min 54 s
Task 2	5 min 30 s	6 min 46 s	5 min 56 s	7 min 17 s	6 min 22 s
Task 3	6 min 19 s	4 min 32 s		7 min 23 s	6 min 5 s
Mean	*6 min 24 s*	*6 min 23 s*	*6 min 51 s*	*9 min 5 s*	*7 min 13 s*

It was said that the average number of errors made per accident report should be less than 1. The usability tests showed that this measure was 0.55; see Table 5.2 for detailed

results. Two of the participants had problems with typing in the time and date of the accidents correctly. One error occurred when a participant, in the third task, mentioned both the person who was involved in the accident and the person who immediately caused the accident. The other two errors were considered as random errors.

Table 5.2. Numbers of errors per accident report

Task	P1	P2	P3	P4	Mean
Task 1	1	0	1	1	0,75
Task 2	0	1	1	0	0,50
Task 3	1	0		0	0,33
Mean	*0,67*	*0,33*	*1*	*0,33*	*0,55*

5.4.3 Changes as a consequence of the usability tests

The following changes were made as a consequence of the outcomes of the usability tests:

- Some minor linguistically corrections were made after the interview with the Local Safety Pillar Leader at the Tetra Pak Converting site in Wrexham, who has English as his native language.
- The modifications of the questions that the Local Safety Pillar Leaders proposed in Section 5.4.1 were made. The first question was added because it is important for Tetra Pak to know, for follow-up and statistical purposes, whether the accidents needed to be reported to the national authorities. It is likely that all the corrective actions have not been taken by the time of the report. To also gather information about planned corrective actions that the system administrator can use for follow-up purposes, the second proposed modification was also made.
- The possibility of adding photos, or other files, was also added.

5.5 Results of the Health & Safety survey

This section aims to present the general results of the H&S survey, in which accident reports were gathered with the developed reporting prototype. The detailed information about the single accidents and the corresponding corrective actions, due to its sensitivity, will not be a part of this paper. The reporting prototype was designed with the purpose of gathering information about serious and extraordinary accidents, which have occurred within Tetra Pak Group during the first 11 months of 2007. Most of the questions in the reporting prototype were answered by 90% or more of the respondents. All of the questions were answered by more than 50% of the respondents.

Two Performance Indicators (PIs) were chosen to measure the H&S performance at Tetra Pak´s sites and clusters. These PIs meet, in my view, the general requirements that were put on PIs in Section 3.6. The following indicators were chosen, they are described in detail in Section 3.6.1 and 3.6.2.

- *Accident Frequency Rate (AFR)* is already an established PI at Tetra Pak Converting. It is, in my opinion, a useful indicator. Therefore, it will be used in this master's thesis to measure the H&S performance. The indicator will be calculated as in Formula 3.2, with the difference that the period for recording the

accidents and the working hours is 11 months, instead of one year, which is the normal recording period at Tetra Pak.

- *Accident Severity Rate (ASR)* will be introduced as the second PI in this master's thesis. This PI is not yet established at Tetra Pak. The reason why ASR will be used in this master's thesis is that there is not a PI within Tetra Pak today that takes the severity of the accidents into consideration. An extraordinary accident will be weighted 10 times heavier than a serious accident. The ASR will be calculated as in Formula 3.4, with the difference that the recording period of the components is 11 months.

5.5.1 Calculating the Performance Indicators

Table 5.3 presents the number of reported accidents divided into the types of sites and into the types of reportable accidents. Altogether 133 accidents were reported during the 11 first months of 2007. See Appendix 4 for a more detailed table, with information about the number of accidents and the calculated PIs, on site-level.

Table 5.3. The number of accidents divided into the types of sites

Type of site	Extraordinary accidents	Serious accidents
Tetra Pak Converting	3	88
Tetra Pak Processing Systems	1	4
Tetra Pak Development & Engineering	0	5
Customer sites	1	31
Total	*5*	*128*

The information about the number of serious and extraordinary accidents during the first 11 months of 2007 at the sites / clusters, combined with the total exposure hours for the same period, enabled the chosen PIs to be calculated. This is done in Table 5.4. To see the same calculation on site-level, please see Appendix 4. The unit of the AFR is the number of accidents per million worked hours. The unit of the ASR is the weighted number of accidents per million worked hours. The calculations in Table 5.4 showed that the accident rates at Tetra Pak's own production facilities were considerably lower than those at Tetra Pak's customers' sites.

Table 5.4. The calculated PIs divided into the types of sites

Type of site	AFR	ASR
Tetra Pak Converting	8,65	11,21
Tetra Pak Processing Systems	4,38	12,26
Tetra Pak Development & Engineering	7,27	7,27
Customer sites	14,64	18,76
Total	*9,15*	*12,24*

As stated in Section 2.4, Tetra Pak has structured their operations geographically in 11 clusters. In Table 5.5, the accidents at Tetra Pak's production facilities and at the Customer sites are consolidated to these clusters. This was done in order to investigate if

there was a correlation between the location of the sites and the value of the PIs. The South European cluster had the highest recorded AFR and the lowest accident rates were found in East Europe & Central Asia; see Table 5.5 for further details. When the clusters were bundled in groups regarding the general development in the regions, it was found that the three clusters in Europe together with the cluster "North America" had in average 60 % higher AFR, compared to the other clusters. This pattern could not be found when the same comparison was made with the ASR as measure.

Table 5.5. The PIs divided on the different clusters

Cluster	AFR	ASR
Central Europe	6,12	6,12
Central & South America	10,05	24,33
East Europe & Central Asia	3,57	3,57
Greater China	4,19	4,19
Greater Middle East	7,38	7,38
North America	13,30	18,09
Northeast Asia & Oceania	5,24	5,24
North Europe	5,54	5,54
South Europe	17,58	17,58
South & Southeast Asia	7,20	16,46
Sub-Sahara Africa	4,86	4,86
Total	*9,15*	*12,24*

5.5.2 Response rate

Table 5.6 visualizes the response rate divided into the types of sites at Tetra Pak on 30th November 2007, which was set as the deadline for the H&S survey. As for the types of sites with more than 10 respondents, Tetra Pak Converting had the highest response rate. The response rate for the entire Tetra Pak Group was 95%.

Table 5.6. The response rate of the H&S survey

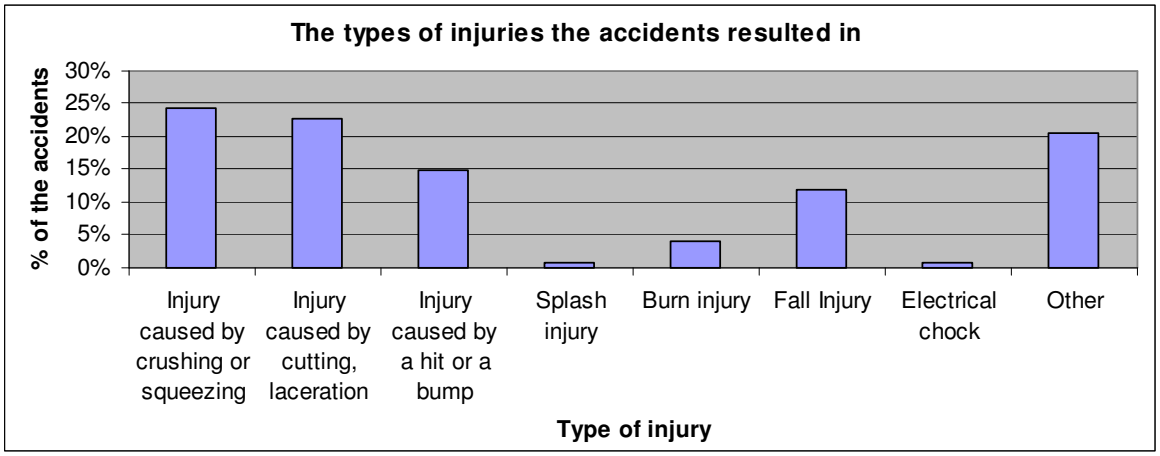
Type of site	Response rate (%)	Number of sites
Tetra Pak Converting	97%	36
Tetra Pak D&E	100%	2
Tetra Pak Processing systems	91%	11
Customer sites	91%	11
Total	*95%*	60

5.5.3 The types of injuries that the accidents resulted in

The types of injury that the accidents resulted in were also recorded in the H&S survey. The respondents could choose from the options as described in Appendix 2. The respondents submitted this information in 127 of the total 133 accident descriptions. Table 5.7 presents how many of the accidents that resulted in a certain type of injury. Crushing- and cutting injuries were found as the most common work-related injuries at Tetra Pak. When the results of this question were divided into the types of sites; it was

found that the squeezing / crushing injuries were most common at the Converting sites. The cutting injuries were most frequently reappearing when Tetra Pak's employees, who are working at Customer sites, were injured. It was also a major "Other" bar which will be analyzed and subdivided further in Section 6.12.

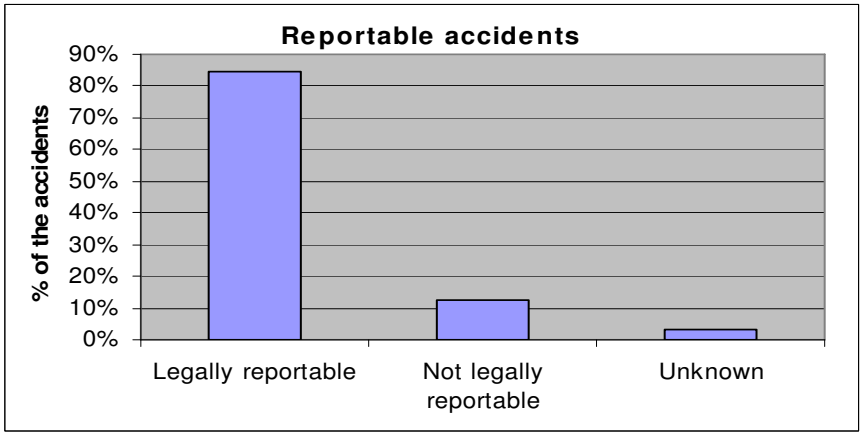
Table 5.7. The types of injuries that the accidents resulted in



5.5.4 Legally reportable accidents

The reporting prototype also enabled the respondents to state whether the accidents, according to the national work environmental legislation, were reportable. This information was given in 131 out of the 133 accident descriptions. Table 5.8 shows that a big majority of the accidents were legally reportable.

Table 5.8. Legally reportable accidents

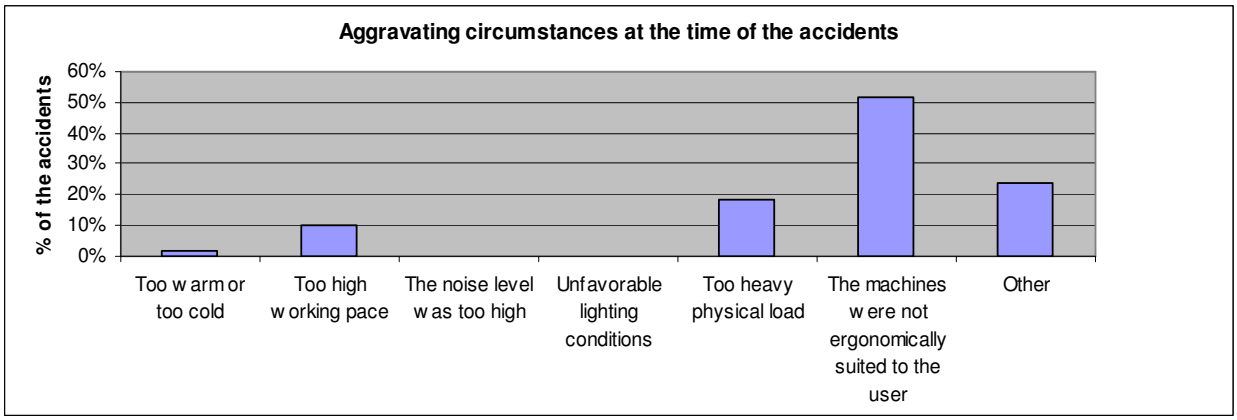


5.5.5 Aggravating circumstances at the time of the accidents

The respondents were asked if there were any aggravating circumstances at the time of the accidents. The respondents could choose among the alternatives that are described in Appendix 2. This information was submitted in fewer reports, compared to the other

questions. The information was given in about 55 % of the accident reports. As seen in Table 5.9, ergonomically problems were listed as the most frequently reappearing aggravating circumstance. When the results were broken down depending on the type of site, the same general patterns were found, for all types of sites.

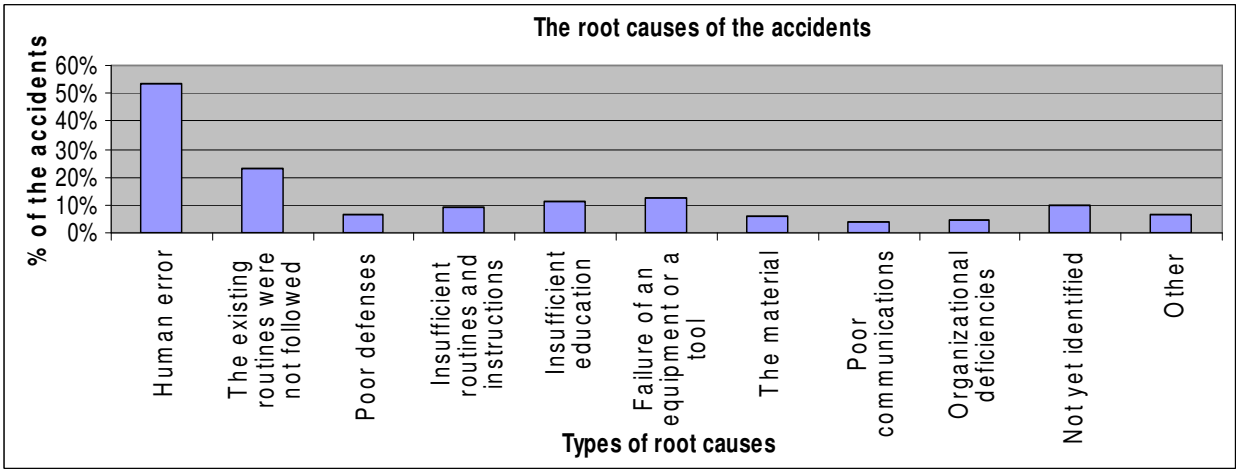
Table 5.9. Aggravating circumstances at the time of the accidents



5.5.6 The root causes of the accidents

The respondents were asked what root causes, to their minds, caused the accidents. The respondents submitted this information in 122 out of the 133 accident descriptions. Table 5.10 shows that a human error was considered, by far, as the most frequent root cause of the accidents. Compared to the Customers site, the Converting sites had a larger share of accidents that were caused by human errors and a smaller share that was caused because the existing routines were not followed.

Table 5.10. The root causes of the accidents



5.5.7 The results of the H&S survey in comparison to earlier known results

Since few similar surveys have been done at Tetra Pak in the past, it is difficult to compare the information in the CARS to other relevant measurements. However, as stated in Section 2.7, two earlier surveys regarding the number of serious and extraordinary accidents at Tetra Pak Converting during the period January to July in 2007, have been made. Table 5.11 shows the results from these surveys and the results from the CARS, for the same sites and during the same period. The only factor that differed between the reporting systems was the respondents.

Table 5.11. Reported accidents at Tetra Pak Converting, according to the different systems

Reporting system	Extraordinary accidents	Serious accidents
GAR	1	8
WCM	1	45
CARS	2	56

To be able to compare the H&S performance at Tetra Pak, as measured in the H&S survey, with other companies' performances the average Accident Frequency Rate (AFR) at manufacturing companies that are operating in Sweden and at six international companies was calculated. The data was gathered from BP (2007), Linder (2007), Malmer (2007), Olsson (2007), Pillay (2007), Sandvik (2007) and from AstraZeneca's homepage. In Figure 5.12, it can be seen that the AFR at Tetra Pak, according to the H&S survey, was close to the mean of this indicator at the six international companies.

Table 5.12. The average AFR at Tetra Pak compared to that at other companies

Benchmarking object	Average AFR
Swedish manufacturing companies	7,06
6 international companies	8,90
Tetra Pak	9,15

6. Analysis

A reporting model has a lot of characteristics. Every characteristic can be designed in many ways. The aim of this chapter is to evaluate the different options and to find their advantages and disadvantages, in order to come to a well-founded suggestion regarding the design of the reporting model. In the last part of the chapter the accident reports collected in the Health & Safety survey are analyzed.

6.1 Analyzing the relation between accident reporting and productivity

This section aims at theoretically deriving how a personnel safety event reporting system can contribute to an improved productivity and improved work environmental conditions. The relations are visualized in Figure 6.1.

In Section 3.11, it was found that an agency that receives deviation reports and spreads relevant, gathered information to other parts of an organization, is a basic condition in order to create organizational learning. Furthermore, it was stated that a fast and easy reporting process also could ease the organizational learning. The CARS and the system analysis of the reports can be seen as an agency that is working with the personnel safety events. A web-based reporting tool enables the reporting to be done efficiently. Therefore, a web-based accident reporting system has the potential, in my opinion, to increase the organizational learning within the H&S area at Tetra Pak.

In Section 3.12, it was stated that a basic condition for the existence of a learning organization is to develop a system that enables organizational learning. It can therefore be said that a personnel safety event reporting system can contribute to continuous learning within the H&S area at Tetra Pak.

In Section 3.13 the GEM-model and the learning organization as a bi-influencing factor was introduced. According to the GEM-model a learning organization can continuously improve the effectiveness and the efficiency of the production system at the same time as it improves the work environment and reduces the accident rates. With that, a model combining personnel safety event reporting with productivity and work environment has, in my view, been designed.

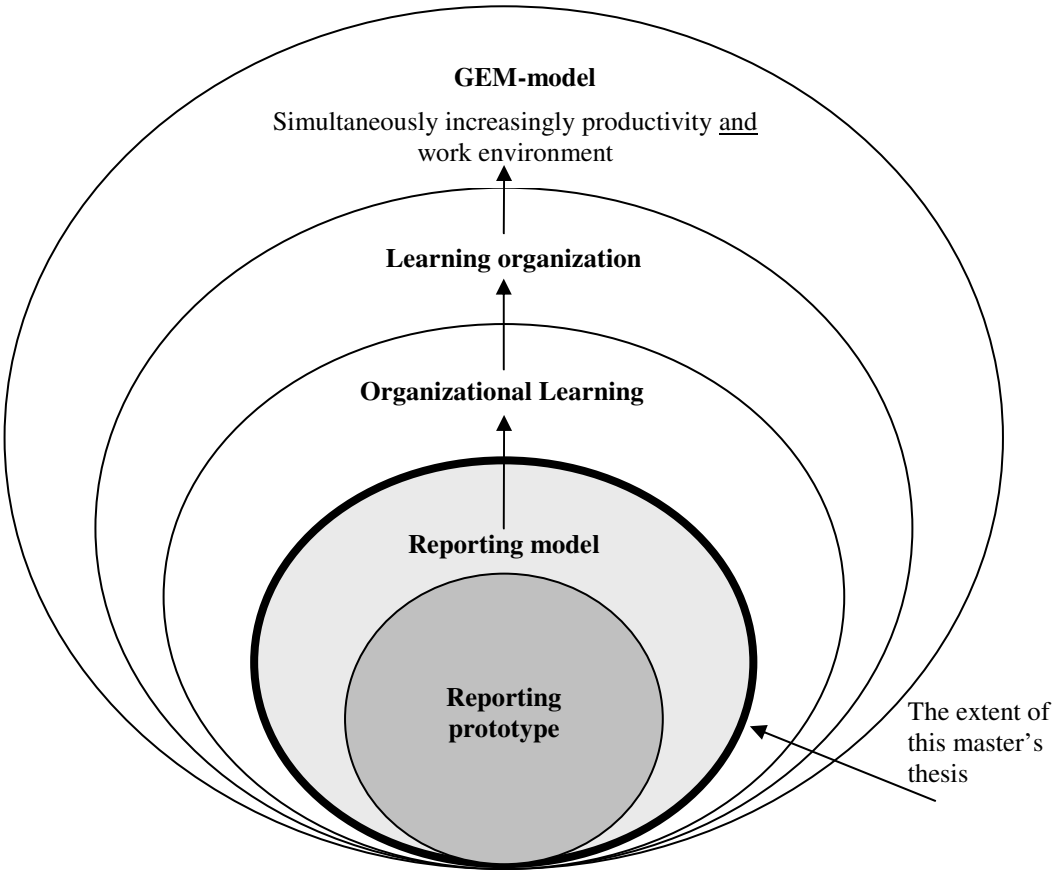


Figure 6.1. Combining the CARS with improved work environment

6.2 Methods for accident reduction at Tetra Pak

This section aims at using the results of the H&S survey and the gathered information about Tetra Pak's H&S efforts on corporate level, to assess their current situation. The first assessment will be made according to Fleming's safety culture maturity model, described in Section 3.14.1. Thereafter the situation will be analyzed according to Dow's methodology to reduce accident rates, as stated in Section 5.2.1.

Although it can be difficult to make one common assessment of the safety culture and of the focus of the H&S efforts in a big, heterogeneous organization like Tetra Pak without extremely detailed information, it was still thought useful to do so. The reason is that ideas about efficient methods for further improvements of the H&S performance at Tetra Pak can be derived from the two models, provided that common assessments have been made.

6.2.1 Fleming's safety culture maturity model

As stated in Section 3.14, the existence of a good safety culture is an effective way of reducing the number of accidents. Improving the safety culture can, according to this argumentation, decrease the accident rates. The first step in Fleming's model is to assess the current safety culture maturity level.

During the interviews it became obvious that there are many H&S MSs on site-level and that the SMP has developed a structure for harmonizing the H&S MSs at Tetra Pak Converting. According to my point of view, Tetra Pak has fulfilled the requirements of the first level of Fleming's safety culture maturity model. As stated in Section 1.1, this project has the top management commitment and Tetra Pak uses AFR, a reactive indicator, to measure their H&S performance. This means that Tetra Pak has fulfilled two requirements of the second level in the maturity model. This project and e.g. Project B aim at involving the frontline staff and within the Converting factories the indicator AFR is monitored. Therefore, it can be said that Tetra Pak has also reached some requirements for the third level. However, Tetra Pak has not reached all the requirements of the third level, since it was in Section 5.5.7 found that their AFR was about average. In the annual global Employee Engagement survey 2007, which all of Tetra Pak's employees can fill in, Jaquenoud (2007) found that the physical work environment only got average grades. It is therefore estimated that Tetra Pak does not meet the requirements of the fourth level in Fleming's model. The overall estimation of the safety culture maturity at Tetra Pak on corporate level, according to Fleming's model, is therefore that the safety culture is between level 2 and level 3. The assessment is visualized in figure 6.2.

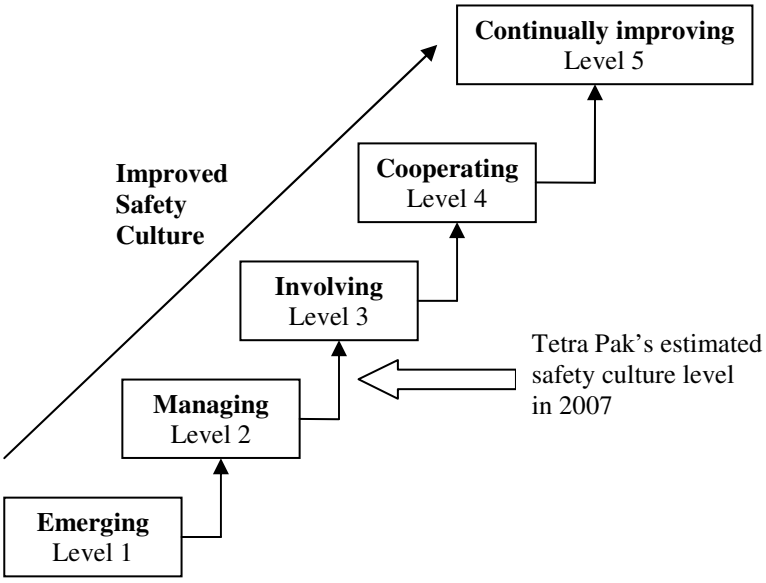


Figure 6.2. The estimated current safety culture maturity level at Tetra Pak

Fleming's recommended way of improving the safety culture and thereby also lower the accident rates, when it is currently assessed as level three, is to engage all staff to cooperate in order to improve the work environmental conditions.

6.2.2 Dow's methodology to reduce accident rates

According to Dow's methodology to reduce accident rates, different methods are efficient to reduce the accident rates depending on the organization's developmental phase concerning their current accident rates and their currently used methods.

Project B aims at improving the H&S performance at Tetra Pak by improving the safety of its equipment and packages. The CARS aims at improving the H&S performance at Tetra Pak, mainly by proposing central corrective actions that can improve the work environment at their sites. My assessment is that both these H&S projects can be categorized to Dow's first category "Design and engineering of the sites". As found in Section 5.5.6, only 5% of the accidents in the H&S survey were, according to the respondents, caused by organizational deficiencies. During the H&S mapping at Tetra Pak, no projects focusing on organizational factors were identified. These two facts indicate that the organization has not come to the second phase of Dow's accident rate reduction methodology.

The recommended method to decrease the accident rates further at Tetra Pak, according to Dow's methodology, is to initiate H&S projects that focus on the organizational factors.

6.3 The need of an accident reporting system

In Chapter 3 results from two independent studies, Jones et al. (1999) and Nielsen et al. (2006), showed that an increased personnel safety event reporting can decrease the number of accidents. It was also found that an accident reporting system can work as an agency that catalyzes the organizational learning. My conclusion is that these two facts can be explained by the model that is described in Figure 6.1. In section 3.5.1 many purposes and advantages with performing measurements within H&S were found. It is thereby clear that Tetra Pak can benefit from implementing personnel safety reporting systems.

In order to create a buy-in in the organization for a specific reporting tool, it must add more value to its users than the efforts doing the input. In Section 5.4.1, it was clear that all of the interviewees thought that there is a need, but perhaps not urgent, to implement a personnel safety event reporting system on corporate level. However, it was also stressed that the system needs to be able to replace some existing reporting systems at Tetra Pak with the same purposes, like the GAR, to really add value and not bureaucracy to its users. Implementing H&S reporting systems on corporate level versus only having reporting systems on site-level can in my opinion provide Tetra Pak with the following advantages:

- The organizational learning process gets faster, since reporting systems on higher organizational level can provide Tetra Pak with more learning opportunities;
- An accident reporting system on corporate level enables internal and external benchmarking studies;
- It will be easier to create an image of Tetra Pak's H&S performance throughout their organization.

Implementing an accident reporting system on corporate level has, in my view, also some risks:

- It can result in an increased administrative workload for the respondents of the system. It is also necessary to allocate financial and human resources to analyze the gathered reports and to promote the willingness to report;
- Due to the large amount of initiatives from corporate level at Tetra Pak, they can sometimes be negatively perceived by the employees on local levels of the organization.

My overall assessment is that there is a need to implement an accident reporting system on corporate level at Tetra Pak, as a complement to the personnel safety event reporting systems on site-level. However, only on the condition that it can replace some of the existing accident reporting structure in the future.

6.4 Factors that stimulate a successful implementation of the system

In Section 3.11.2 top management commitment and a high willingness to report were found as two basic conditions for a successful implementation and running of reporting systems.

In Section 1.1 it was said that this project had the top management's commitment. This statement was in my opinion verified, when all of the 11 Cluster Technical Service Leaders were willing to appoint persons to be users of the CARS. The top management's commitment to the frequently use among the respondents of the system and to appoint adequate respondents, is a very important a factor. Therefore, continuously efforts need to be made in order to maintain and strengthen this commitment.

Creating a high willingness to report, once the CARS is implemented, will to my mind be a bigger problem. One of the interviewees stressed this as a potential problem in his cluster. In Section 2.7.4 it was also found that the willingness to report into the GAR has been low. In the interviews and in Chapter 3 many ways of improving the reporting culture and the willingness to report were suggested. The following actions were considered as efficient and feasible, within the framework of this master's thesis:

- *Ease the reporting procedure.* A web-based reporting prototype will be highly accessible. One of the main goals, when the reporting prototype was developed, was that it should be fast and easy to use. The usability tests indicated that the reporting prototype fulfilled the needs of being fast and easy to use.
- To *de-identify the involved* person once the report is received is possible in the developed reporting prototype.
- *Fast and useful feedback* will be delivered to the respondents by sending a monthly consolidation. This consolidation will include the relevant reported accidents together with the taken and planned corrective actions.
- Create a *procedure*, where it is stated that the reporting is mandatory to do.

In order to maintain a high willingness to report in the future, the following three actions are considered as the most important ones. The actions are seen as particularly efficient, when it comes to increasing the willingness to report near misses at Tetra Pak:

- *Visualize the short- and long term effects of reporting accidents and near misses*, e.g. by monitoring the Performance Indicators (PIs). If the positive effects, on the PIs, of an increased reporting are showed to the employees, they will be stimulated to report more in the future. In this way, a positive spiral can be created.
- *Educate* in H&S-related issues and *have campaigns* directed to Tetra Pak's employees in general and the users of the CARS in particular. Such efforts can raise the awareness and make everyone understand the importance of reporting personnel safety-related events.
- During the project it was found that the chosen group of respondents and the appointed owner of a reporting system are highly influencing its chance of being established and frequently used. Appointing an adequate owner of the CARS is important since this entity should have the responsibility to promote the willingness to report into the system and to raise the management's commitment to these kinds of issues. In Section 5.5.7 the group of respondents' strong influences on the number of reported accidents was visualized.

In Section 5.1.12 it was discussed whether economic incentives can be an efficient way of stimulating the willingness to report personnel safety events. In my opinion it is extremely difficult to design a reward system that stimulates the willingness to report. If incentives for low accident rates are introduced there is a major risk for underreporting. On the other hand, if the employees get a bonus for every report they submit, there is an imminent risk of getting many reports with low quality. My recommendation is therefore not to introduce any economic incentives to stimulate the willingness to report personnel safety events at Tetra Pak.

6.5 When should the accidents be reported?

The accidents that occurred during 2007 were recorded in the period 15th to 30th November 2007. As for the accidents occurring during 2008, they could either be continuously reported or reported on predefined times. If the reporting would take place on predefined times, a monthly basis was considered as a suitable reporting frequency. A majority of the interviewees would prefer a continuous reporting. The following advantages were found with using a monthly and a continuous reporting, respectively:

Advantages with a reporting on a monthly basis:

- A routine and a discipline for reporting personnel safety events will be created faster. It will be easier to follow-up and to remind the respondents that who not report. This will probably result in a higher response rate.
- The success of a reporting system on a monthly basis does not, to the same extent, depend on a high reporting culture.
- An event-triggered reporting could build up unreasonable expectations among the employees that corrective actions will be taken immediately for all submitted reports.

Advantages with a continuous reporting:

- The system administrator will be informed about the accident at an early stage and can early inform the relevant stakeholders.
- The quality of the reports will probably be higher, since the time between the accident and the time for the reporting will be minimized.
- The system will always be updated and not be lagging.

A personnel safety event reporting system with reporting on a continuous basis was considered as ideal, with the above-mentioned advantages. However, it was also found that the successful implementation of such a system is, to a higher extent, depending on a high willingness to report and a high level of the reporting culture. In Section 6.4 it was found that there was a major risk of a low willingness to report at Tetra Pak. Since a continuous reporting is especially sensitive to a low willingness to report, a monthly reporting will be recommended in order to secure a successful implementation of the CARS.

However, when the reporting routine is established and the willingness to report has increased, an event-triggered reporting would most probably work. Then, but first then, it is important to change to an event-triggered reporting in order to utilize its advantages.

6.6 Reportable personnel safety events

In Section 5.1.5 it became clear that it is important to clearly define which types of personnel safety events that are reportable. It was found suitable to make a differentiation, regarding which types of personnel safety events that should be reportable in the different stages of the implementation of the CARS.

In the first stage information about the accidents that have happened during 2007 was collected. At this stage it was decided to only make extraordinary and serious accidents reportable. Minor accidents were excluded in this template, since it was assessed that the response rate could be low due to the high input efforts.

During 2008 the reporting template will also include minor accidents. Since the reporting is done on a monthly basis, there will on an average be 12 times fewer accidents compared to the scenario during 2007, where all accidents during one year were reported at one occasion. According to the Safety Iceberg assumption mentioned in Section 3.9.1, the ratio between serious and minor accidents are 1:10. If minor accidents also are reportable, the monthly workload for the respondents will be comparable with the workload for recording the accidents during 2007. Therefore, my recommendation is to make minor, serious and extraordinary accidents reportable during 2008.

Once the CARS is running, it must be assessed whether the system is adding value to its users. If it is proven that the system actually adds value, the future existence of the system is, in my view, justified. In this stage major near misses should also be introduced as a reportable personnel safety event. Section 3.10 stated that reporting near misses provides many learning opportunities and is an effective method for decreasing the number of accidents. However, it was also stated that near misses are in general reported

less frequently, compared to accidents. Therefore, it is important that major near misses are reportable in the CARS, but not until the benefits from the reporting of the personnel safety events are apprehended by the users of the system.

6.7 The included user groups in the reporting system

In Section 1.1 the following potential user groups were found:

- A Tetra Pak employee who is involved in an accident or near miss at Tetra Pak's production facilities;
- Any of Tetra Pak's employees who is involved in a personnel safety event, when working at Tetra Pak's customers' sites;
- Tetra Pak's customers' employees, who get injured using Tetra Pak's equipment;
- Personnel safety events occurring at Tetra Pak's Office sites.

The purpose of the master's thesis made it, to my mind, clear that the first potential user group should be included in the CARS. In order to drive improvements of the work environmental conditions at Tetra Pak, a basic condition is to include their own production facilities in the reporting system. As stated in Section 5.1.3 the main target group of the reporting system will probably be the FSEs. The FSEs are exposed to bigger risks, since they are often hired in the starting-up phase of a Customer site, or at a Customer with lower work environmental standards than at Tetra Pak's production facilities. In Section 5.5.1 calculations confirmed that the accident rates at Tetra Pak's customers' sites were considerably higher than those at Tetra Pak's own production facilities. The second user group should therefore be included in the reporting system. One of the main purposes of Project B is to collect information about undesired events occurring when Tetra Pak's customers' employees are using Tetra Pak's equipment. According to my point of view, the CARS would not add any additional value to this category. Therefore, these personnel safety events will not be reportable in the CARS. During the interviews it was stated that a big majority of the personnel safety events occurring at Office sites are minor and site-specific and can therefore not provide any organizational learning. The fourth potential user group will therefore be excluded from the use of the system. A majority of the interviewees also had the same opinion when asked which groups that should use the CARS.

Accidents occurring when traveling from or to work will not be reportable. For instance, commuting accidents are included in some national definitions and excluded in others. Therefore, it could be chosen whether commuting accidents should be reportable. These accidents happen in an environment where Tetra Pak, in my opinion, can neither influence nor take corrective actions in. Furthermore they cannot contribute to any organizational learning, from Tetra Pak's point of view. Therefore, accidents when traveling to or from work will not be reportable in the CARS.

In this section the following two user groups have emerged:

- A Tetra Pak employee who is involved in an accident or near miss at Tetra Pak's production facilities;
- Any of Tetra Pak's employees who are involved in a personnel safety event, when they are working at Tetra Pak's customers' sites.

6.8 Appointing the persons to do the reporting

To be able to obtain a high level of quantity and quality of the accident reports, finding appropriate users of the reporting tool is an important factor. It is crucial to appoint persons on adequate levels of Tetra Pak.

Appointing persons that have a more central position in the line organization, e.g. respondents on site-level, would, in my view, have the following advantages:

- Fewer respondents will result in lower complexity in the rolling out and the running of the CARS;
- The English skills tend to be better on hierarchical, higher levels of Tetra Pak;
- It will be easier to take actions against a low response rate if the number of respondents is low.

Appointing persons on locals levels in line organization, e.g. one respondent per department, could provide Tetra Pak with the following advantages:

- The respondents are closer to the accidents, which will enable them to easier gathering of information about the accidents. This will result in a high quality of the reports;
- Involving the frontline staff in the personnel safety event reporting is, according to Fleming's safety culture maturity model, the recommended way for Tetra Pak to increase their safety culture;
- A high number of respondents can ease the buy-in of the CARS from the organization.

It would probably be ideal to appoint persons on local levels in the line organization, since this could ease a high quality of the reports and increase the safety culture at Tetra Pak. As found in Section 5.1.9, this was also a widespread opinion among the interviewees. However, with the background of the low willingness to report into the GAR, a successful implementation of such a system would, to my mind, be unlikely at Tetra Pak. My recommendation is therefore to start with choosing respondents from more central levels of the organization.

However, when the CARS is successfully implemented the number of respondents should gradually increase by appointing persons on local levels of the line organization. The vision should be to have a personnel safety event reporting system where every employee is respondent.

6.8.1 Accidents on Tetra Pak's production facilities

As for accidents at Tetra Pak's production sites, it was found that one respondent per site was the appropriate level. As stated in Section 2.4 there are three types of production sites at Tetra Pak:

- Converting sites;
- Development & Engineering sites;
- Processing sites.

At the Converting sites there is a Local Safety Pillar Leader at every site. They are already responsible for gathering information about personnel safety events that have occurred at their sites. Therefore these persons were appointed as users of the CARS in this user group.

The Development & Engineering sites and the Processing sites did not have a common structure, including at each site similar positions that have the responsibility to gather information about personnel safety events. Therefore, it was up to every site to appoint one person, who best could gather this information and to do the input into the reporting system. Mainly Production Managers, Safety Representatives and HR specialists were appointed.

6.8.2 Accidents at Customers' sites

As for accidents occurring at Customers' sites, the choice was between one respondent per market company and one respondent in every cluster. It was decided that the reporting should be done on cluster-level, since it would be easier to find contact persons there and these persons would have a better overview of the situation. However, the respondents could choose between gathering information about the accidents themselves and delegating this task to their market companies. It was up to the Cluster Technical Service Leader in each cluster, to appoint one suitable person for this task. Most of the appointed persons were Managers for FSEs, Technical Service Secretaries or Human Resources Directors.

6.9 Analyses in the system

In this master's thesis, two types of analyses of personnel safety events are discussed. The Root Causes Analysis (RCA) is made to determine the true causes of the accidents. The system analysis is made on the material, gathered with the reporting prototype. This section aims to describe where at Tetra Pak, these two analyses should be made.

6.9.1 Root Causes Analysis

In Section 5.1.10, it was found important to have knowledge about the local work environmental conditions in order to successfully perform an RCA. According to my point of view, the RCAs should, also in the future, be performed on local levels of Tetra Pak. In complicated analyses the local investigators shall contact their Industrial Safety Engineer and use her / his competence.

The RCAs should, in my opinion, be done as soon as possible after the accidents have occurred. This enables corrective actions to be made at an early stage and sends a signal to the employees that the investigations of personnel safety events have a high priority at Tetra Pak.

6.9.2 System analyses

The system analyses of the gathered accident reports need to be done on corporate level at Tetra Pak in order to measure their H&S performance and to perform comparisons between the entities at Tetra Pak. The best solution, in my view, would be if the person who is operatively responsible for running of the CARS also did the system analyses. The reason is that this person already is familiar with the material and the reporting system.

The Health and Safety Executive (2001) stated that if the measurement of the H&S performance shall be efficient, it is important to determine an adequate frequency of the system analysis. The time between the analyses must be long enough to enable a significant change. The Health and Safety Executive further argued that the system analyses must be made often enough to control the development of the PIs. Since the reporting is done on a monthly basis, there is no point in doing the system analyses more often than once per month. Doing the system analysis annually or bi-annually, would result in that feedback to the respondents cannot be sent back more than once respectively twice per year. This would, to my mind, lower the respondents' value of the CARS. Therefore, my recommendation is to make the system analyses, for all types of sites, on a monthly basis.

6.10 Spreading information

In Section 3.11, it was stated that an agency, e.g. a personnel safety event reporting system, can catalyze the organizational learning. However, this can only occur if the agency spreads some of the gathered information and the results of the system analyses to all relevant parts of the organization. The main objective, in this section, is to propose the entities that should get access to the different types of information gained from the CARS.

The raw data in the reporting system is sensitive data, including e.g. names and descriptions of unsafe acts. This data should therefore only be accessible to the authorized people at Tetra Pak.

Information that describes the accidents and the corresponding corrective actions must, in my opinion, be spread to a larger number of stakeholders in order to catalyze the organizational learning within H&S at Tetra Pak. The Health & Safety Executive (2001) stated that this information needs to be spread to all the people with particular responsibilities within the H&S MS. However, in the interviews it became obvious that there is no need to transfer this type of information between the different types of sites, since the local conditions differ too much. My recommendation is therefore to split the consolidated material, considering the type of site where the accidents occurred. Information about the accidents that have occurred at a certain type of site, shall on a monthly basis be sent to the respondents in this user group. For example, the respondents responsible for the Customer sites shall monthly get a report about the accidents that have happened at all Tetra Pak's customers' sites. In this way, the respondents will only get information about for them relevant accidents. This solution creates, in my view, the highest value for the users of the CARS.

The results from the system analyses, including for example general seen patterns and comparisons between the plants should be spread to all the respondents. These statistics are, to my mind, also relevant to transfer between all types of sites, since all respondents should have an interest in getting this information. My recommendation is to also spread this data once per month.

6.11 Analyses of the results from the survey

The purpose of this section is to detect patterns in the occurrence and severity of the accidents by analyzing the information gathered with the reporting prototype. The first part describes the methods that were used to analyze the gained material. The second part describes the outcomes from these analyses.

6.11.1 The measures used to analyze the accident reports

In Section 5.5 it was stated that Accident Frequency Rate (AFR) and Accident Severity Rate (ASR) were chosen as the Performance Indicators (PIs) that were used to measure the H&S performance in this master's thesis. Blom et al. (1998) suggested the measures presented in Formula 6.1 and 6.2, as suitable for determining the spread of collected data. The two measures are in principle different since the standard deviation is an absolute- and the coefficient of variation is a relative measure of the spread. Both these measures will therefore be used to analyze the spread of the AFR and the ASR.

$$\text{Standard deviation (s)} = \sqrt{\frac{1}{n-1} * \sum_{i=1}^{n} (x_i - \bar{x})^2} \qquad (6.1)$$

Where

n is the number of submitted accidents reports;

x_i is the value of the chosen PI in accident report i;

$\bar{x}$ is the weighted arithmetical mean for the chosen PI.

$$\text{Coefficient of variation } (c_v) = \frac{s}{\bar{x}} \qquad (6.2)$$

6.11.2 Analyzing the results from the Health & Safety survey

In Table 6.1 the standard deviation is calculated as in Formula 6.1. The measure is calculated separately for the different types of sites at Tetra Pak. As for the AFR it was found that the standard deviation was similar for all types of sites, except for Tetra Pak D&E. However, since Tetra Pak D&E only has two sites, no conclusions can be drawn from this result. As for the ASR the standard deviations were higher and they differed more between the types of sites. According to my point of view, this was due to the fact that the few extraordinary accidents had a major influence on this PI.

Table 6.1. The standard deviation of the PIs divided into the types of sites

Type of site	s for AFR	s for ASR
Tetra Pak Converting	13,29	18,67
Tetra Pak Processing Systems	11,54	36,33
Tetra Pak Development & Engineering	6,49	6,49
Customer sites	11,06	21,60

Table 6.2 shows the coefficient of variation. In most cases the value of this measure was about 100%, which is considered as high. However, the coefficient of variation was even higher for the TPPS sites. An explanation for the fact that the TPPS sites had a higher coefficient of variation compared to the other types of sites, is in my opinion that most of their accidents occurred at sites with few total exposure hours. This resulted in that some sites had no accidents and some sites had high accident rates, which caused the high coefficient of variation.

Table 6.2. The coefficient of variation of the PIs divided into the types of sites

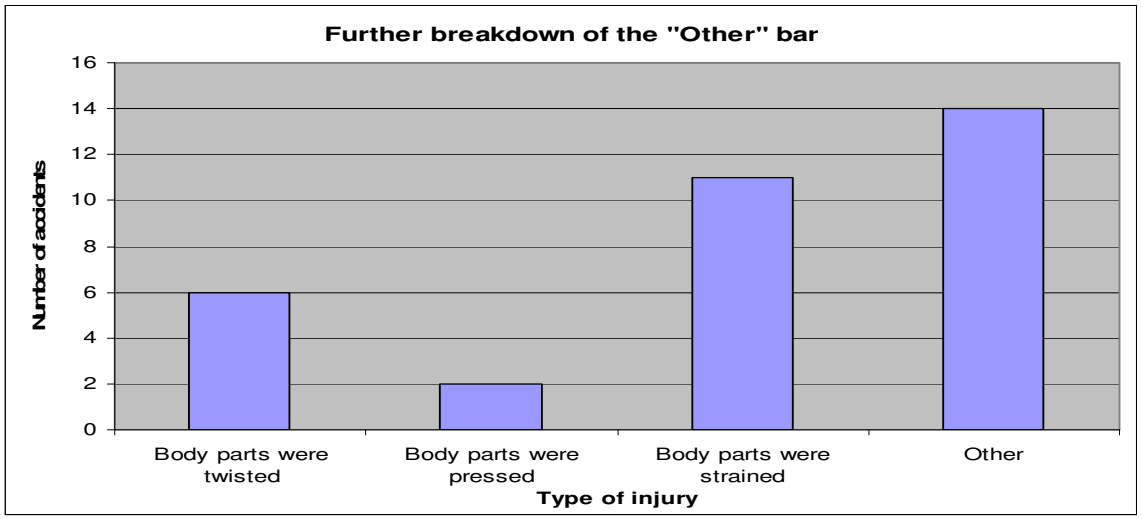
Type of site	Cv for AFR	Cv for ASR
Tetra Pak Converting	154%	166%
Tetra Pak Processing Systems	264%	296%
Tetra Pak Development & Engineering	89%	89%
Customer sites	76%	115%

The respondents were asked what type of injury the accidents resulted in and whether there were any aggravating circumstances at the time of the accidents. It was found that the answer option “other” was one of the most frequently chosen for these questions in the H&S survey. If the answer “other” was chosen, the respondents were asked to specify their answers in a free-text box. Analyzing these answers would enable a more precise presentation of the results of the H&S survey. Furthermore, this analysis can provide the future reporting prototype with additional relevant answer options.

As for the aggravating circumstances, no patterns in the free-text answers could be traced. Therefore, this “Other” bar will remain unchanged.

When the “Other” answers for the different types of injuries were analyzed, two frequently reappearing answers were found. In Table 6.3 the bar “Other” from Table 5.7 is broken down further. The answers that only were submitted once are put in a new “Other”-bar. The table shows that both injury caused by pressing and by twisting had occurred more than five times during 2007. These two answer options will therefore be added to this question in the future reporting prototype.

Table 6.3. Breakdown of the “Other” bar for the types of accident



7. A Tetra Pak Group procedure for accident reporting

This chapter aims at giving a suggestion for what a procedure for the Corporate Accident Reporting System could look like.

Almeida (2007a) defined a procedure as a proven, formulized manner to perform a work. To fulfill its purposes, a procedure needs to be available, adequate, known and followed. Within Tetra Pak Group, the procedures are mandatory behaviors on a detailed level. Furthermore, they are a part of the Corporate Governance and revised on an annual basis.

The purpose of this procedure is to regulate the responsibilities of the reporting system during 2008. This chapter can be seen as a summary of the outcomes from Section 6.5 to 6.10.

7.1 Accident reporting group procedure

7.1.1 Introduction

This Tetra Pak Group Procedure is written to define the responsibilities for the Corporate Accident Reporting System. This is done with the purpose of clarifying, for all stakeholders, the following issues:

- When, what and by whom the reporting should be done;
- The tasks for the owner of the reporting system;
- How to operatively run the system;
- The tasks in the system analysis.

7.1.2 Content

Responsibilities for the reporting
In the reporting template minor, serious and extraordinary accidents will be reportable. The following definitions will be used for these types of accidents:

- *Minor Accidents***:** Injuries that can be treated on site or that do not require medical advice/attention or loss of time less than 1 working day (e.g. minor cuts, bruises, contusions, scrapes, temporary dizziness or nausea).
- *Serious Accidents:* Injuries that cannot be treated on site or that require medical advice/treatment or loss of time amounting to more than 1 working day. Examples of serious accidents are cuts requiring sutures, broken bones and fractures.
- *Extraordinary Accidents:* Any injury causing death, loss of a body part or total or partial disability. Injuries included in this group could be loss of fingers or hands, injuries of such a nature that the employee will never be able to perform his/her regular job function again or will not be able to perform his/her regular job without additional aid.

Tetra Pak's employees, who are working in the following four types of sites, will be covered by the Corporate Accident Reporting System:

- Converting sites;
- Equipment Manufacturing sites (Packaging);
- Equipment Manufacturing sites (Processing);
- Customer sites.

In the first three user groups, one person in every production facility is responsible for reporting into the system. As for Tetra Pak's employees working at Customer sites, the Technical Service Director in each cluster is responsible for appointing one person to do this task. It is the respondents' responsibilities to gather adequate information, in order to do the input to the system

The reporting should be done on a monthly basis. The respondents shall report all reportable accidents that have occurred since their last report was submitted, in their area of responsibility.

The tasks for the owner of the reporting system

On completion of this master's thesis a decision regarding which entity at Tetra Pak that shall take the ownership of the Corporate Accident Reporting System will be taken. The appointed owner has to fulfill the following duties:

- Appointing one person who is responsible for the operative running of the reporting system;
- Promoting the willingness to use the reporting system among the respondents and other stakeholders;
- Deciding to which stakeholders the information gathered in the reporting system should be distributed;
- Follow-up on set H&S targets.

How to operatively run the system

The person who is responsible for the operative running of the reporting system has the following tasks to fulfill:

- Continuously revising and maintaining the reporting prototype and the list of the group of respondents;
- Provide the respondents with feedback and ask for further information, when it is considered as needed;
- On a monthly basis perform system analyses on the information that was gathered with the Corporate Accident Reporting System;
- Propose central corrective actions, whenever it was considered as necessary, in the system analysis;
- Spread relevant information about the accidents to the relevant stakeholders.

The tasks in the system analysis

The information collected with the Corporate Accident Reporting System needs to be analyzed in order to provide any value. The following things should be included in the system analysis:

- Calculate the performance indicators and visualize their development over time;
- Use the performance indicators to perform relevant internal and external Benchmarking;
- Seek for general patterns about the occurred accidents in the collected material.

8. Discussion and Conclusions

This chapter describes the conclusions that were drawn in this master's thesis. This includes a description of overlaps between existing accident reporting systems at Tetra Pak, conclusions that were based on the results of the Health & Safety survey and on the developmental process of the reporting system. The last parts of this chapter contain suggestions on how the Corporate Accident Reporting System can be developed further and the reliability of the results in this master's thesis.

8.1 Overlaps between existing reporting systems at Tetra Pak

It is important to investigate if there are overlaps between the Corporate Accident Reporting System (CARS) and other existing reporting structures within Tetra Pak. The result of such overlaps is that some user groups must report the same event twice. This increases the workload for the respondents and creates confusion among Tetra Pak's employees.

8.1.1 The overlap between the Corporate Accident Reporting System and the Global Accident Report

The SMP Leader argued that the CARS and the Global Accident Report (GAR) have the same purposes, which is to spread information about accidents and to raise the awareness of Health & Safety (H&S)-related issues. As long as the CARS and the GAR coexist, the Local Safety Pillars Leaders at the Converting sites must report accidents that have occurred at their sites twice. The major differences between the systems, in my view, are that the CARS has a more standardized and efficient way of gathering information about the accidents. Furthermore, more types of data can be gathered with the CARS and the system covers a broader spectrum of user groups. Therefore, the CARS covers, to my mind, all needs of the GAR regarding user groups and the gathered information. Figure 8.1 visualizes the overlap between the CARS and the GAR.

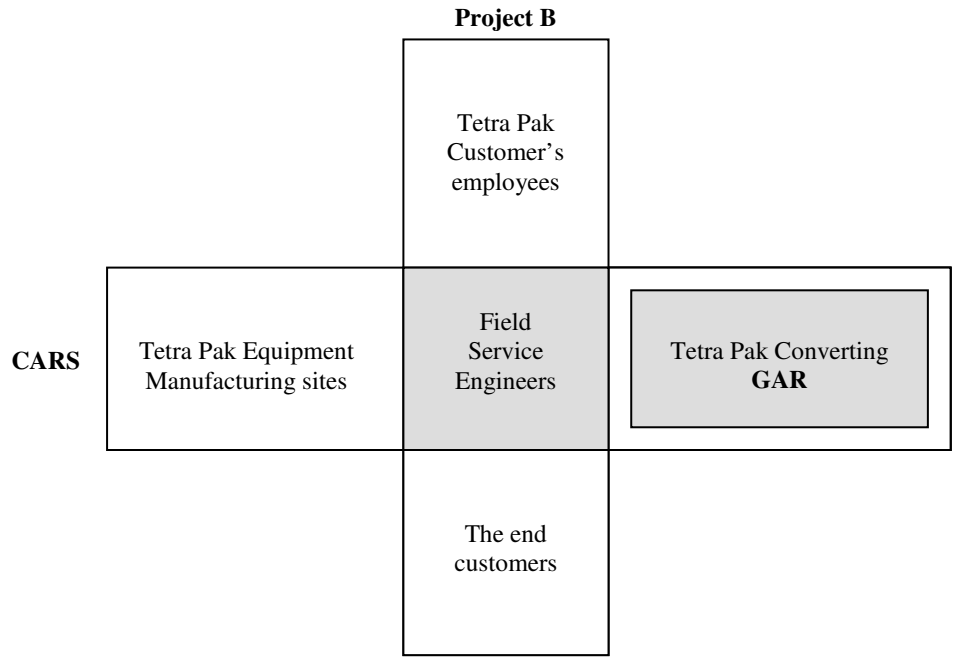


Figure 8.1. Overlaps between the CARS and the existing accident reporting structures within Tetra Pak

8.1.2 The overlap between the Corporate Accident Reporting System and Project B

The purpose of Project B is to standardize the Root Causes Analysis (RCA) and the corrective actions for any undesired event caused by equipment and packages produced by Tetra Pak. This means that the CARS and Project B have completely different purposes. The systems also differ regarding which types of events that are reportable. In the CARS only personnel safety events are reportable; in System B many types of undesired events are reportable. The potential user groups of the two systems are also not the same. Project B includes events with any person that comes in contact with equipment or packages produced by Tetra Pak. The CARS includes Tetra Pak's employees who get injured working at Tetra Pak's production facilities or at Tetra Pak's customers' sites. The only possible overlap between the systems is, in my opinion, when a Field Service Engineer (FSE) gets injured when she / he is working with Tetra Pak's equipment at a Customer site. This overlap is visualized in Figure 8.1.

8.1.3 A proposal for how to solve the problems with the overlaps

As stated in Section 8.1.2 Project B and the CARS have different purposes. Furthermore, their overlap is small compared to the spectra of user groups and reportable events in the two systems. Therefore, there is, in my view, no need to combine these two systems. However, at first sight the projects look similar. Therefore, it is important to clearly communicate the differences between the systems to all relevant stakeholders, in order to create a buy-in for both projects in Tetra Pak's clusters. It is also crucial to continuously coordinate the two projects.

As found in Section 8.1.1 the CARS and the GAR have similar purposes. The CARS covers, to my mind, all of the GAR's capabilities. This means that the GAR does not add any value once the CARS is established. It is therefore recommended to combine these two reporting systems. However, this should not be done until the CARS has been successfully implemented.

8.2 Discussion about the Health & Safety survey

This section aims at describing the conclusions that were drawn from the results of the H&S survey.

8.2.1 Conclusions drawn of the results in the Health & Safety survey

As found in Section 6.11 the spread of the PIs between the same types of sites was very high in the H&S survey. The coefficient of variation was in most cases about 100% and, for the TPPS sites, more than 250%. This has, in my opinion, two explanations. The true reason is likely a combination of the following two explanations:

- The true accident rates differ a lot between the different parts of Tetra Pak. This means that also the work environmental standards differ a lot between the sites / clusters. If Tetra Pak introduced more corporate minimum work environmental standards and implemented an accident reporting system on corporate level, the differences in the accident rates would likely decline.
- Although there were accident definitions in the reporting prototype, the respondents did not have a common opinion regarding how to classify the personnel safety events. As found in Section 5.5.1 the European clusters together with the North American cluster had, in average, an about 60 % higher AFR compared to the other clusters. This difference is, in my view, much more likely due to differences in reporting cultures, just cultures and accident classifications than due to differences in the true accident rates. In Section 5.5.7 the collected data from three accident reporting systems within Tetra Pak was compared. Although the data was from the same time period and from the same sites, there were extremely big differences in the number of reported accidents between the reporting systems. This shows that the input in an accident reporting system at Tetra Pak is highly depending on the chosen group of respondents. It also supports the statement that the employees at Tetra Pak do not have a common view on how to classify accidents. To harmonize the used accident classifications within Tetra Pak, is therefore a very important factor to be able to perform high reliable internal H&S benchmarking studies at Tetra Pak in the future. To harmonize the used accident definitions at Tetra Pak, my recommendation is to clearly and frequently communicate the suggested classification system to all parts of Tetra Pak.

In Section 5.1.3 it was argued that the FSEs who are working at Customers sites, are the main target group for the CARS, since they are exposed to the biggest work environmental risks. In Section 5.5.1 calculations confirmed that the accident rates for Tetra Pak's employees who are working at their customers' sites were considerably higher than those at Tetra Pak's own production facilities. It can be difficult for Tetra Pak

to improve the conditions at their Customers' sites. However, my recommendation is still that Tetra Pak must allocate more resources to improve the work environment for their FSEs in the future.

As stated in Section 3.8.2, 85% of all accidents are in average caused by unsafe acts. In the reporting prototype "Human error" and "The existing routines were not followed" can be derived to this accident causation category. According to Section 5.5.6 these two factors caused 76% of the accidents at Tetra Pak during 2007, which is close to the industry praxis. The results were broken down further and were compared between the types of sites. It was found that the number of accidents that were caused by human errors at Tetra Pak Converting was very big in proportion to the accidents caused by non compliance of existing routines. The reason could either be that Tetra Pak Converting is good at communicating their procedures to their employees or that there exists a culture at these sites, where accidents are assessed to be caused, to a high extent, by individuals. It is important to investigate, which of these two explanations that is correct. My recommendation is therefore to investigate the accidents that are caused by unsafe acts at Tetra Pak Converting more deeply, in order to find efficient actions.

8.2.2 Sites and clusters at Tetra Pak that require improvements

As stated in Section 8.2.1 the big differences of the recorded PIs between Tetra Pak's sites can partly by explained by that the employees within Tetra Pak do not use a common classification system for their accidents. However, the reason is also that the true accident rates and therefore probably also the work environmental conditions differ a lot between the sites / clusters. The following entities at Tetra Pak have been identified as those with the highest AFR. To see the PIs at all sites / clusters, see Table A.2.

- Le May
- Pune
- Skoghall
- Longview
- Cluster South Europe
- Vancouver

My recommendation is to first carefully examine the accident reports from the above-mentioned sites / clusters, in order to conclude whether the high PIs are correctly measured. Thereafter, it is important to investigate whether the accident rates also have been high in the past or if the recorded accident rates are a one-off event. When these two suggested controls have been made at all entities, the data is, to my mind reliable. The outcomes can thereafter be used as a basis for the prioritization of H&S resources and efforts between the sites /clusters; see Section 8.4.1 for further details.

8.2.3 External Benchmarking

In order to assess the H&S performance at Tetra Pak during 2007, according to the H&S survey, their average AFR was compared to the same measures at other companies. In Section 5.5.7 it was found that the AFR at Tetra Pak was on the same level as the mean, of this indicator at six international companies. My conclusion is that Tetra Pak's H&S performance is somewhat worse than many of the interviewees thought, even though the

current situation is not alarming. Tetra Pak must put additional efforts and recourses into the H&S area in the future, to be able to improve their work environment and their H&S performance.

8.2.4 How the project was received at Tetra Pak

Except for some minor pushback, this project has mainly received positive feedback from the respondents in the H&S survey and from the interviewees. As stated in Section 5.5.2 the response rate in the survey was 95%, which was higher than expected. The response rate was broken down on the types of sites and it was found that Tetra Pak Converting had the highest response rate. It was easier to find adequate respondents at the Converting sites and the information from these sites were submitted, to a higher extent, without further reminders. The SMP members were also supportive throughout the process and reminded their Local SMP Leaders, on several occasions, to use the CARS. Although the response rate at the TPPS sites was high, 91%, major efforts were needed before data was submitted to the system. Compared to the TPPS sites it was easier to collect information about the accidents at the Customer sites. This is not expected, since it should be more complex for these respondents to gather information about accidents that have happened in their geographically vast areas.

To sum up, the project and the H&S survey was, in my opinion, well received by all parts of Tetra Pak and very well by Tetra Pak Converting. The following conclusions were come to, using this information:

- The safety culture at all parts of Tetra Pak seems to be high enough to enable a successful implementation of the CARS, on the condition that the system is frequently promoted by its owner. However, this does not mean that Tetra Pak has the highest level of safety culture. The organization must put great efforts to improve their safety culture in the future. My recommendation is to achieve this by engaging all Tetra Pak's employees in the H&S work and by starting H&S projects that are focusing on organizational factors. Implementing the CARS, can raise the awareness of H&S-related issues, which can contribute to an improved safety culture.
- Tetra Pak Converting indicates that they have a more developed safety culture compared to the other parts of Tetra Pak. The main reason is that the Converting sites already have established an existing accident reporting structure. This means that they already have a discipline for reporting accidents. The TPPS sites have not yet established an inter-site H&S structure and that was clearly reflected in the H&S survey. The reason why the H&S survey was easier to conduct at the Customer sites than at the TPPS sites, was, in my view that the appointing of the respondents was made on top management level. The appointed respondents therefore felt that the survey was important and put great efforts on collecting accident information in their clusters.

8.3 Discussion about the reporting system

8.3.1 The reporting prototype

One basic condition, demanded by Tetra Pak, was that the reporting prototype should be fast and easy to use. In Section 5.4 it was indicated in usability tests that the reporting prototype fulfilled these demands. Adding more questions to the reporting prototype would increase the time to do the input into the CARS, which contradicts the need of having a reporting prototype that is fast to use. Therefore, additional questions should, to my mind, only be added if it is assessed that the additional submitted data can provide significant value to Tetra Pak. During the project no such additional questions were identified. As stated in Section 5.5 most of the questions in the reporting prototype were answered by more than 90% of the respondents in the H&S survey. My conclusion of this is that none of the questions were, by the respondents, considered as irrelevant or impossible to answer. Therefore should, in my opinion, none of the questions be removed from the reporting prototype. My recommendation is to use the questions in the reporting prototype, as proposed in Appendix 2, with the addendums that were suggested in Section 6.11.2. However, it is important to continuously revise the reporting prototype and to continuously identify potential new questions to add to the reporting prototype.

In Section 5.1.7 it was found that all of the interviewees preferred a web-based reporting prototype. When the reports about the accidents that have occurred during 2007 at Tetra Pak, were gathered with the reporting prototype, no disadvantages with a web-based solution could be found. The survey has indicated that a web-based reporting prototype can be used at Tetra Pak to collect information about their personnel safety events. However, it is, in my view, given the results in this master's thesis, impossible to conclude whether a web-based reporting prototype is the most efficient technical solution in order to gather information about personnel safety events on corporate level at Tetra Pak.

8.3.2 The need of implementing the Corporate Accident Reporting System

In Section 8.2.3 it was stated that the current accident rates at Tetra Pak, is close to the average compared to the same indicator at six other industry companies. It was therefore concluded that more efforts need to be made in the future to improve their H&S performance. In Section 6.1 it was stated that a reporting system can serve as an agency which catalyzes the organizational learning within H&S at Tetra Pak. The organizational learning process is in my opinion faster for a reporting system on corporate level, since the learning opportunities occur more frequently. In Chapter 3 empirical data showed that a successfully implemented reporting system for personnel safety events can reduce the number of accidents within an organization. It is thereby clear that the implementation of the CARS can contribute to improvements within H&S at Tetra Pak. Furthermore, in Section 5.1.4 it was found that most of the interviewees saw a need for implementing the CARS, provided that double reporting could be avoided.

My conclusion is that there is a need to implement the CARS at Tetra Pak, as a complement to the personnel safety event reporting systems on site-level. The ideal accident reporting structure at Tetra Pak, in my mind, is to have reporting systems on site-level that take local conditions and national work environmental legislation into consideration. These systems shall be complemented by an accident reporting system on corporate level, to be used for internal and external Benchmarking and to identify general patterns in the occurrence and the severity of the accidents at Tetra Pak. According to my point of view, the accident reporting systems on type of site-level, which in the present situation only includes the GAR, are superfluous and shall therefore be replaced by an accident reporting system on corporate level.

8.3.3 Factors that contribute to a successful implementation of the system

To be able to use the advantages stated in the previous section, it is necessary that the CARS gets successfully implemented and is used frequently. In Section 6.4 it was found that top management commitment to H&S issues, and a high willingness to report were the two most important factors in order to successfully establish and run the CARS at Tetra Pak. To maintain the top management commitment this project needs to be continuously promoted by the owner of the system. The top management needs to be reminded that their commitment to promote the willingness to report and to appoint adequate respondents is a basic condition for utilizing the advantages of accident reporting. As found in Section 6.4 the willingness to report will probably be the most crucial factor at Tetra Pak. To secure high long term willingness to report, the following recommendations are given in this master's thesis:

- Visualize the short- and long term effects of reporting accidents and near misses by actively monitoring the PIs;
- Educate in H&S-related issues and have campaigns directed to Tetra Pak's employees in general and to CARS' respondents in particular.

8.3.4 The vision of the Corporate Accident Reporting System

According to my point of view, the vision of the CARS should be to create an H&S-reporting system on corporate level at Tetra Pak that catalyzes the organizational learning and contributes to creating a learning organization. Furthermore, it is requested that the system contributes to creating a high willingness to make H&S changes.

It is desired to create a buy-in, from the organization, of the CARS. This should be done by involving as many employees in the H&S efforts, as possible. In Section 6.8 it was found ideal to have an H&S-reporting system on corporate level, where all of Tetra Pak's employees are respondents.

8.4 The handling of the system at Tetra Pak

This section aims at presenting a suggestion for how Tetra Pak should use the CARS to best be able to utilize its advantages, which are mentioned in Section 8.3.2. In the last part of the section, the ownership of the system is discussed.

8.4.1 Suggestions for how the Corporate Accident Reporting System can be used

My suggestion is not to only use the CARS as a reactive tool to gather and consolidate information about accidents that have happened to Tetra Pak's employees. To be able to utilize the potential advantages with the CARS, it must also be used for proactive purposes. The following suggestions are given for how Tetra Pak best can use the CARS:

- The consolidated material in the CARS should be used to identify areas of weaknesses to improve in the work environmental conditions at Tetra Pak. When such areas have been identified, possible central corrective actions can be proposed by the person who is responsible for the operative running of the system.
- Comparisons of the recorded PIs can, after the actions to raise the material's reliability that were proposed in Section 8.2.2 are taken, be used as a method for establishing priorities between the sites / clusters and to allocate central H&S recourses. This should be done, in order to assist the sites, with constantly high accident rates, to improve their work environmental conditions. It is important that this internal Benchmarking is not seen as a competition. This could lead to the result that the respondents underreport their number of accidents to improve their recorded H&S performance or that they are over-reporting, in order to get additional resources. In my opinion, all work environmental improvements should be done on the operative level at the sites, since these entities have the best knowledge about the current conditions.
- The CARS will be able to involve its respondents and hopefully also some of the management at Tetra Pak in H&S-related issues. Engaging all Tetra Pak's employees in the H&S work was, in section 8.2.4, recommended in order to improve the safety culture at Tetra Pak. Therefore, provided that the CARS and the importance of reporting personnel safety events are frequently communicated, implementing the CARS can result in an improved safety culture at Tetra Pak.

8.4.2 The ownership of the Corporate Accident Reporting System

As found in Section 6.4, choosing an adequate owner of the CARS within Tetra Pak, highly influences the two major factors that are determining the system's chance of being successfully implemented. In Section 7.1.2 responsibilities for the entity that will own the CARS are proposed. The ideal would, in my view, be if somebody in the entity who will own the CARS also is responsible for the operative running of the system. This section aims at presenting possible owners of the CARS and state which advantages and disadvantages the potential owners would provide Tetra Pak. The information in this section could be the foundation for later decisions on this issue. The following possible owners of the CARS, who are all back-office entities with global roles at Tetra Pak, were identified:

- When the efforts to implement an accident reporting system on corporate level was first started, it was decided that the *Human Resources Management (HRM) at Tetra Pak* should own and drive this project in the future. HRM is also the initiator of this master's thesis. The CARS initiative was, in my opinion, apprehended highly as a HR project. Major disadvantages by putting the

ownership of the CARS on HRM, are that they neither have sufficient competence in work environmental issues nor experience of implementing similar reporting systems

- One of the *Corporate Governance's* main tasks is to measure performances in many areas. This entity is therefore highly experienced in successfully implementing and running reporting systems and performing system analyses. However, a major disadvantage is that Corporate Governance has insufficient competence within the H&S area, to be able to propose central corrective actions that can improve the work environmental conditions at Tetra Pak.
- *Tetra Pak OHS* has a global, corporate all-embracing role within the H&S area at Tetra Pak. This means that the entity has the needed competence to propose central corrective actions for improving the work environment at Tetra Pak. As found in Section 5.1.15, the Industrial Safety Engineer and the Industry Physician who both work at Tetra Pak OHS, suggested that their entity should take the ownership of the CARS. The fact that the entity wants to take the ownership will likely result in a frequently promoting of the system, which in this master's thesis was found as an important factor. A disadvantage with appointing Tetra Pak OHS as the owner is that they have little experience of implementing and running reporting systems.
- Putting the ownership of the CARS on *the Safety Master Pillar (SMP)* would ease the coordination between the CARS and the GAR. Furthermore, the experiences gained from the harmonization of the H&S MSs at Tetra Pak Converting and the implementation and the running of the GAR could efficiently be used in the CARS project. Disadvantages with this solution would be an increased risk that the CARS will be apprehended as a Tetra Pak Converting initiative and that the SMP would lose their current focus on Converting-related issues.
- Many companies, e.g. Dow Chemical Company, have bundled their H&S efforts together with their Environmental function. However, putting the ownership of the CARS on the *Environmental function* would, in my view, not provide Tetra Pak with any advantages. The reason is that environmental safety events and personnel safety events mostly do not have any connection. Furthermore, the Environmental function does not have sufficient experience within H&S, to be able to use the CARS for proactive purposes.

8.5 Further Health & Safety development at Tetra Pak

In this section suggestions are made for how Tetra Pak can develop their central H&S efforts further. The recommended actions in Section 8.5.1 can be done immediately; those that are suggested in Section 8.5.2 can be implemented in the future.

8.5.1 Actions that are recommended to be done immediately

In Section 3.5.1 many advantages and purposes for an organization to measure the H&S performance were found. Although measures are a basic condition for performing measurements, it was in section 3.6.1 found that Tetra Pak Converting is the only part of Tetra Pak that has implemented an indicator for assessing their H&S performance. In Appendix 4 it is visualized that the needed information, for calculating the two measures

AFR and ASR, was possible to collect in 95% of the entities at Tetra Pak, when the H&S survey was conducted. As stated in Section 3.6 the AFR can give incentives to reduce the number of accidents and the ASR can stimulate the reduction of the severity of the occurred accidents. To sum it up, the two measures are in principle different and possible to calculate at almost all Tetra Pak's sites. My recommendation is therefore to introduce both AFR and ASR as new Key Performance Indicators (KPIs) at Tetra Pak Group during 2008.

Benchmarking studies have showed that Best Practice companies, e.g. Dow, have set specific goals for the development of their H&S performance. Although Tetra Pak Converting has set a zero accident ambition, no tangible goals for the development of the PIs within H&S, has been set at Tetra Pak on corporate level. The recommendation given in this master's thesis is that Tetra Pak should set specific goals regarding the development of the AFR and the ASR on corporate level. Provided that Tetra Pak can decrease their accident rates in the same pace as Dow Chemical Company, an adequate goal is to reduce the average AFR and ASR, on corporate level, with 75% until 2017.

8.5.2 Recommended changes for Tetra Pak's future central Health & Safety efforts

As stated in Section 3.10 reporting near misses can provide many learning opportunities and is an effective method for an organization to decrease its accident rates. The general major problem with near miss reporting is the low willingness to report. According to my point of view, this is due to that the purposes and the advantages of reporting near misses are insufficiently communicated. My recommendation is to make major near misses reportable in the CARS. However, not until the benefits, of personnel safety event reporting, are apprehended by all the respondents of the CARS and other stakeholders.

In Section 6.2.1 conclusions on a superficial level regarding Tetra Pak's safety culture were made, according to Fleming's safety culture maturity model. It was found that an efficient way of improving the safety culture at Tetra Pak is to engage all staff to cooperate in H&S-related issues. One way of getting all the employees' involvement is to give all employees at Tetra Pak 1st level read and write access to the CARS. The read access would enable all of Tetra Pak's employees to read all information, except for the involved persons' names, in all accident reports. A faster buy-in of the system in the organization would probably be a positive side-effect of this action. Dow's LER-program could then partly serve as a role model for the new CARS. However, my suggestion is to wait with giving everyone read and write access to the system until the above-mentioned actions have been made.

As found in Section 3.5.2, only using reactive PIs, like the AFR and the ASR, would have some major disadvantages for Tetra Pak. For instance, accident rates do not reflect the potential severity of the personnel safety events, only the actual consequences. Therefore it is, in my view, important also to establish proactive KPIs. However, this should be done in a long time perspective, when the two suggested KPIs AFR and ASR are well established. As suggested in Section 3.5.2, "*Activities for reduction of accidents"* can be introduced as a future proactive KPI at Tetra Pak.

Another long term perspective improvement of the CARS is to expand the system to also include other modules than personnel safety events. Occupational diseases and security events like fires and data trespasses are possible new modules that could be integrated into the system.

At the end of 2007 there was not a common H&S MS on corporate level at Tetra Pak. As stated in Section 2.7, a part of the first step in the route of implementing a common H&S MS at Tetra Pak Converting was to implement a common personnel safety event reporting system. Provided that a decision was taken, to implement a common H&S MS on corporate level and that an implementation route, similar to the one at Tetra Pak Converting was chosen, the CARS would be an already existing structure.

The identified root causes of an accident are depending on which method that is used to perform the RCA. There is no current standardized way of performing the RCA when a Tetra Pak employee gets injured, although the SMP recommends that the 5-Whys method should be used at Tetra Pak Converting's sites. The non-existence of a standardized RCA method at Tetra Pak means that there is a risk that the outcomes of an RCA are depending on where in the organization it was performed. This will make internal benchmarking of root causes less reliable. To be able to perform high reliable internal benchmarking studies of the root causes in the future, it is necessary for Tetra Pak to create a standardized method to make RCAs throughout the company. As found in Section 5.1.6, the RCAs at Tetra Pak Converting in Wrexham are standardized and integrated into the SHEMAS. The RCAs could be integrated into the CARS, if the methodology was standardized on corporate level.

Another adequate way of involving all Tetra Pak's employees in the H&S work and at the same time work proactively with H&S issues is to implement a tool similar to PODAR on corporate level. PODAR is a proactive H&S tool on Tetra Pak Converting level. The purpose of the tool is to involve everyone in the safety work by changing Tetra Pak Converting's employees' attitudes against H&S issues; for details see Section 2.7.3.

8.6 Risks with implementing the Corporate Accident Reporting System

According to the argumentation in Section 5.3 the reporting prototype will only be available in an English version. The consequences of this are that the following risks against the use of the system will arise:

- Due to the linguistically barriers there is a risk that the quality of some accident reports will be low;
- The English skills tend to get lower on local levels of an organization. Therefore, having the reporting prototype only available in English would complicate the requested process of appointing respondents on more local levels of Tetra Pak.

Designing an adequate reporting tool for recording personnel safety events at Tetra Pak has the potential to catalyze the organizational learning and contribute to creating a

learning organization, within H&S at Tetra Pak. However, as found in Section 3.11, the employees in an organization are those who perform the organizational learning. Therefore, the implementation of a reporting system can never replace behavioral H&S efforts within an organization. Tetra Pak needs to continuously stress the importance of reporting personnel safety events and put additional resources and major efforts on raising their employees' awareness of H&S-related issues.

8.7 The reliability of the collected material

It is difficult to assess the reliability of the collected material. The factors listed in this section are in my view important for determining the reliability of the results in the master's thesis.

Even though efforts have been made in this master's thesis to choose PIs that are in principle different and commonly used in the industry, no guarantees can be given that the development of the work environmental conditions at Tetra Pak's sites / clusters are highly correlated with the development of the PIs. The ASR is, in my opinion, a more uncertain indicator than AFR, since every extraordinary accident highly affect this indicator.

The reliability of the CARS as a tool to gather the information that is necessary for calculating the chosen PIs at Tetra Pak is to my mind still not fully investigated. As found in Section 5.5.7 the number of recorded accidents for the same time period and for the same sites, differed very much between the CARS and other existing accident reporting structures at Tetra Pak. In order to investigate how well the number of accidents, according to the CARS, agrees with the actual number of reportable accidents at Tetra Pak, further investigations need to be done.

To ensure that the information in the CARS really can be used to identify areas of improvements, the reliability of this information must be taken into consideration. In Section 3.9.3 it was found that the reliability of the conclusions that were drawn from the statistics is strongly correlated with the size of the database. On site-level every accident strongly influenced the recorded PIs in the H&S survey. Therefore, high reliable conclusions are only possible to come to on type of site-level. However, the recorded PIs on site-level have a higher reliability after the actions to raise the material's reliability that are suggested in Section 8.2.2 have been taken. This material is thereafter, in my opinion, reliable enough to be used for identifying areas of improvements and as a method to establish priorities in the allocation of central H&S recourses to the sites / clusters. In 2008, when also minor accidents will be reportable, the number of reported accidents and the size of the database will increase. This will make the PIs more reliable. As for the other information gathered with the reporting prototype, reliable conclusions can, in my view, be drawn on type of site-level.

8.8 Summarized conclusions

Empirical data have showed that a personnel safety event reporting system can be used in order to decrease the accident rates within organizations. It was also found that an accident reporting system can catalyze the organizational learning. It is argued that the organizational learning process is faster for a reporting system on corporate level, since the learning opportunities occur more frequently.

The following recommendations for how Tetra Pak should use the CARS to be able to efficiently utilize the above-mentioned advantages were given in this master's thesis:

- The consolidated material in the CARS can be used to identify areas of weaknesses to improve the work environment at Tetra Pak. When such areas have been identified, possible central corrective actions should be proposed.
- Comparisons of the recorded indicators can be used to establish priorities between the sites / clusters and to allocate central H&S recourses and efforts
- The CARS will be able to involve its respondents and probably also some managerial persons at Tetra Pak in H&S-related issues. This can increase the awareness of H&S-related issues at Tetra Pak.

The previous sections concluded that the implementation of an accident reporting system, on corporate level, can bring Tetra Pak many advantages. My conclusion is that there is a need within the organization, to implement an accident reporting system on corporate level. However, only on the condition that the system is able to replace the existing accident reporting structures on type of site-level at Tetra Pak, in order to avoid future areas of double reporting. My recommendation is to combine the CARS with the GAR as soon as the CARS has been successfully implemented.

To be able to successfully implement the CARS at Tetra Pak the following factors were found as most important:

- Maintaining and increasing the top management commitment to this project and to other H&S-related projects;
- Create a high willingness to report. It is recommended, in this master's thesis, to do this by an increased education in H&S-related issues and by visualizing the effects of an increased reporting of personnel safety events.

Tetra Pak must put great efforts on improving their safety culture in the future. My recommendation is to achieve this by engaging all Tetra Pak's employees in the H&S work and by starting H&S projects that are focusing on the organizational factors.

The following conclusions were drawn in this master's thesis, on basis of the results in the H&S survey:

- The AFR at Tetra Pak was on the same level as the mean of this indicator at six international industry companies.
- It was found that the spreads of the PIs between the same types of sites was high in the H&S survey. Two reasons for the big spreads were found. The true accident rates and the work environmental conditions differ a lot between the different parts of Tetra Pak. The second reason was that Tetra Pak does not have a common

view on how to classify their accidents. My recommendation is to introduce more corporate minimum work environmental standards and to clearly and frequently communicate the suggested accident definitions to all parts of Tetra Pak.
- The H&S survey confirmed that the accident rates at Tetra Pak's customers' sites were considerably higher than those at Tetra Pak's own production facilities. My recommendation is that Tetra Pak should allocate more resources to improve the work environment for their FSEs.
- The safety culture at all parts of Tetra Pak is high enough to enable a successful implementation of the CARS, on the condition that the system is frequently promoted by its owner. The implementation of the Safety Pillars at Tetra Pak Converting seems to have resulted in that they have a higher safety culture level compared to the other parts of Tetra Pak.

The following recommendations, for future development of the central H&S efforts at Tetra Pak were suggested in this master's thesis:
- To introduce the measures AFR and ASR as new KPIs at Tetra Pak Group during 2008. In a long term perspective it is important to also introduce proactive KPIs.
- To set specific goals regarding the development of the two suggested KPIs at Tetra Pak.
- A suggested method to improve the safety culture at Tetra Pak is to involve all their employees in their H&S efforts. This can for instance be done by giving the employees at Tetra Pak 1st level read and write access to the CARS or by introducing a tool, similar to PODAR, on corporate level.
- To enable high reliable internal benchmarking studies of the root causes at Tetra Pak, it is necessary to create a standardized method of performing the RCAs throughout the company. The standardized RCA could be integrated into the CARS.

The reliability of the results in the master's thesis was found to depend on the following three main factors:
- How well the work environmental conditions at Tetra Pak's sites / clusters are reflected in the development of the chosen PIs;
- The reliability of the CARS as a tool to gather information about the number of occurred accidents;
- The assessed organizational level of Tetra Pak on which reliable conclusions of the results in the H&S survey can be drawn.

The vision of the CARS is to create an H&S reporting system, on corporate level, at Tetra Pak that catalyzes the organizational learning and contributes to creating a learning organization.

9. References

Literature and Electronically sources

- Akselsson R., (2007), "Människa, Teknik, Organisation och Riskhantering" Institutionen för Designvetenskaper, Lunds Tekniska Högskola.
- Akselsson R., Bohgard M., Johansson G., Swensson L.G., (2005), "Arbete-Människa-Teknik", Prevent, pp 47-111.
- Albinsson P., (1998), "Den lärande organisationen: från vision till verklighet", Brain Books.
- Almeida J., (2007a), "SAFETY PKE SAFETY TOUR".
- Almeida J., (2007b), "PODAR".
- Andersson, B. E., (2001), "Som man frågar får man svar", ISBN 91-7297-505-9, pp 181-182.
- Argyris C., (1999), "On organizational Learning", Second Edition, Blackwell Business, pp 67-90.
- AstraZeneca, 2007-12-18, http://www.astrazeneca.com/Article/511621.aspx.
- Blom G., Holmquist B., (1998), "Statistikteori med tillämpningar", Studentlitteratur, pp 33-37.
- BP, (2007), "Sustainability Report 2006".
- Bureau Veritas Certification, 2007-11-09, http://www.bvqi.se/homeframset.html.
- Converting Reporting & Business Control, (2007) "KPI Guidelines - ver.10".
- Dahl L., (2007), "Accidents 20052006 and YTD 2007".
- De Laval, 2007-10-15, http://www.delaval.com.
- Det Norske Veritas, (1999), "Occupational health and safety management systems —Specification.
- Dow's Progress Report, 2007-11-09, http://www.dow.com/commitments/goals/protect-sub.htm.
- Dumas J. Redish J., (1999), "A Practical Guide to Usability Testing", Intellect Books".
- Ekman C., (2006), "CAMU - The Central Occupational Safety & Health Committee".
- Fleming, M., 2001. Safety culture maturity model. Prepared by the Keil Centre for the Health and Safety Executive. Offshore Technology Report 2000/04.
- Goering N., (2007), "Environment Health & Safety".
- Health & Safety Executive, (2001), "A guide to measuring Health & Safety performance".
- Health and Safety Executive, (1999), "Health & Safety benchmarking – improve together", HSE Books, ISBN 0717624943.
- iSixSigma, 2007-11.08, http://www.isixsigma.com/library/content/c020610a.asp.
- Jacobson A., (2001), "Draft Guidance on Safety Performance Indicators, Section A: Draft Guidance for Industry".
- Jaquenoud L., (2007), "Tetra Pak Employee Engagement - Global Survey 2007 results".
- Jones S., Kirchsteiger C., Bjerke W., (1999), "The importance of near miss reporting to further improve safety Performance", Journal of Loss Prevention in the Process Industries 12 pp 59–67.

- Koornneef F. Organised Learning from Small-scale Incidents. PhD Thesis. TU Delft, 2000. Delft University Press, September 2000. ISBN: 90-407-2092-4.
- Larsson B., (2007a), “Classification sheet”.
- Larsson B., (2007b), “Accident & IncidentHandling @ Tetra Pak”.
- Leander L., (1995), “Tetra Pak – Visionen som blev verklighet”, ISBN 91-630-4788-8.
- Lee, T.R., (1996), “Perceptions, attitudes and behavior: the vital elements of a safety culture, Health and Safety, October 1-15.
- Lindemann U., (2006), ” Methoden der Produktentwicklung :Vorgehensmodelle, Grundprinzipien und Methoden“, Lehrstuhl für Produktentwicklung, Technische Universität München.
- Linder R., (2007), “Arbetsskador 2006”, ISSN 1652-1110.
- Ljungberg A., Larsson E., (2001), “Processbaserad verksamhetsutveckling”, Studentlitteratur, pp 222-231.
- Löwgren J.,(1993), ”Human-computer interaction”, Studentlitteratur..
- Malmer L.G., (2007), “SKF Annual Report 2006 including Sustainability Report”
- Minawa E., (2007a), “Accident and Incident Investigation and Analysis”.
- Minawa E., (2007b), “WCM Global Accident Report”.
- Moberg M., (2007), “TS Position Count Template TGT 2008”.
- Mårtensson C., Winter S., (2005), “OHSAS 18001 – Systematisering & Introduktion till Certifiering av Arbetsmiljöarbetet på TPP AB”.
- Nielsen K. J., Carstensen O., Rasmussen K., (2006), “The prevention of occupational injuries in two industrial plants using an incident reporting scheme”, Journal of Safety Research 37, pp 479–486.
- Nilsson P., (2007), “FSE Clusters Processing”.
- Olsson M., (2007), “Annual Report 06”.
- Pillay Y., (2007), “SCA Sustainability Report 2006”.
- Persson J., (1998), “Incident reporting- A survey on existing systems with discussion”, ISSN 1400-1306.
- Reason J., (1997), “Managing the Risks of Organizational Accidents”, Ashgate, Aldershot.
- Sandvik, (2007), “Sandvik Sustainability Report 2006”.
- Sidel, 2007-10-15, http://www.sidel.com.
- Smerdzinski T., (2002), “Business Case for Occupational Health and Safety, Corporate Leadership Council, CLC1RCTF6.
- Socialstyrelsen, “Klassifikation av sjukdomar och hälsoproblem 1997”, (1997), ISBN 91-7201-125-4.
- Technical Service, 2007-10-28, http://technical-service.tetrapak.com.
- Tetra Laval, 2007-10-15, http://www.tetralaval.com.
- Tetra Pak, (2007), “Organisation Update 2007”.
- Tetra Pak, 2007-10-15, http://www.tetrapak.com.
- Tetra Pak Converting, (2007), “Tetra Pak Converting factories”.
- Tetra Pak Packaging Technology, (2007), ”Classification Sheet”.
- Tetra Pak Processing Systems, (2007), “Processing Intro”.
- Thurbin P.J., (1994), “Implementing the Learning organization: The 17-Day Learning Program”, Pitman Publishing.

- Van der Schaal, (1992) “Near miss Reporting In the Chemical Process Industry”, ISBN 90-386-0181-6.
- Virzi R., (1992), “Refining the test phase of usability evaluation: How many subjects is enough, Human Factors, pp 457-468.
- Wärneryd B., (1988), “Att fråga – Om frågekonstruktion vid intervjuundersökningar och postenkäter”, Statistiska centralbyrån.
- Zeng S.X., Shi J. J., Lou G.X., (2007), “A synergetic model for implementing an integrated management system: an empirical study in China”, Journal of Cleaner Production 15-2007.

Interviews

- Berg Stefan, Technical Service Director, Tetra Pak Cluster Middle, 2007-08-23 and 2007-10-02.
- Gram Stefan, Industry Physician, Tetra Pak OHS, 2007-09-04 and 2007-10-02.
- Grönevik Dag, Director for Service Operations, Tetra Pak, 2007-10-05.
- Gunn Stewart, Local Safety Pillar Leader, Tetra Pak Converting Wrexham, 2007-10-17.
- Hansen Henry, Industrial Safety Engineer, Tetra Pak OHS, 2007-08-22 and 2007-10-01.
- Hellström Anders and Visson Arielle, Legal Councils, TPPS and Tetra Pak Packaging Materials, 2007-09-12 and 2007-10-05.
- Larsson Bjarne, Project Leader, Tetra Pak D&E, 2007-09-20.
- Larsson Ove, Chairman in the Work Environmental Committee in Lund, TPPS, 2007-10-22.
- Malmgren Per and Trapman Frans, TPEC members, Tetra Pak, 2007-09-10, 2007-10-11 and 2007-10-24.
- Minawa Edson, Safety Master Pillar Leader, Tetra Pak Converting, 2007-08-29 and 2007-09-20.
- Nettersheim Rolf, EH&S Manager, Dow Germany Stade, 2007-10-09.
- Nilsson Leif, Operations Director, Tetra Pak Dairy & Beverage Systems AB, 2007-09-13.
- Nilsson Lennart, Director of Corporate Governance & Business Structure, Tetra Pak, 2007-09-04 and 2007-10-24.
- Persson Karin, Local Safety Pillar Leader, Tetra Pak Converting Lund, 2007-08-23, 2007-10-02 and 2007-10-15.
- Persson Thomas, Field Service Engineer, TPPS, 2007-10-15.
- Rubin Lennart, Security Manager, Tetra Pak Sweden, 2007-09-05 and 2007-10-05.
- Söderholm Torbjörn, Personnel Director, Tetra Pak Cluster Northern Europe, 2007-09-10 and 2007-10-25.
- Williams Phil, Health and Safety Manager, Tetra Pak Converting Wrexham, 2007-08-30 and 2007-10-03.

Appendix 1 The interview questions

In this appendix the interview questions that were asked to all interviewees are listed.

What position and working tasks do you have?

What kind of preventive Health & Safety work are you at the moment prosecuting?

Is it, in your view, a need within the organization to implement a reporting system for personnel safety events on a corporate level? Would it make your work easier?

Do you have previous experiences of similar reporting systems? If that is the case, what in these systems was good and in which improvements could have been made?

What is your opinion about a web-based reporting prototype?

What questions or kinds of questions do you think should be asked in the reporting prototype?

Who, in your opinion, should report into the system? Do you think that the reporting should be done continuously or at predefined times?

To enable for Tetra Pak to learn from the personnel safety events, it is necessary to perform root causes analysis and system analysis. By whom and how often do you consider that these should be done?

How can Tetra Pak secure a high level of reporting among its employees? Could some kind of economic incentives be efficiently?

Do you think that the accidents occurring at Tetra Pak's customer sites also should be reported into the system? If that is the case, should this only include Tetra Pak's employees or also when Tetra Pak's customers' employees get injured using Tetra Pak's equipment? Do you wish to also include accidents occurring at Office sites?

In order to secure an efficient flow and handling of the accident reports, some kind of accident classification is necessary. How do you think that this classification should be done?

How do you think that a reporting scheme should be designed, in order to get a flow of the personnel safety event reports that is efficient?

Do you think that the statistics of the Health & Safety performance and the raw data of the system should be accessible to all employees at Tetra Pak or only to those with a specific eligibility?

Do you think that a personnel safety event reporting system on a corporate level should take country specific work environmental legislation into account or should the local reporting systems fulfill that need?

Who, in your view, should own the personnel safety event reporting system? Who should be responsible for the operative running of the system?

Appendix 2 The manuscript of the reporting prototype

This appendix contains the full version of the manuscript of the reporting prototype, which was used to collect information about the accidents at Tetra Pak during 2007.

Survey Title:

Accidents that have occurred during 2007

Opening text:

Try to answer the questions as concisely as possible, but without missing any important details. It is important to keep the language clean and objective.

If there are photos that help describing the accident or the corrective actions, please mail them to fredrik.gratte@tetrapak.com.

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1. Which type of accident has occurred?

- Serious Accident (Definition: Injuries that cannot be treated on site or that require medical advice / treatment or loss of time amounting to **more than 1 working day**. Examples of serious accidents are cuts requiring suturing, broken bones and fractures.)
- Extraordinary Accident (Definition: Any injury causing **death**, **loss of a body part** or total or partial **disability**. Injuries included in this group could be loss of fingers or hands, injuries of such a nature that the employee will never be able to perform her / his regular job function again or will not be able to perform her / his regular job without additional aid.)
- Neither a serious nor an extraordinary accident has occurred during 2007

2. Where did the accident occur?

- At a Converting site
- At an Equipment Manufacturing site (Packaging)
- At an Equipment Manufacturing site (Processing)
- At a Customer site

If ("At a Converting site" or "At an Equipment Manufacturing site (Packaging)" or "At an Equipment Manufacturing site (Processing)") ->

3. In which Cluster did the accident happen?

- North America
- Central & South America

- Sub-Sahara Africa
- North Europe
- Central Europe
- South Europe
- East Europe & Central Asia
- Greater Middle East
- Greater China
- South & Southeast Asia
- Northeast Asia & Oceania

If ("North America") ->

4. At which of the following sites in North America did the accident occur?

- Denton
- Greenwood
- Longview
- Queretaro
- Sikeston
- Vancouver
- Winsted

If ("Central & South America") ->

5. At which of the following sites in Central & South America did the accident occur?

- La Rioja
- Mariara
- Monte Mor
- Ponta Grossa

If ("Sub-Sahara Africa") ->

6. At which of the following sites in Sub-Sahara Africa did the accident occur?

- Nairobi
- Pinetown

If ("North Europe") ->

7. At which of the following sites in North Europe did the accident occur?

- Aarhus
- Lund, Converting
- Lund, Development & Engineering
- Lund. Dairy & Beverage Systems
- Lund, Processing Components
- Sherborne
- Skoghall

- Sunne
- Wrexham

If ("Central Europe") ->

8. At which of the following sites in Central Europe did the accident occur?

- Berlin
- Budaörs
- Gornji Milanovac
- Leeuwarden
- Limburg
- Moerdijk
- Romont

If ("Southern Europe") ->

9. At which of the following sites in Southern Europe did the accident occur?

- Arganda
- Dijon
- Latina
- Le May
- Modena
- Rubiera

If ("East Europe & Central Asia") ->

10. At which of the following sites in Central East Europe & Central Asia did the accident occur?

- Kiev
- Kuban
- Potok

If ("Greater Middle East*") ->*

11. At which of the following sites in Greater Middle East did the accident occur?

- Izmir
- Jeddah
- Lahore

If ("Greater China") ->

12. At which of the following sites in Greater China did the accident occur?

- Beijing
- Foshan
- Kunshan
- Shanghai, Dairy & Beverage Systems

- Shanghai, Ice Cream
- Taipei

If ("South & Southeast Asia") ->

13. At which of the following sites in South & Southeast Asia did the accident occur?

- Jakarta
- Jurong
- Pune

If ("Northeast Asia & Oceania") ->

14. At which of the following sites in Northeast Asia & Oceania did the accident occur?

- Fairfield
- Gotemba
- Yoju

If ("At a Customer site") ->

15. In which Country is the Customer site located?

- Afghanistan
- Albania
- Algeria
- Andorra
- Angola
- Antigua and Barbuda
- Argentina
- Armenia
- Australia
- Austria
- Azerbaijan
- Bahamas
- Bahrain
- Bangladesh
- Barbados
- Belarus
- Belgium
- Belize
- Benin
- Bhutan
- Bolivia
- Bosnia and Herzegovina
- Botswana
- Brazil
- Brunei

- Bulgaria
- Burkina Faso
- Burundi
- Cambodia
- Cameroon
- Canada
- Cape Verde
- Central African Republic
- Chad
- Chile
- China
- Colombia
- Comoros
- Democratic Republic of the Congo
- Republic of the Congo
- Costa Rica
- Croatia
- Cuba
- Cyprus
- Czech Republic
- Denmark
- Djibouti
- Dominica
- Dominican Republic
- East Timor
- Ecuador
- Egypt
- El Salvador
- Equatorial Guinea
- Eritrea
- Estonia
- Ethiopia
- Fiji
- Finland
- France
- Gabon
- Gambia
- Georgia
- Germany
- Ghana
- Greece
- Grenada
- Guatemala
- Guinea
- Guinea-Bissau
- Guyana

- Haiti
- Honduras
- Hungary
- Iceland
- India
- Indonesia
- Iran
- Iraq
- Ireland
- Israel
- Italy
- Ivory Coast
- Jamaica
- Japan
- Jordan
- Kazakhstan
- Kenya
- Kiribati
- Korea, North
- Korea, South
- Kuwait
- Kyrgyzstan
- Laos
- Latvia
- Lebanon
- Lesotho
- Liberia
- Libya
- Liechtenstein
- Lithuania
- Luxembourg
- Macedonia
- Madagascar
- Malawi
- Malaysia
- Maldives
- Mali
- Malta
- Marshall Islands
- Mauritania
- Mauritius
- Mexico
- Micronesia
- Moldova
- Monaco
- Mongolia

- Montenegro
- Morocco
- Mozambique
- Myanmar
- Namibia
- Nauru
- Nepal
- Netherlands
- New Zealand
- Nicaragua
- Niger
- Nigeria
- Norway
- Oman
- Pakistan
- Palau
- Panama
- Papua New Guinea
- Paraguay
- Peru
- Philippines
- Poland
- Portugal
- Qatar
- Romania
- Russia
- Rwanda
- Saint Kitts and Nevis
- Saint Lucia
- Saint Vincent and the Grenadines
- Samoa
- San Marino
- São Tomé and Príncipe
- Saudi Arabia
- Senegal
- Serbia
- Seychelles
- Sierra Leone
- Singapore
- Slovakia
- Slovenia
- Solomon Islands
- Somalia
- South Africa
- Spain
- Sri Lanka

- Sudan
- Suriname
- Swaziland
- Sweden
- Switzerland
- Syria
- Taiwan
- Tajikistan
- Tanzania
- Thailand
- Togo
- Tonga
- Trinidad and Tobago
- Tunisia
- Turkey
- Turkmenistan
- Tuvalu
- Uganda
- Ukraine
- United Arab Emirates
- United Kingdom
- United States
- Uruguay
- Uzbekistan
- Vanuatu
- Vatican City
- Venezuela
- Vietnam
- Yemen
- Zambia
- Zimbabwe

16. Who was injured in the accident? What position did the person have?
Fill in the blank

17. Who was his / her closest manager in the line organization?
Fill in the blank

18. Time and date of the accident?
HH:mm, YYYY-MM-DD

19. Which type of injury did the accident result in?

- Injury caused by crushing or squeezing
- Injury caused by cutting, laceration
- Injury caused by a hit or a bump
- Burn injury
- Electrical chock
- Fall injury
- Splash injury
- Other _____

20. How did the accident occur?

Please, give an account of what happened and what body injuries the accident resulted in.
Fill in the blank

21. Was the accident, according to the national legislation, legally reportable?

- Yes
- No
- Unknown

22. Were there, in your opinion, any aggravating circumstances in the physical environment at the time of the accident?

Choose all that apply

- Too warm or too cold
- Too high working pace
- The noise level was too high
- Unfavorable lighting conditions
- Too heavy physical load
- The machines or the tools were not ergonomically suited to the task performed by the user
- Other _____

23. What were, in your opinion, the causes of the accident?

Choose all that apply

- Human error
- The existing routines were not followed
- Poor defenses (Failures in warning systems or Personnel Protective Equipments)
- Insufficient routines and instructions
- Insufficient education
- Failure of an equipment or a tool
- The material
- Poor communications
- Organizational deficiencies (e.g. stress, fatigue and unclear responsibilities)
- Not yet identified

- Other _____

24. What actions have already been taken, in order to stop the reoccurrence of an accident with the same set of causes?
Fill in the blank

25. What corrective actions are planned to be taken?
Fill in the blank

26. When is the deadline for the implementation of these actions?
Fill in the blank

Closing Text:
Thanks for your report. Feedback will be given as soon as possible.

Appendix 3 The Usability tests

This appendix describes the tasks in the usability tests as well as the pre- and the post test questionnaires.

3.1 Pre-Test Questionnaire

What position and working tasks do you have?

Do you think you could be a potential user of the reporting tool?

How long have you been working at Tetra Pak and in your current position?

3.2 The tasks

The three following accident descriptions were given as tasks to the participants of the usability tests. The first description is a true story, although the name of the involved person has been made up. The other two are fictitious, although the ambition was to make the descriptions as realistic as possible.

3.2.1 The first accident description
22nd of June 2007 at 3 PM an accident at the Converting plant in Dijon occurred. Due to a preventive maintenance stoppage on a laminator, the maintenance technician Henry Lamotte had to switch off a low voltage circuit-breaker. After the stoppage it was not possible to switch on the circuit-breaker. After several attempts an electrical flash occurred and the technician was injured. He was standing just in front of the cabinet and was very seriously burnt, especially his face.

The injured person was wearing Personal Protective Equipments, but it was insufficient

on arms and face. The first accident investigations showed that the normal procedures were followed and that first aid was quick and efficient. However, the cabinet door was closed but not locked. The root causes have not been identified yet. After the accident it became compulsory to wear full-face protection in similar situations. The “lock cabinet door before switching on the circuit-breaker“ procedure was updated and all similar circuit-breakers were inspected.

3.2.2 The second accident description
During the start-up of a new dairy in Beijing, China, a homogenizer from Tetra Pak was installed by Xie Wie Wie, a Field Service Engineer (FSE) from Tetra Pak. The equipment was transported from a warehouse to the installation site by a fork lift on the 19th of July, 2007. At 10:30, when the homogenizer was unloaded, the fastening device suddenly came loose with the consequence that the homogenizer fell from half a meter to the ground. The homogenizer landed on the foot of the FSE. Although he was wearing safety shoes, two of his toes on the left foot were broken. The FSE was in the sick-list for 2 weeks. It was extremely warm in the dairy at the time for the accident.

The first analysis showed that the existing routines for lashing the load and the use of Personnel Protective Equipment had been followed. Later the root causes analysis was made and came to the conclusion that the accident was caused by the type of chain that was used was not strong enough. After the accident fewer types of chains were used and their use was expressed in a clearer way.

3.2.3 The third accident description
Jan Jansson, a co-worker at Dairy & Beverage at Tetra Pak Processing in Lund, was walking from his workplace in the production area to the canteen at noon on the 13th of March, 2007. He was stressed due to the high working pace the last days and does not notice that he is walking in the middle of a truck way. Suddenly a truck, fully loaded with components, came driving around a corner. The driver did not discover the person who was walking there. The person got hit by the truck and got his left leg broken; this resulted in a two-month-long absence from work.

The root causes analysis concluded that the truck driver had not breeched any regulations and that the accident was caused by unawareness of the involved person in combination with stress, which probably was triggered by the high working pace. In order to prevent the same type of accident from reoccurring, a major safety campaign, focusing on changing the attitude of the employees against unsafe situations was started.

3.3 Post-Test Questionnaire

Do you think that there is a need for implementing this tool?

Did you think that it was easy to use the reporting tool?

Did you like the tool?

How do you think that the reporting tool can be improved further? Would you like to have more or less questions?

Appendix 4 Further results from the Health & Safety survey

This section presents the results of the H&S survey, which were not considered as important enough to be a part of Section 5.5.

Table A.2 presents the number of extraordinary and serious accidents that have happened during 2007. NA in Table A.2 indicates that no answers have been submitted. Some sites only had information about the number of employees in the production. To calculate the worked hours, the assumptions about the in average annually worked hours at Tetra Pak's productions facilities that are visualized in Table A.2 were made. These assumptions were made after consultations with the Operations Director at Tetra Pak Dairy & Beverage Systems AB. Please note that the reliability of AFR and the ASR presented in Table A.2 are, in my opinion, low.

Table A.1. Assumptions about the annually worked hours per employee at Tetra Pak's production facilities

Region	Annually worked hours
Europe	1700
America, Oceania and Africa	1750
Asia	1800

Table A.2. The calculated Performance Indicators on site-level

Factory/Cluster	Extraordinary accidents	Serious accidents	Worked hours in operative units	AFR	ASR
Tetra Pak Converting					
Arganda	0	4	510847	7,83	7,83
Beijing	0	5	418606	11,94	11,94
Berlin	0	4	338831	11,81	11,81
Budaors	0	2	287065	6,97	6,97
Denton	0	2	465211	4,3	4,3
Dijon	0	9	511953	17,58	17,58
Foshan	0	0	299855	0	0
Gornji Milanovac	0	1	153625	6,51	6,51
Gotemba	NA	NA	NA	NA	NA
Izmir	0	3	232844	12,88	12,88
Jeddah	0	0	318027	0	0
Jurong	0	3	616061	4,87	4,87
Kiev	0	0	338572	0	0
Kuban	0	1	115500	8,66	8,66
Kunshan	0	0	27399	0	0
La Rioja	0	7	340632	20,55	20,55
Lahore	0	3	290472	10,33	10,33
Limburg	0	0	426226	0	0

Longview	0	6	160022	37,49	37,49
Lund	0	1	484772	2,06	2,06
Mariara	1	0	110688	9,03	90,34
Moerdijk	0	1	492540	2,03	2,03
Monte Mor	1	2	684744	4,38	17,52
Nairobi	0	1	114400	8,74	8,74
Pinetown	0	1	242840	4,12	4,12
Ponta Grossa	1	0	443675	2,25	22,54
Pune	0	1	25790	38,77	38,77
Queretaro	0	0	510885	0	0
Romont (Tetra Recart)	0	3	90716	33,07	33,07
Rubiera	0	8	358568	22,31	22,31
Sikeston	0	1	187785	5,33	5,33
Skoghall	0	3	77532	38,69	38,69
Sunne	0	3	429036	6,99	6,99
Taipei	0	0	108158	0	0
Vancouver	0	12	232604	51,59	51,59
Wrexham	0	1	76149	13,13	13,13
Tetra Pak Processing Systems					
Aarhus	0	0	110642	0	0
Greenwood	0	0	16800	0	0
Jakarta	0	0	160050	0	0
Leeuwarden	0	0	7792	0	0
Le May	0	2	60775	32,91	32,91
Lund, Dairy & Beverage Systems	0	0	87267	0	0
Lund, Processing Components	0	1	261800	3,82	3,82
Shanghai, Dairy Beverage Systems	NA	NA	NA	NA	NA
Shanghai, Ice Cream	0	0	237600	0	0
Sherborne	0	0	102850	0	0
Winsted	1	1	96250	20,78	114,29
Tetra Pak Development & Engineering					
Lund	0	0	142800	0	0
Modena	0	5	544602	9,18	9,18
Customer sites					
Central Europe	NA	NA	NA	NA	NA
Central & South America	0	7	311208	22,49	22,49
East Europe & Central Asia	0	1	105967	9,44	9,44
Greater China	0	1	341550	2,93	2,93
Greater Middle East	0	2	242229	8,26	8,26
North America	0	2	210146	9,52	9,52
Northeast Asia & Oceania	0	1	190896	5,24	5,24
North Europe	0	2	213492	9,37	9,37
South Europe	0	13	345950	37,58	37,58
South & Southeast Asia	1	2	169950	17,65	70,61
Sub-Sahara Africa	0	0	54542	0	0
Total	*5*	*128*	*14537783*	*9,15*	*12,24*

Appendix 5 Information flow chart

This appendix aims to consolidate the most important information from Section 6.5 to 6.10. This is done with the purpose of clarifying outline the existing flow of accident reports at Tetra Pak and how it would have been changed if an accident reporting system on corporate level was implemented.

The first quarter in 2008 is chosen as the time for the mapping, since Project B will be implemented by then. Since the accident reporting structure is different depending on at the type of site the accident occurred, three flow charts have been made. The black arrows indicate an, in the first quarter of 2008, existing accident information structure. The blue, dashed arrows describe the situation, if the CARS as proposed in this master's thesis, was implemented. The red-marked "Corporate Accident Report" puts the reporting prototype in a corporate perspective.

Figure A.1 describes the accident reporting structure at Tetra Pak Converting. The present structure has been verified by the Local Safety Pillar Leader at Tetra Pak Converting in Lund.

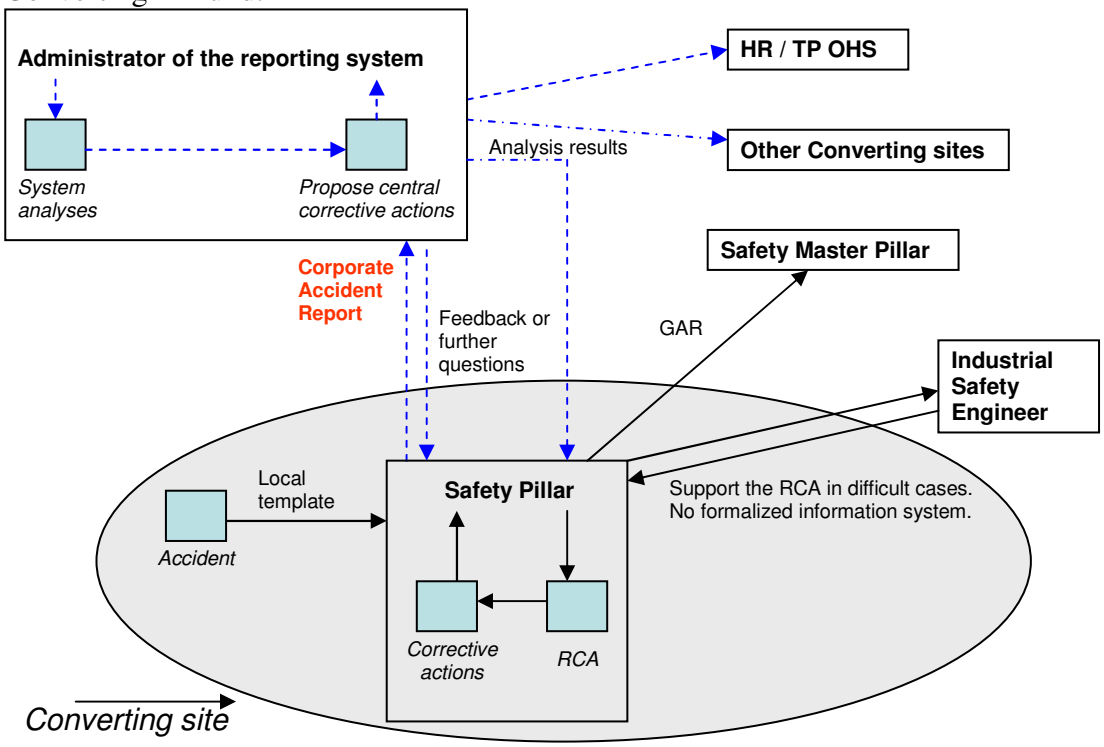

Figure A.1. Accident reporting structure at Tetra Pak Converting

In Figure A.2 the corresponding information flow for TPPS is described. The content was confirmed by the Chairman in the Work Environmental Committee at the TPPS plant in Lund.

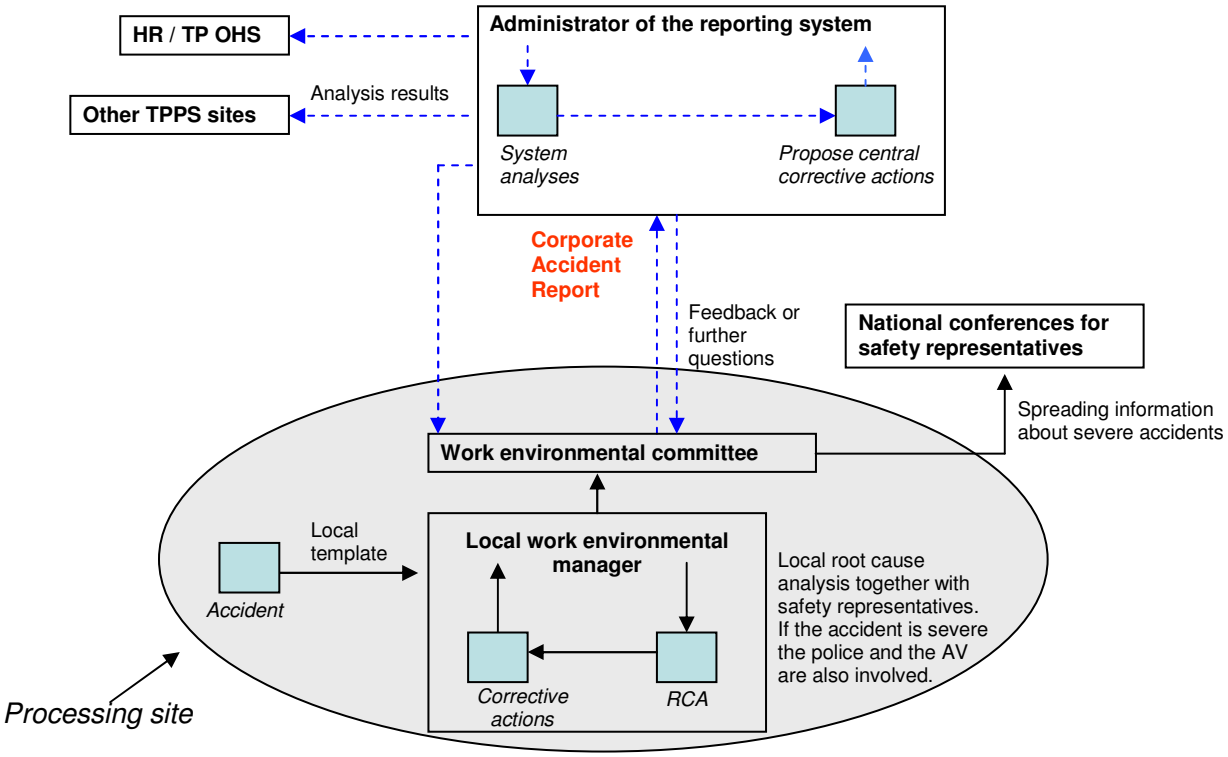

Figure A.2. Accident reporting structure at Tetra Pak Processing Systems

Figure A.3 describes the reporting structure when a FSE get injured, while she / he was working at one of Tetra Pak's customer sites. The flow was verified by the FSE in the usability tests.

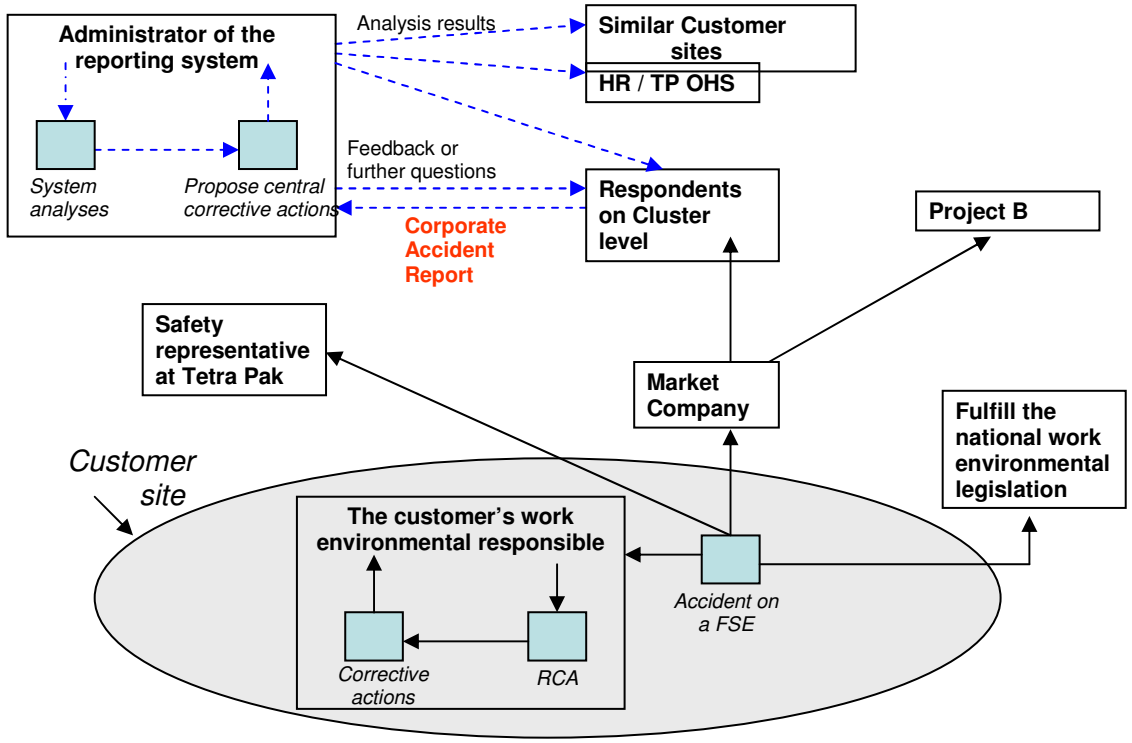

Figure A.3. Accident reporting structure at Tetra Pak's customers' sites