Organisation for efficiency in design activities.

- **Design audit at Tetra Top**

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Summary

Title:	Organisation for efficiency in design activities - Design audit at Tetra Top
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Problem:	Tetra Pak is continuously working to increase the efficiency of the whole organisation. There is currently a general demand to improve by 20%. The number is not to be taken literately since efficiency is not defined nor is it specified how it should be measured. At Tetra Top the interpretation is that it is important to focus on efficiency and that it is up to individuals how and when it can be attained. In the Tetra Top engineering design department various projects have been undertaken in order to satisfy this demand. When external consultants have been used, it has not been to the satisfaction of Business System Tetra Top because the suggested solutions have not been viable. The problem is hence to find viable solutions to increase the efficiency in design activities at Tetra Top.
Purpose:	After having established what the current situation is, the aim is to suggest, and thoroughly motivate, changes to the organisation that will satisfy both the demand for increased efficiency and the people who are affected by the changes.
Method:	The current situation will be investigated with a study. This study will show which activities occupy the working day of the mechanical engineers. Follow up interviews will give more in-depth information about the engineers' own opinion of the problem and its possible solutions. The engineers will also be able to comment on the collected data of the study to ensure that the measured time period was representative of normal

working hours. Based on the study and the interviews, theory will be chosen and studied to give credibility to the suggested solutions.

Conclusions: The study found that the mechanical engineers have too many tools for too many different tasks. The complexity of the computer aided tools and the variety of the tasks makes it impossible to know them well enough in order to be efficient when working with all of them. This is especially true for tasks that are performed infrequently which include documentation and administration. It is therefore suggested that the mechanical engineers are off-loaded with these tasks and that a Technical Assistant is hired to specialise in these infrequent tasks.

It was also found that Tetra Pak has a history of releasing products that are of prototype standard. The costs of replacing products or parts of products at customers' sites are high and so is the cost due to loss of confidence in the Tetra brand when new products don't work. It is recommended to proceed in the direction of Robust Design Engineering as well as providing opportunities for adequate testing.

Tetra Top is not taking advantage of the paperless system of distributing information even though the equipment for doing so is already present. The reason for this is pure habit and it is recommended that the routines for distributing information both within the company and to suppliers are developed.

Key words: Efficiency
Specialisation
Hierarchy
Robust Design Engineering

Specialisation

An expert is one who knows more and more about less and less (and when he has reached perfection he knows everything about nothing).

Excerpt from address of welcome by
Nicholas Murray Butler,
President of Columbia University, N.Y. 1902

The generalist is one who knows less and less about more and more (and when he has reached perfection he knows nothing about everything).

Authors remark

Preface

This M.Sc. Thesis was carried out as the final part of my M.Sc. education in Technology Management at Lund University and Lund Institute of Technology in Sweden during 2001

The thesis was written at Tetra Pak in Lund, mainly Business System Tetra Top. I wish to thank my supervisors Peter Eriksson and Mats Andersson. I also thank other members of staff at Business System Tetra Top, Anna-Lena Mårtensson at Business system Tetra Brik in Modena Italy and Jane Wickwire at Business system Tetra Rex in USA. Special thanks to the participants in the study who put time and effort into providing empirical information and I hope that their expectations of increased efficiency will be filled and that it will serve as a symbol of my gratitude.

I also wish to thank my supervisors at Lund University, Robert Bjärnemo at Division of Machine Design, Lund Institute of Technology and Christer Kedström at Department of Business Administration, School of Economics and Management, for guiding me through the process.

Last but not least I want to thank Isis Anaya for making sure that the language is correct and that it is possible to understand the content of this thesis.

Lund, 020121

Konrad Höije

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1 Introduction

1.1 Background

Tetra Pak is active in a market where very few machines are sold to even fewer customers for a considerable price. They also supply packaging material to their filling machines and here the numbers are the opposite. Traditionally, the cost of producing machines has not been so important. It was usually higher then the customers were prepared to pay. The price was set depending on the market and not on actual costs. Any losses on the machines were covered by profits on the packaging material.

This way of doing business is no longer legal and Tetra Pak was heavily fined a few years back by the European court. This and the fact that it is always a good idea to be efficient means that Tetra Pak has joined the struggle to continuously increase the efficiency of the whole organisation the same way so many other companies have done for some time already. Hence there is currently a general demand to improve efficiency by 20%.

This also applied to design and at the engineering design department at Tetra Top, it has meant that new ways to increase efficiency have to be found. When the department has been looking for external help from consulting firms in the past, the result has not been satisfactory for the management at Tetra Top due to lack of feasibility.

1.2 Problem

The problem of increasing efficiency is that efficiency does not have an absolute definition. In the case of design activities it is questionable whether it can be measured in a practical way or if only parts of the total efficiency can be measured. If the wrong approach to efficiency is taken, risk of sub optimisation will result. Sub optimisation in this case could give excellent values for chosen measures while the quality of the overall efficiency is unknown.

This led to a number of sub problems: What is efficiency? How should it be measured? How efficient is the department currently and how efficient do people think they are? Solving these sub-problems provided many answers but also brought up new questions. Putting it all together led to fulfilling the purpose of this thesis.

1.3 Constraints

When looking at possible solutions to the problem, I have not looked at alternatives to the different tools that are used for engineering design and in which way they have been used. Even though I have worked as a mechanical engineer in the past I don’t consider myself qualified for this type of work. Any suggestion on that subject could also become obsolete in a short period of time because of the frequent updates just like when dealing with any other software. Nor have I looked at the workforce to see who was efficient and who was not in order to suggest changes in the staff. Instead I have been focusing on the situation of employees and trying to sort out which obstacles have hindered their efficiency so that ways could be found to remove these obstacles.

1.4 Purpose

The assignment was to find concrete, realistic and feasible ways to increase the efficiency at the engineering design department at Tetra Top.

1.5 Methodology

The methodology used in this thesis is only briefly presented here in order to give the reader a general idea of how the information that the conclusions are based on is gathered. Later on in the chapter “Tetra Pak study”, both the theory behind information gathering and motivations to decisions are presented. All actions are also presented in a chronological order.

In order to be able to suggest ways to increase efficiency, a point of departure was established. This was necessary in order to find out, which actions were appropriate and second so that further improvements can be measured in the future. The mechanical engineers established this point of departure by punching in their daily work into a database. Later, the collected information and other questions were discussed during interviews with the engineers.

Literature and presentation material on Tetra Top and Tetra Pak and their history were studied and interviews were held in order to find out both how things are done now, how it has been in the past, and if there is any link. Manuals for the systems for managing projects and engineering design were studied, how strict they controlled the work and if it had any connection to how things were really done.

The gathered information leads to studying of general literature regarding efficiency and ways to organise work but it also lead to more narrow subjects. However, It is my strong belief that the best clues to how to find ways to change the organisation or to implement any new theory are to be found in the department and given by the people already in it.

1.6 Criticism of sources

The sources to most of the information in this thesis come from the mechanical engineers who are at risk of becoming victims of changes that result from it. Even if it was up to me as the interviewer and researcher to put them at ease and to make sure that the information was correct, it can never be completely excluded that it might be possible that people might be talking at times in their own interest rather than in the interest of increased efficiency. Since I was not trying to find individuals who were not efficient but rather obstacles in the organisation preventing people from being efficient, I think that the level of accuracy in this information is high. In this case the interest of the employer and the employee correlates.

The literature presented in the theoretical foundation was not easy to find and it was not written to suit the subject of this thesis. Therefore only the parts of it that has meaning to the subject is presented. I have looked for contributors that have different or even opposite views and think I have completed the picture.

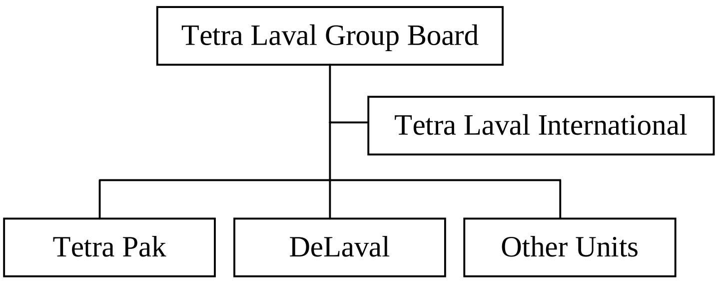
The most difficult area of investigation was the history of Tetra Pak. The only source that is not based on promotional material, the book “tetra”, has not been accepted by the Rausing family. This book is very critical towards the Rausings and especially towards Ruben, his personality and his methods. However, this is not an issue in this thesis so the accuracy of this information is of no interest. I find no reason to doubt the credibility of the detailed descriptions of events presented in this book. It would have been nice to have confirming sources to this information but this luxury is not available.

2 Presentation of Tetra Pak

In this chapter I present the company, Tetra Pak, through a description of the integral parts and a brief history. Some Tetra Pak or industry specific characteristics will be presented to provide the reader with a general knowledge of how the environment and history affect the company activities. On parts where it gets interesting, the history will be studied in more detail and the focus will not necessarily be on Tetra Top. Tetra Top is sprung from the bigger organisation and people in Tetra Pak frequently move in the organisation resulting in a homogenous culture in the large organisation.

2.1 Tetra Laval

Operating activities within Tetra Laval is organised in two autonomous industry groups: Tetra Pak and DeLaval. This organisational structure, focusing on food, was built up to promote the combined competitive strength of the Tetra Laval Group.



Organisation	Employees 2000	Net Sales 2000, Mio Euro
Tetra Laval	24000	8900
Tetra Pak	18900	7300
DeLaval	4500	700
Other Units	600	900

Figure 1, The Tetra Laval organisation and distribution of personnel and sales

The head of each industry group has the consolidated responsibility for his industry group and therefore reports directly to the Tetra Laval Group Board. Dr Göran Grosskopf is Chairman of the Board. The Group Board has overall responsibility for the Group's strategic development.

Strategic planning includes issues related to coordination between the industry groups, major investments, all acquisitions and divestments, program for research and the development of new and existing systems.

2.2 DeLaval

DeLaval is a full-service supplier to dairy farmers. The company develops, manufactures and markets equipment and complete systems for milk production and animal husbandry. Service and sales of a wide range of accessories are also key aspects of its operations.

Alfa Laval Agri became DeLaval on April 14, 2000, a name that links back to Gustaf de Laval, who invented the centrifugal cream separator over 120 years ago[1]. This device was a breakthrough and soon became part of farmers' everyday life all over the world. A few decades later, the introduction of the milking machine began to gradually supersede the burdensome chore of hand milking. Since the 1880's, the world of farming has succeeded in inventing its future. Technology has revolutionised the dairy farmers' working day, and since its foundation in 1883 DeLaval has been part of that progress. Since those early days, milking technology has steadily evolved to increase productivity as well as working comfort. Milking systems are still the core business of DeLaval. Today, however, these systems are totally integrated with all the various on-farm functions related to the herd and its optimal management.

2.3 Tetra Laval International

Tetra Laval International has responsibility for financing the Tetra Laval Group. It also operates as a support function for the industry groups. The organisation is the result of a merger of what used to be Tetra Laval Finance and the Holding & Staff functions.

Financial information and analysis is provided to the group and adequate control procedures are ensured. Tetra Laval International is also responsible for mergers and acquisitions. Recently, Sidel S.A., the world's leading PET equipment manufacturer was acquired. Sidel will form another independent industry group within the Tetra Laval Group[*].

2.4 Tetra Pak

Tetra Pak is dedicated to the development, manufacture and sale of systems for the processing, packaging and distribution of liquid food products. Tetra Pak is the only company of its kind capable of supplying its customers with comprehensive systems that integrate processing lines with packaging and distribution systems. Tetra Pak do not produce any packages except for those containing packaging material. To develop food products, market, package and sell them to consumers is done by the customers of Tetra Pak.

[1] http://www.delaval.com/

[*] The acquisition was later stopped by the EEC

In the year 2000 the decision was taken to change the organisational structure of the company. The Carton Division was split into two Business Areas – Carton Ambient and Carton Chilled. The main reason for this was to apply increased management focus to the chilled segment that, even if the packages and packaging machines sometimes appear identical, is supplying a completely different market.

Tetra Pak’s goal is to grow 50 per cent before the year 2005 and found the high expectations on the fact that Tetra Pak only has nine per cent of total global packed liquid market share. Of the total global liquid market, Tetra Pak only has one per cent.

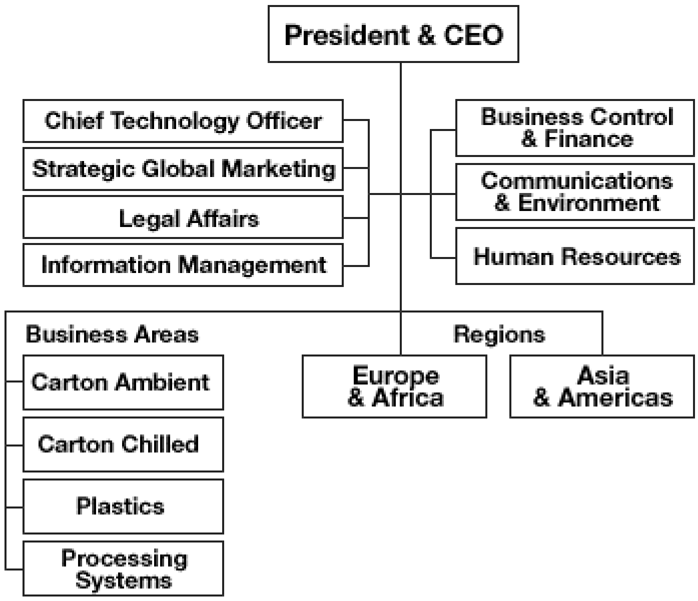


Figure 2, Organisation of Tetra Pak

AB Tetra Pak was established in 1951 by Ruben Rausing and Erik Wallenberg, but the development work began at Åkerlund & Rausing in 1943[2]. The first package, now called Tetra Classic was seen at supermarket shelves in 1952. In 1956 Tetra Pak moved into new factory premises in Lund, Sweden, on the site it occupies to this day. The manufacturing activities here consist of the assembling and testing of packaging machines, and the production of packaging material.

Tetra Pak's acquisition of Alfa-Laval, one of the world's largest suppliers of equipment and plants to the food industry, processing industries and agriculture, was finalised in 1991 and the Tetra Pak Alfa-Laval Group is formed. Tetra Pak and Alfa-Laval's activities continue to be conducted separately by the two companies. In 1993, the company takes the name Tetra Laval. The new Tetra Laval Group consists of four industrial groups: Tetra Pak, Tetra Laval Food, Alfa Laval and Alfa Laval Agri. Tetra

[2] http://151.183.33.121/corporate/eng/frameSet1.asp?navId=12

Laval Holding & Finance holds overall financial control of the Group. The Headquarters of the Group was moved back to Lund, Sweden after a tour to Lausanne, Switzerland who was not part of and had no plans to join the EEC.

Today, there are 77 marketing companies across the world, 68 packaging material plants including licensees, and 12 packaging machine assembly factories[3]. Tetra Pak products are sold in more than 165 markets. In 2000, the company produced 89 billion packages that delivered 51 billion litres of liquid food products to the consumers of the world.

2.5 Carton Chilled

Carton Chilled consists of the packaging systems that are not aseptic and requires refrigerated distribution and storing after being filled. They are Tetra Top in Lund, Sweden, Tetra Brik in Modena, Italy and Tetra Rex in Minneapolis, USA. Since these Business Systems are under the same management and demands it was natural not to just focus on Tetra Top but to also have a look into the way the other Business Systems are working and their approach to improve the efficiency. The Business Systems does not just refer to different packaging systems but they are also spread around the world. Each of the different offices is influenced by the local work organisation culture.

To investigate this I contacted people in Modena and Minneapolis who are involved with managing mechanical design and technical administration and they were very helpful in providing their view, tradition and current development on the subject of specialisation in the engineering design activities.

In Modena, things are not so much different from Lund but the level of hierarchy is higher. There is no support function for documentation and administration of the output of the engineers so they find themselves performing many more tasks then what would be expected in traditional engineering design. About half of the designing staff consists of consultants and this group is able to spend about twice the time on primary activities for the mechanical engineer. There are plans to start experiment with support that will perform “activities not adding value for the mechanical engineer”[4]. Other considered solutions that are improved training on design tools, supply chain management, paperless distribution, tutoring and career planning.

In Minneapolis, it is a completely different story[5]. Being on the other side of the big pond and originally a small company called Liquipak that became part of Tetra Pack fifteen years ago, they have been left on their own to do as they saw fit. The Tetra Pak standards have been implemented gradually at a comfortable rate and were finalised

[3] http://151.183.2.142/companypres/textpres/text.html
[4] Anna-Lena Mårtensson
[5] Jane Wickwire

eight years ago. They have a group of persons who take over the project from the mechanical engineers when they are done. The group then let the project go through a process called Technical Administration (TA) that includes checking, releasing, approval, entering information into R/3 and filing.

They are happy with their process and the way it works. The approval rating at the copy department in Lund is 100%. Trouble-shooting is minimal due to using the most knowledgeable persons for processing and mechanical engineers time is not tied up with activities they in general are lousy at, don't care about and would do so infrequently that there would be problems with release if they did. It's not a perfect world though. Engineers apply an "off my desk – not my problem" attitude once they have handed over to Technical Administration and since TA does not make corrections, only checks, time is wasted handing a project back and forth. On average 9 days are lost in this way. Finally, both engineers and management think documentation takes too long and costs too much.

To fix these remaining problems, two solutions are currently being considered. The first one is to give responsibility back to the engineers and only use TA in a mentoring and training capacity and the other one is to take on a drawing resource into TA that can resolve the hand-overs between TA and the mechanical engineers.

2.6 Tetra Top

Tetra Top Packaging Systems AB is a Business Unit within Carton Chilled[6]. The company is responsible for the total packaging line including the distribution equipment. Tetra Top packages are used for liquid food products. The headquarters and production are situated in Lund, Sweden. Tetra Top has approx. 130 employees. Today there are 80 commercial filling machines divided into 27 different markets and sales of packaging material in 2000 were 900 million packages.

Tetra Top was founded in June 1992. But the story starts much earlier. The creator of Tetra Top, Wilhelm Reil, made the first hand-made Tetra Top package in Pfungstadt and the first patents for the package and the machine were filed during 1979/1980[7]. By mid 1982 the first TT/1 prototype machine was running (round top) and in 1985 a field test of the TT/1 machine was done in Belgium. The TT/1 round package was introduced in at this time in Belgium, packaging drinking yoghurt. A disadvantage with the round shape was that it did not fit in the existing distribution units. The TT/2 square-formed package was tested in Sweden and England in 1989. It was a blanks-fed machine and the production of packaging material was much more expensive than for the round package. It was also complicated to produce the plastic lid with sharp edges, without having leakage. A combination of the best characteristics in distribution and production was found in the round corner package. The first TT/1 round corner package was field tested in 1990 in France. The round corner package

[6] http://151.183.1.200/director/org/companies/top.html
[7] http://151.183.2.69/company/company.html

fits well into standard distribution equipment and is therefore cost effective. In 1993, the TT/3 filling machine was field-tested in UK, and TT/3 is now the major machine type sold.

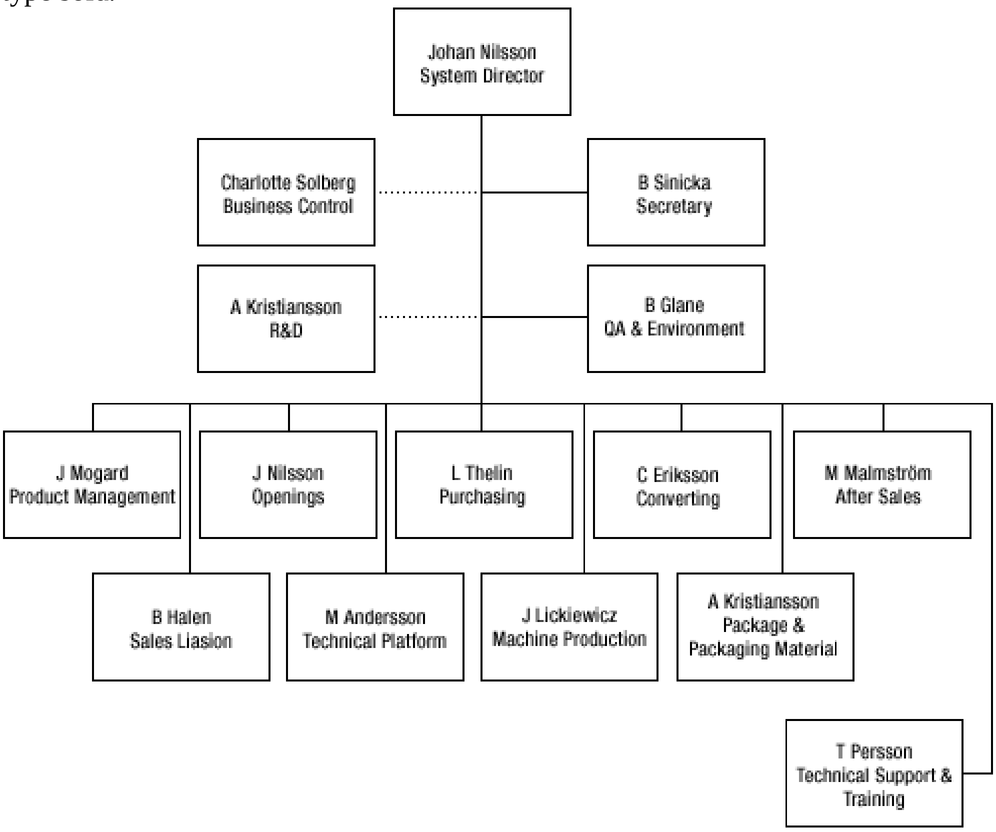


Figure 3, Organisation of Tetra Top[8]

2.7 History

There are some interesting facts in the past that can provide an explanation to the way work is carried out today. The way things have been done in the past often becomes part of the culture and is not easily changed. This might become a problem if strategies are based on conditions that, even though they were true in the past, are no longer present. In this chapter I will try to explain factors that have contributed to the success story of Tetra Pak but that might be a burden today.

There are two mayor sources to the history of Tetra Pak. One[9] is based on speeches given by the founder Ruben Rausing, newspaper articles and a collection of the newsletter "Tetra Pak" directed to customers. The other one[10], which is partly a

[8] http://151.183.23.43/
[9] Rydenfelt 1995
[10] Andersson, Larsson 1998

critical report on the Rausing family, is at large based on the diary of Erik Torudd, a Bachelor of Economic Science who was employed in 1934, became sales manager and deputy managing director 1953 and member of the board the following year. When reading the first one, one has to keep in mind that it at large is a collection of promotional material and when reading the second one, that Erik Torudd was removed after having spent most his professional life at Tetra Pak and being vital to the success. He was also led to believe that his efforts at Tetra Pak would make him a rich man but this promise was never honoured. Since the personal character of the Rausing family is of no interest to this thesis the information in the second book is found as the relevant one.

It is described how Tetra Pak always used to be at the verge of bankruptcy. Ruben wanted to form a dynasty and refused to convert the company to a joint stock. Much effort was spent on getting new loans and funding. At the same time expensive R&D was performed in areas of material and applications where little previous knowledge was present. In order to impress creditors, Ruben often had to push for early release of techniques, which were not viable in real industry environments and sometimes, not even in the laboratory. It was often up to the persuading abilities of Ruben and his co-workers to keep the machines in the dairies. R&D was not organised in a structured manner and it had many parallel projects running after an evolutionary model. The consistency of inconstancy of Ruben and the group surrounding him changed the focus and priorities of the projects in a way that made working conditions frustrating for developers.

At the end of the fifties things could have changed when Åke Gustafson was employed. He was a Master of Engineering and was recommended to Ruben by Curt Nicolin, an influential person in the vast network of Ruben. It become clear that Åke was an intelligent young man and he was promoted to design manager. Holger Craford, (MD 46-65) who at this time held a strong position, perhaps even stronger then Ruben himself, was especially impressed by the young engineer.

Åke used to say: “These days you design a machine so that when it is ready, it is a machine that works. There won’t be any adjustments afterwards, nor will there be any need for them.” This was also the view of Holger. Finally deadlines would be kept and no more adjustments would be necessary at the site of irritated dairy managers. He said: “It is wonderful that we at last have a mechanical engineer who works in a modern way. To make adjustments afterwards was the way to do it in the nineteenth century”. However, time would prove that the agreement of Åke and Holger was not as perfect as they thought at this time.

Åke started, on the side of his other duties, to develop a new package because he was not impressed by the tetrahedron-shaped package that was the identity of Tetra Pak. He thought it was impractical to transport and to handle for the consumer. Since Tetra Pak felt very emotional towards their baby, the tetrahedron, it was not until the market share started to decrease that anyone was interested in Åkes brick-shaped package. It was decided that a prototype of a machine should be developed and in spite of everyone's expectations Åke managed to do it in two years. He was now told that he should develop a dependable machine for series production and do it in another two years. Åke accepted under protest because he knew it could not be done and informed Holger that as soon as it was done he would resign. The machine was developed and Åke left with the words: "But I warned them. They did not want to listen to me".

The machine was too complicated and the staff at the dairies could not handle it. There was also leakage, the cost of service was high and the package was far from the success Åke and the board at Tetra had expected. Even though the Tetra Brik system was draining the financial situation and put the company in deep crisis it took seven years before Åke was brought back and asked to fix the situation. He agreed to do so if he got the time and resources he saw fit and this time he got what he wanted. Soon he had made alterations both in engineering design and production and the following years the turnover increased by between 20 and 30 percent each year. The Rausings had started their climb towards becoming the richest people in the world.

One would think that with the experiences of launching both the tetrahedron package and Tetra Brick, Tetra Pak should have learnt the lesson. Especially since the financial situation has long since changed. However, the history seems (as always) to repeat itself. I was personally involved in the introduction of TT/3 in UK as a service engineer. Tetra Pak was loosing market share in UK and the big threat came from plastic bottles. The traditional Tetra-packages could not compete with them but the "sexier" Tetra Top package had a chance and especially the new TT/3 machine that was supposed to run more economically then the older TT/1. TT/3's were sold and installed all over UK and for a brief moment the situation appeared to have been saved. The problem was that the TT/3 was a prototype and also performed like a prototype. Many dairy managers pulled their hair and threw out the machines before the TT/3 was working satisfactorily.

In 1995 McKinsey performed an analysis at Tetra Pak and as a part of it they evaluated a number of projects. The project they found to be the most successful was the TR7. The key factor to this success was rigorous testing before release[11]. This was, however, not done on purpose. The machine was developed especially for a customer in Japan but the customer lost interest in the project. This meant that launch of the machine was delayed for a year. This year was used to make additional testing and modifications to the machine and when it was finally introduced in the market it was functioning at a very high level.

2.8 Tetra Pak Innovation Network (TPIN)

TPIN is a new tool for the innovation Process at Tetra Pak. The first version was launched 1999, it was first used at Tetra Top in 2001 and is still under construction[12].

[11] Rune Berg
[12] Anders Kristianson

It is an of-the-shelf system that is being tailored to Tetra Pak's special needs by consultants. The following map gives the structure of TPIN.

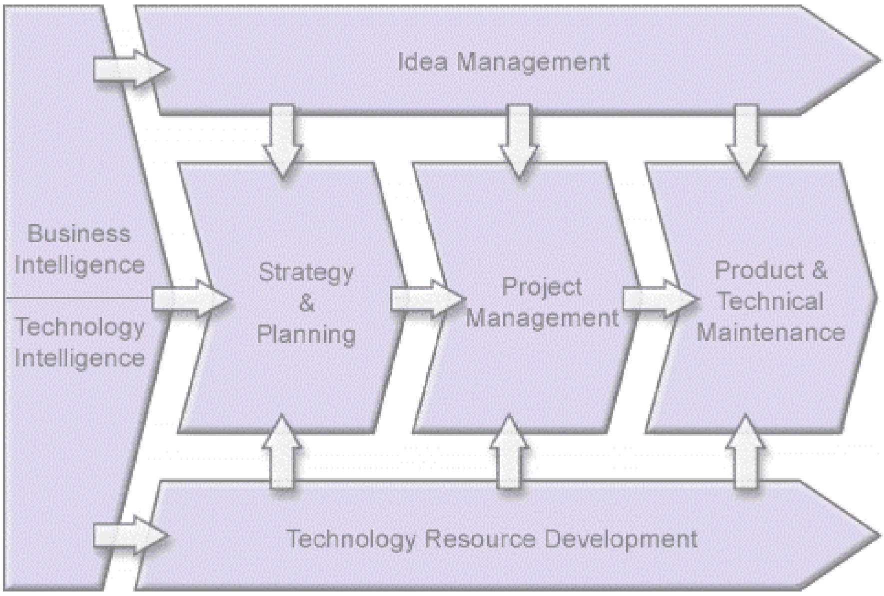


Figure 4, TPIN

The need for it was clear when projects considered to bee a success were never finalised due to lack of consumer interest. It provides a structured way of working and is the same all over Tetra Pak. Since it has been found that the cost of a project does not follow a linear development and that early work is inexpensive, more preparations are required now in order to start a project then before. More aspects have to be considered than just the technical ones before a project will get green light to go ahead. TPIN does not only cover product development but instead most activities in the company.

The integral parts of TPIN are:

- **Business Intelligence**. Information about the market, the customers and consumers, the players and the competition. Overall threats and opportunities and threats in the business and industry.
- **Technology Intelligence**. New technologies are listed for possible wide use within the company. Technologies developed both inside and outside Tetra Pak are presented.
- **Idea Management**. A traditional phase one funnel[13] is used to collect all the ideas in the company. As the map illustrates this does not just include technical ideas.

[13] Wheelwright, Clark 1992, page 124

- **Strategy and Planning**. The project portfolio is evaluated and its concordance with overall, area and system strategies is ensured. The portfolio is budgeted and planed and priorities are set.
- **Project Management**. Project has to go through five steps: Project definition, Concept development, Prototype development, Field test and Commercial launch. Each with their tollgates and milestone review meetings that have to be passed before the next step can be taken.
- **Product & Technical Maintenance**. Released product's behaviour at the customer's sites is monitored and if it is not satisfactory, actions are planned, executed and evaluated.
- **Technology Resource Development.** Here it is secured that the right technological resources are available when needed. Key technologies are identified and developed, competencies and resources are developed and a supplier base capable of delivering the know-how needed is established.

3 Theoretical Foundations

The object of this chapter is to provide a platform for analysis regarding areas that were found interesting after the Tetra Top study. These areas include hierarchical systems that often are symbolised with use of pyramids, efficiency in general and Robust Design Engineering. It has been hard work to find relevant literature and the chosen theories sometimes only touch the subject of this thesis. Only relevant parts are presented in this chapter.

3.1 Pyramids

Jan Carlzon, former managing director of SAS[14], is commonly known as SAS-Carlzon and became famous in the eighties for sending his employees on charm-courses. He is of the opinion that the organisation of a company must reflect on the organisation of the society that people in the company live in. The key for him is knowledge and efficiency. Knowledge because the people who have the best knowledge about the background to a decision should make the decisions and efficiency because these decisions should be made without any waste in form of time, documents or travel through levels in the traditional pyramid shaped organisation of the company. There is and has been a lag between the development of organisation in the society and the development of organisation in companies. This lag is robbing people of their motivation for and commitment to their work.

Ever since the times of feudalism and up to the middle of the twentieth century, society had a vertical, hierarchic structure. On top was God, followed by the king and the archbishop. Below them was level after level: the county governor, the bishop, the professor, the director and the landlord, the doctor, the lawyer, the priest and the schoolteacher. Ordinary people were found at the bottom, standing humble with cap in hand. The vertical structure was built on a number of differences, different access to information, different levels of knowledge and difference in economic power. These differences were inherited and were passed on from generation to generation. It was in many ways natural to organise the companies in the same way. If it was a good idea to organise society like a pointed pyramid, why not organise the miniature society of a company as an image of the society that the company existed in. Especially since the director was often the owner or was closely related to the owners. All decisions regarding the company were taken at the top and carried out at the bottom of the pyramid. All the different bosses in between were called bosses but in reality, they had no area of responsibility where they were allowed to make decisions. They were a mere channel for decisions. Decisions to be taken were passed upwards and already taken decisions were passed downwards. The only ones with all the information and knowledge were at the top of the pyramid.

In Sweden and the rest of the western world, society has evolved. Education is available to everyone with talent and ambition and knowledge is available to

[14] Carlzon, Lagerström 1985

everyone through Internet and other channels. The distance between top and bottom of society has narrowed considerably and people at the bottom no longer look up to and respect the higher classes anymore. This is especially true for the upper class (owners) and continuously growing middle class (educated). Jan Carlzon argues that when you take a person, who has grown up in this new society and is educated, ambitious, has access to all sorts of information and has self-esteem, and put them in a hierarchic organisation where they have no power over their situation, the result is disappointment, stress, inefficiency and lack of motivation.

He continues stating that the people on top of the pyramid do not have the information necessary to make day-to-day decisions about running the company. Only the people who act as a front towards the market have this knowledge. Nor should they waste their valuable time on details that are better carried out by others. An opportunity, which could have been taken advantage of, is often lost due to the loss of time when the question is moved up and down in the organisation. Other times it is completely forgotten about when it reaches a level where it gets low priority.

The solution according to Jan Carlzon is decentralisation and a different type of pyramid, much wider than before and with only three levels. Contrary to the title of his book “Tearing down the pyramids” and popular misconception he does not suggest to do away with the pyramids altogether in favour of the shape of the popular Swedish candy “Ahlgrens cars”. The highest level of this new pyramid is occupied with the vision, goal and strategy in the company. The middle level is responsible for planning and adjusting resources by investing or hiring people. It should make sure that conditions for following the strategy exist. Third level is operations. All decisions regarding daily activities should be taken here in line with the goals and strategies from the first levels and by using the resources and planning from level two.

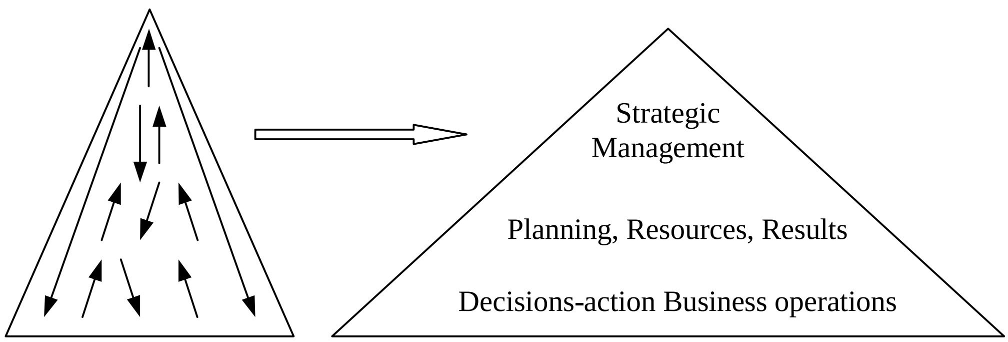


Figure 5, Old and new pyramid according to Jan Carlzon

This new form of organisation calls for a new form of leadership based on information rather than instruction. Instead of giving limitations by acting as a traditional boss, the new leader has to give opportunities by delegating responsibility and decision-making. Modern employers look for the visionary, the strategist, the informer, the pedagogue and the inspirer in their leader at work as they have always done outside the company gate.

The transition is a source of anxiety for many people. What will happen to all those in middle management with large offices and impressing titles when they become obsolete? The work they did, passing decisions up or down is no longer called for. Nor is their position in the company. Nor the salary they lifted. The ladder of promotion that junior employees used to look forward to and motivated them to outstanding performances is also gone. Jan Carlzon suggests that we have to change the way we look upon success. It must be possible to be promoted in other directions than upward in the pyramid. Instead of an impressing title, the actual contents of the work and its importance for the company should be valued. He is however aware that this is a difficult task and illustrates with an example from the Chinese army. When they tried to remove all badges of rank, a system of different sized and coloured pens in the breast pocket was instantly developed to show the rank of the person.

It took thirteen years before the obvious reply came in form of the book “Rebuild the pyramids”[15] where the authors try to set off an earthquake to turn all our dogmas upside down. Not only about the praised flat organisation which is supposed to solve all problems and make everyone happy and rich, but also the myths about the speed of change, complexity and knowledge in society today. With a vast number of examples they argue that it could rather be the other way around and that the times we are living in are more stable, less complicated and that you are able to survive with less knowledge than ever before. They take the metaphor very seriously, perhaps too seriously and spend a lot of effort and pages defining what a pyramid and a flat pyramid are. However, it becomes very interesting when they point out that splitting up operations into small groups (an action usually associated with flat organisation) rather sharpens the pyramid instead of the reverse.

The authors use yet another metaphor (than the pyramids) when they compare organisation with the health treatment of the seventeenth century. The only remedies they had then were enema and leeches and they were used regardless of the disease. Therefore the diagnosis was of minor importance. They are of the opinion that, in the recent decades, flattening of the organisation has been used in much the same way no matter what business or situation. Just like modern medicine has different remedies for different diseases, the shape and size of the organisation should depend on what the organisation is doing. They argue that the diagnose speed, complexity and knowledge intensity is faulty and that the medicine flatness does not even cure these symptoms. Flattening the organisation does not even have the effects that are usually associated with tearing down the pyramids.

In spite of the title of her book[16], Birgitta Södergren is not so interested in what a pyramid is and instead focus on the effects that you can get by what she refers to as

[15] Ohlsson, Rombach 1998
[16] Södergren 1987

decentralisation. “When the pyramids have been torn down” is her contribution to the pyramid metaphor. According to her, the tearing down of the pyramids completes the full cycle of the role that the worker has had during industrialisation. In the beginning the worker (skilled tradesman) was in full control of the methods used and quality of the work he performed. He was not easily replaced and it could take a lifetime to learn the profession who was often passed on from father to son. Taylor[17] came along with Scientific Management 1911 and reduced the worker to an easily replaced cog in a big machine. This was possible by the means of specialisation and by standardisation of the working methods. A centralised planning department performed this standardisation. From Birgitta Södergrens view, tearing down the pyramids means getting rid of this centralised planning department in favour of empowerment of the individual (worker). Birgitta Södergren is of the opinion that specialisation itself leads to the creation of hierarchic systems. That and refined division of duties also creates efficiency but at the cost of co-ordination. The parts have to be put together to form a whole and that demands bosses in many levels. She states that the opposite is also true; to reduce the level of specialisation also reduces the need for hierarchy. She also claims, contrary to Ohlsson and Rombach, that dividing workforce into small groups decrease the pyramid and that flat organisation is not a trend nor that the pendulum will ever swing back and that the pyramids will be rebuilt.

In her follow-up ten years later she states that the pyramids have not only completely flattened but also grown together by means of supply chain management and networking to form a horizontal organisation[18]. Although decentralisation has many positive effects she admits that there is no proof of increase of efficiency as a result of removed hierarchy.

3.2 Efficiency

In order to be able to suggest actions that will have the effect of increased efficiency it is important to first establish what exactly efficiency is. The dictionary[19] gives us the following two explanations. 1: the ratio of useful work performed to the total energy expended or heat taken in. 2: the state or quality of being efficient. The first one is a bit too scientific for our needs and the second leads us to 1: productive with minimum waste or effort and 2: capable person, acting effectively. By following up this new word and link we find effective which among many other less interesting explanations mean: having a definite or desired effect. Closely related and often used is also efficacious which is a little bit stronger: producing or sure to produce the desired effect.

Does this unwinding of the word efficiency have any purpose or is it merely a task of academic nature? Well, it is a bit of both. It is essential to make sure that the

[17] Fredrick W Taylor (1856-1915)
[18] Södergren 1997
[19] The Oxford English Reference Dictionary 1996

assignment has been properly understood and also that it is correctly communicated to the readers of this report. When the assignment was first accepted it was thoroughly discussed and the understanding was not based on the definition of a word alone. The readers of this report should understand that whenever efficiency is mentioned, it does not just refer to the transformation of energy in a process but to a much wider, more general concept. This concept includes parts of the meaning of efficiency, effectiveness and efficacy. Instead of spelling out which parts are included it are of course the ones that are meaningful to the subject of this thesis.

The total efficiency consists of inner and outer efficiency[20]. Inner efficiency is to be able to do things the right way. In other words, it is to be able to produce a product or service at a minimal use of resources. In businesses characterised by fierce competition and over-capacity this inner efficiency is often the most important and crucial for survival. For most businesses however, the outer efficiency is by far the most important. Outer efficiency is to do the right things. In order to score high here a company has to make decisions about their strategic position. If a company has a big market share in a growing business, their profit potential is good and so is their strategic position and outer efficiency.

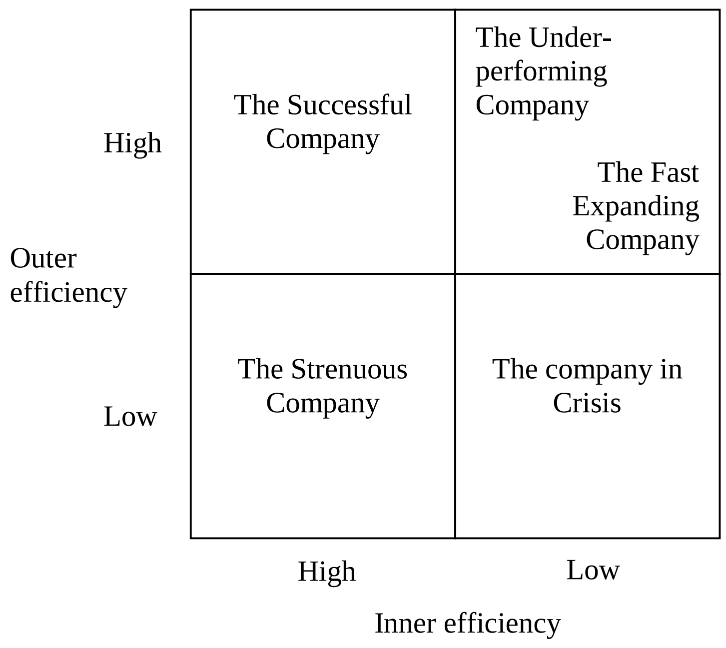


Figure 6, Interplay between inner and outer efficiency

Another, perhaps more modern definition is that outer efficiency is value added to customers or to which degree the performance of the company meets the demands of their customers. The relative importance is hence depending on the situation and it is

[20] Bruzelius, Skärvad 1995

never possible to substitute one for the other. The different combinations of high and low inner and outer efficiency are shown in figure 6.

Another interesting contributor to the efficiency discussion is Ohno of Toyota. He internationalised the Japanese word *muda*, which means waste and he has worked very hard at Toyota to completely abolish it. All actions in any company or organisation can be divided into three groups[21]:

1. Value creating. Actions that directly lead to value for the customer
2. Type One *muda.* Actions that do not create any value but are unavoidable under current circumstances
3. Type Two *muda.* Actions that do not create any value and are immediately avoidable

Ohno stated his list of different kinds of muda as follows:
- Defects in products
- Overproduction of goods not needed
- Inventories of goods awaiting further processing or consumption
- Unnecessary processing
- Unnecessary movement of people
- Unnecessary transport of goods
- Waiting by employees for process equipment to finish its work or on an upstream activity

Womack and Jones added another muda of special interest to this thesis:
- Design of goods and services which do not meet users' needs

Ohno's work at Toyota led to the concept of Lean (-thinking, -production, -manufacturing) including kanban, JIT and TQM and it can be summed up as ten simple rules[22]. They have been tested, proven and adapted to a vast number of functions like logistics, customer service, health care, finance and even construction.

Lean Rule 1: Eliminate Waste. Eliminate anything that does not add value to the final product as mentioned above. Use value stream analysis to find different, more efficient ways to add the same value.

Lean Rule 2: Minimise Inventory (Minimise Intermediate Artefacts). Inventory is waste because it consumes resources, slows down response time and hides quality problems. It gets lost; it degrades and becomes obsolete. The costs of inventory outweigh the benefits. With inventory comes documentation and there are many wastes associated with excess documentation: Waste of time producing the documents, waste of time reviewing the documents, the work that goes into change requests and associated evaluations, priority setting and system changes. The biggest

[21] Womack, Jones 1996
[22] Kathleen Eisenhardt, Harvard Business Review

wastes, however, is building the wrong system if the documentation does not correctly and completely capture the user requirements.

Lean Rule 3: Maximise Flow (Drive Down Development Time). Reducing development cycle time should be done using the same techniques employed to reduce manufacturing cycle time. This means looking for and reducing accumulations of WIP (Work In Process). Just as in manufacturing, if WIP is reduced, the cycle time will be reduced. In order to reduce WIP, small batches and smooth flow principle should be used. Iterative development is basically the application of these principles by design and delivering of small but complete portions of a system throughout the development cycle, each one adding an additional set of features. Each iteration should engage the entire process from gathering requirements to acceptance testing.

Lean Rule 4: Pull from Demand (Decide as Late as Possible). Rather than to try to make perfect forecasts of future demand, reducing the reliance on forecasts by reducing the system response time is a better solution. Then the system can respond to change rather than predict it. This is especially important in volatile business environments, where customers are not able to forecast their future needs accurately. The ability to make decisions as late as possible provides a competitive advantage.

Lean Rule 5: Empower Workers (Decide as Low as Possible). A basic principle of Lean Manufacturing is to drive decisions down to the lowest possible level, providing both the tools and the authority for people "on the floor" to make decisions. One of the problems with heavyweight intermediate documentation is that it attempts to make all of the decisions for developers, rather than giving them a set of guidelines. In general, raising the level of abstraction of intermediate artefacts will give guidance as well as freedom to the developers as they make the detailed design decisions. It is always better to tell developers what needs to be done – not how to do it. Developers need to understand the goal of their work, how it fits into the overall flow and what it means to meet customer requirements. They also need to know what they must accomplish, by when, and how to tell when it is complete. Finally, their work needs to be made visible in short iterative cycles to provide the feedback necessary for continual improvement.

Lean Rule 6: Meet Customer Requirements (Now and in the Future). The most common cause of railed projects is missing, incomplete or incorrect requirements. A response to this risk has been to gather detailed user requirements and getting user sign-off prior to proceeding with design. Instead of encouraging user involvement, user sign-off tends to create an adversarial relationship between the developers and the users. Users are required to make decisions early in the development process, and are not allowed to change their minds, even when they do not have a full concept of how their business situation may develop in the future. Customers are understandably reluctant to make these commitments, and they will instinctively delay decisions to as late in the process as possible. The most effective way to accurately capture user requirements is found in the iterative approach. By developing core features early and obtaining customer feedback in a focus-group demonstration of each iteration, a far more correct definition of customer requirements can be obtained. In addition, if we accept that the requirements will necessarily change over time, we must start with the essential requirement that the system must be designed to easily adapt to changes over its lifecycle.

Lean Rule 7: Do it Right The First Time (Incorporate Feedback). It costs 100 times more to find and fix a problem after delivery than to find and fix it in early design phases. Just as Lean Manufacturing builds tests into process so as to detect when the process is broken; continually testing development reduces long expensive loops.

Lean Rule 8: Abolish Local Optimisation (Sub-Optimised Measurements are the Enemy). Project managers have been trained to focus on managing scope, just as in manufacturing were trained to focus on maximising machine productivity. In the same way that localised productivity optimisation creates a sub-optimised overall process, so too, does focus on managing scope create a sub-optimised project management process.

Lean Rule 9: Partner With Suppliers (Use Evolutionary Procurement). Trusting relationships with single suppliers create an environment that allows optimising the overall value to both companies. The quality and creativity, which resulted from collaborating supply chains, has demonstrated to far outweigh the apparent (and sub-optimal) benefits that came from competitive bids and rapid turnover of suppliers. Partnering companies help each other to improve product designs and product flows. They link systems to allow just-in-time movement of goods across several suppliers with little or no paperwork. The long-term advantages of collaborative supply chain relationships are well documented.

Lean Rule 10: Create a Culture of Continuous Improvement. Improvements that span more than a single project are needed. Future project performance must improve by learning from existing ones. Here again, Lean Manufacturing can point the way. During the 1980s, a set of practices summarised in the ten rules of Lean Manufacturing were adopted widely across most manufacturing plants in the West. These practices then spread to service organisations, to logistics organisations, to supply chains, and beyond. They have withstood the test of time across multiple domains. Following the simple rules of Lean Manufacturing has brought dramatic improvements to every industry in which they have been applied. These same rules can and should be applied to development projects. The resulting Lean practices will lead to the highest quality, lowest cost, and shortest lead-time development possible.

3.3 Robust Design Engineering

The Taguchi methods[23] refer to using statistical tools in order to optimise robustness in regard to cost. A robust product is one that is able to perform under all the different environments that the customer might expose it to. With an example from the TV set-

[23] Taguchi 1993

producing industry Taguchi illustrates the importance of not just staying within tolerance but to try to stay as close to the mean value as possible. The Sony factory in Japan had the bell-shaped, normal distributed curve with the mean value on target while the San Diego factory, making the exact same TV set, had a uniformly distributed curve within spec. Even though more sets actually had to be scrapped in Japan than in San Diego due to being outside spec, the costs of customers preferring the sets with perceived higher quality weighed in favour of the Japanese factory.

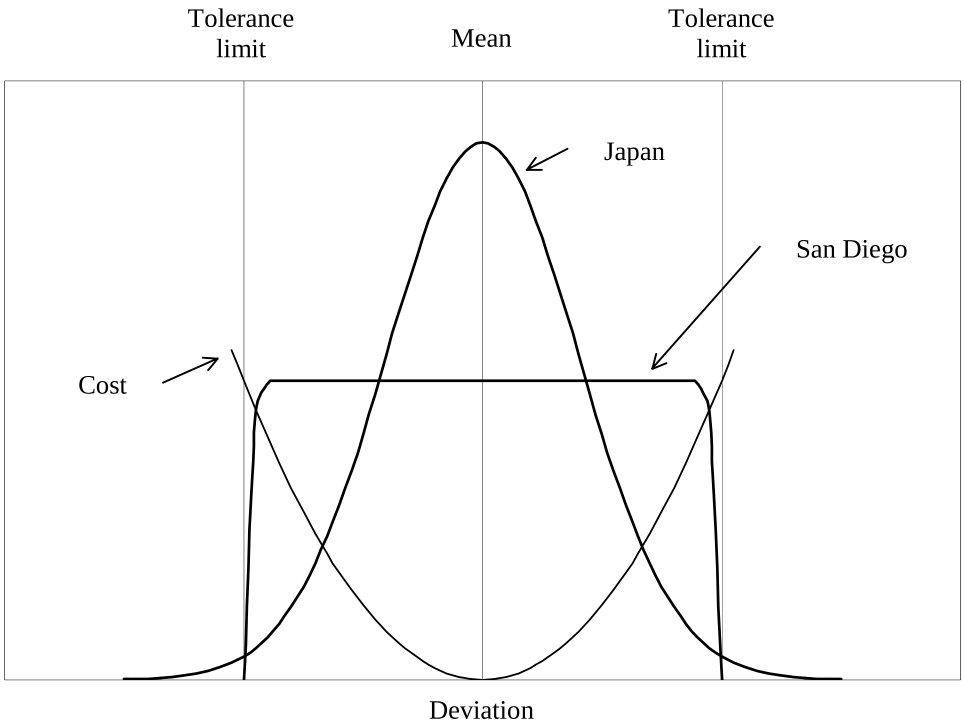


Figure 7, Cost of deviation and the respective distribution in Japan and San Diego

Operating conditions in research departments are usually quite different from the actual production processes or actual users' operating conditions. Taguchi refers to these differences as noise and introduces the signal-to-noise (S/N) ratio. The S/N ratio is a measurement of how much the function of a product is changed when exposed to noise. Instead of trying to control the noise sources, products should be designed in such a way that that they become insensitive to variations, i.e. robust to the various noise sources. In general, technologies that are not robust under actual production or operating conditions are useless and wasteful. Research done in research departments should be applied to actual mass production processes and should take into account all kinds of operating conditions. Therefore research departments should focus on technology that is related to the functional robustness of processes and products, and not just to meeting customers' requirements.

There are basically two different approaches to robustness. One is to design manufacturing processes in such a way that they become robust to variations and yield consistent results. The other way is to design robust products that can be "rapped, overloaded, dropped and splashed"[24] and still perform on target.

The most accurate information on how a system responds to input variation is acquired through testing the system in a real-life situation[25], where the system output is sampled and subjected to various types of analyses. In such situations, the input variations can also be measured, and the true relationship between input and output variation can be established. Designed experiments have been used for a long time in the chemical and pharmaceuticals industries. The major part of Taguchi's contribution lies in the fact that he introduced the electronics and mechanical industries to experimental techniques. By simulating the influence of noise on a prototype by means of a laboratory experiment, the response could be analysed and measures taken to improve the robustness of the prototype. The designed experiment provides the foundation for the Taguchi method and is by far the most popular approach to robust design.

[24] Taguchi, Clausing 1990
[25] Andersson 1996

4 Tetra Pak study

The purpose of the thesis from the commissioners' point of view was to increase the efficiency of the mechanical engineers. The obvious starting point would be to establish the zero level, i.e. how efficient mechanical engineers are in the situation and organisation they find themselves in now. In order to find different kinds of muda it was important to evaluate the current situation in the engineering design department at Tetra Top. Another purpose of the study was to investigate what the general attitude towards efficiency is and if there are any suggestions within the department to increase the efficiency. The following chapter explains how the study was performed, why it was performed that way and the result.

4.1 To make a study

There are four ways of gathering data for a study[26]: the interview, observation, using data gathered by others and using the Internet. When conducting an interview it is important to decide whether it should be structured or not and who to interview. The advantage with the structured interview is that it becomes time efficient to interview a large quantity of people. On the other hand, the unstructured interview can capture the view of the subject in greater detail without spending time on a form that has all the right questions. The two dimensions regarding observations is level of interaction and open versus concealed. Interacting in an observation means taking active part in the work performed and by interacting, the scientist may acquire in-depth knowledge about the object of study. The drawback of interacting is that the observations might get distorted. That might also happen if the observation is open. Some subjects might want to give the scientist what he wants while others react in the opposite way. Therefore observations are often concealed. The level of structure is a factor also in observations. Data gathered by others might be partial in some way and it is important to have a sceptical attitude while using the information. Studies, like this one, that have the purpose to give an explanation to something are called diagnostic studies.

A study can be performed either with high or a low structure[27]. In the former, standardised forms are often used and the answers "yes" or "no" are often the only available. The latter is characterised by the two-way communication and higher complexity. A mix of the two is also possible. Another dimension is whether the study is direct or indirect. Direct is when the researcher participates in the study and thereby acquires first hand information and competence whereby the opposite means that only second-hand information from other researchers is valued.

[26] Lundahl, Skärvad 1999
[27] Wigblad 1997

4.2 The study

The study at Tetra Top was performed in two stages: an observation followed up with interviews. The first stage was done in order to get some concrete numbers on how the mechanical engineers were spending their time. The second stage was done to verify the validity of the observation, obtain the subjects opinions on efficiency in general and their potential suggestions.

4.2.1 The introduction

It was important to secure the co-operation of the subjects in order to get a correct image of the current situation. For that purpose, a meeting was held with all the subjects where the purpose of the survey was explained and their collaboration in the design of the survey was encouraged. This was done for two reasons: to increase the subjects' motivation to spend time on taking part in the survey and to do so with accuracy and to use their help in making the survey as good as possible. The persons attending this meeting and who also took part in the survey were suggested by Peter Eriksson, one of my supervisors who were also present at the meeting. They were all employees who take part in mechanical design and are using the design tools in their working day. The complete list of participants is presented in appendix 1.

The initial scepticism of the subjects to yet another survey was soon converted to a positive atmosphere when it was understood that the result of their efforts could lead to increased work satisfaction and more interesting duties. Besides presenting myself and talking about the survey, efficiency and organisation in general was discussed at this meeting.

4.2.2 The Observation (survey, audit)

To call the survey an observation might be slightly confusing since nobody was standing over the shoulder of the mechanical engineers, watching their every move. Under the definitions of data gathering it is still the same information that is the result and it therefore makes sense. The subjects were asked to keep track of the tasks that they performed during the day and how much time they spent on every task. Even though I have experience as a mechanical engineer I did not take part in daily operations. The observation qualifies hence as open and with zero level of interaction.

In spite of the risk of distortion when using the open method, it was chosen because of the difficulties to gather the quantity and quality of data with the concealed method. The work conditions would make it almost impossible to observe the engineer during the whole day and it would be completely impossible to decide what he was doing all of the time. One way to increase the concealed factor is to pretend that the survey is about something else but this solution was not chosen because of the obvious risk of subjects feeling "cheated" when results were presented. This could have serious negative effects on the possibilities to implement any actions that would result from the observation. The fact that the identities of the individual mechanical engineer were hidden and they only appeared as a number in the collected data provided some concealment, however.

On the scale of structure, this observation was on the higher end. A form was designed using FileMaker Pro, a database software program. The subjects could access this form through the Intranet at Tetra Pak. At the end of each day the mechanical engineer would make a record by punching in the hours spent at each task. In order to guarantee enough data but not to take up too much of the engineer's time, it was agreed that the observation would continue over a period of ten days (two normal working weeks).

On the first day every subject picked a number from a hat and that number became his/her identity when logging on to the database. Initially the response was poor and records did not appear on the database in the frequency expected. After the introduction of a top list of identities with highest number of records recorded which was distributed daily, the response soon picked up. To make up for the lost days at the beginning, the engineers were asked to continue until they had a total of ten records. Some continued further while others never reached the agreed number. The result, however, was an average amount of records per subject very close to ten.

The response and details for the audit was as follows:

- Total number of records: 157
- Number of participants: 16
- Number of days: 13
- Average amount of records per person: 9,8
- Average time spent on task per day: 1,75 h

It might surprise someone that entries like "wasting time due to lack of motivation" or "prolonged coffee brake" are not included in the survey depending on that someone's attitude to work politics. It was, however, never the ambition of the survey to catch cheaters or low achievers but instead to find sources in the organisation, routines or traditions which were holding people back and preventing them from being efficient in their work. I am also sceptic whether a survey could catch cheaters and the more likely result of such entries would be to upset subjects and decrease their motivation to fill in the form with consistency and accuracy.

It had been decided in the previous meeting that the following tasks would be available in the form:

Pro/E / Medea / E/plan-21
- Model work
- Drawings
- PDM handling

Lists and ECM
- ECM handling
- BoM/ECM in R/3
- BoM/ECM in AS/400
- BoM handling in excel

Request of new article
- Request of new article

Supporting other functions
- Support to tech. doc.
- Other support

Other technical activities
- Gather tech. information
- Calculations
- Incoming doc. Control
- Solve technical task
- Retrieval of information from standards /guideline
- Testing

Resources
- Manage consultants / system suppliers
- Provide released doc. To suppliers
- Prov. / handle not rel. doc. to suppl. / cons. / int

Material
- Purchase requisition
- Monitoring and handling of incoming parts and in stock
- Handling/shipping of parts

Other
- Purchase component handling
- Follow up on old/previous design activities
- Reports and documentation

Unpredictable activities
- Hardware/software problems
- Explain daily work due to lack of English knowledge
- Tutorship for new empl. / consultant

Training / Education
- Update/information/training regarding Tools and methods
- Training according to training plan

Meeting
- Meeting relevant for your design activity
- Other meeting

Travel
- Travel preparation (money and ticket…) and reporting
- Travel time to visit supplier
- Travel time for business trip

- Vacation/holiday/illness
- Other

The complete result of the observation is listed in appendix 2, sorted by identity number.

The best way to illustrate the result of the observation is by means of a pie-diagram where the quantity of every individual task is represented by the size of its slice of the pie.

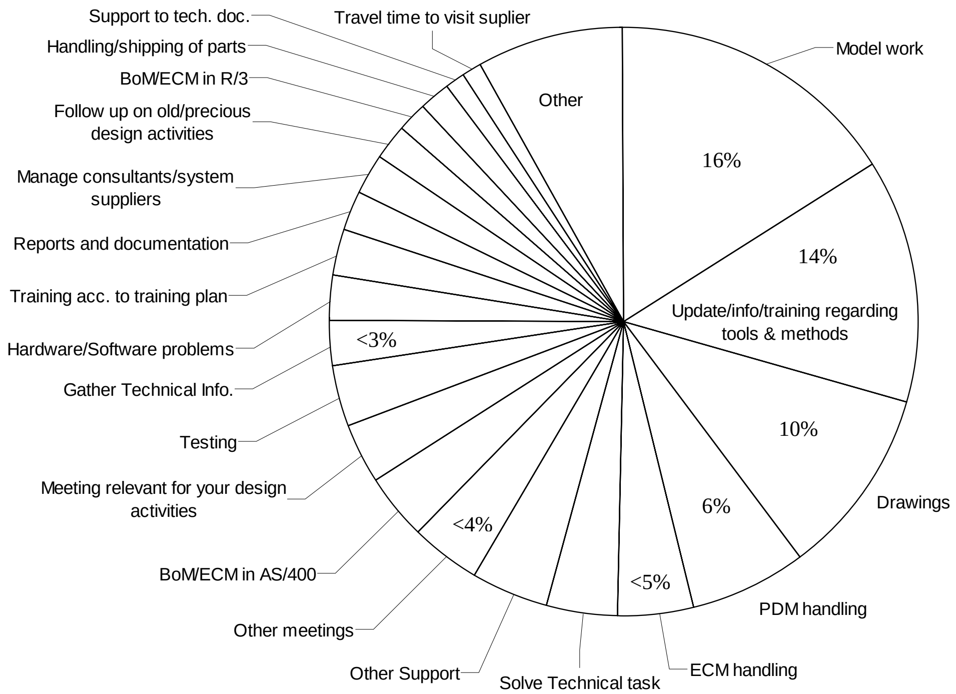


Figure 8, Result of the observation

The result was reviewed assisted by my supervisors and it did not come as a complete surprise to them. The exception to this was; Update/info/training regarding tools & methods, PDM and ECM handling, Hardware/Software problems and BoM/ECM in R/3 and AS/400 that all scored higher then expected. It was expressed that more in depth knowledge was desired towards the explanation to the high scores for these tasks. Also, the entries were categorised depending on how crucial it was that they were performed by a mechanical engineer and whether the task was in line with the mechanical engineers' talents and choice of profession.

The categorisation came out as follows:

Primary activities for the mechanical engineer (32% of the time)

- Model work
- Drawings
- PDM handling

Secondary activities for the mechanical engineer (11% of the time)

- Solve technical task
- Meeting relevant for design activities
- Gather Technical Info.
- Calculations

Activities not corresponding to the talents of the mechanical engineer (13% of the time)

- ECM Handling
- BoM/ECM in SAP/AS400
- Provide released doc. to suppliers
- Prov./handle not released doc. to suppl/cons/internal
- Purchase Requisition
- Incoming parts
- Outgoing parts
- Purchase comp

4.2.3 The Interviews

The purpose of the interviews was to gather in depth information about the situation, opinions and experience of the subjects. Therefore an unstructured interview should be used. At the same time, it would be an advantage if it were possible to compile the resulted data in a structured manner in order to get the collected views of the subjects. This argument pushed in favour of a structured interview. The obvious choice hence was to use a combination of them and make sure to get the desired qualities from the two combined techniques. This was done by using a structured questionnaire but to not stick very hard to it. The questionnaire was enclosed in the request for the interview to every subject and the mechanical engineer was encouraged to have a look at the questions and prepare for the interview. Some of the subjects had filled in answers to the questions on the enclosed form and brought this to the interview. These forms were not collected during the interviews but the subject instead used them to trigger his memory during the discussion.

The questionnaire was developed based on the result of the previous observation and the information I was interested in and could not get from the audit. When my supervisors reviewed it, one question was added by one of them regarding personal feedback on his duties from the engineers. The information on that question has been given directly to him and will not be presented or analysed in this thesis.

The original questionnaire is enclosed in appendix 3 and had the following 12 questions:

1. Did anything unusual happen during the measured period or was the punched in value representative for your normal work?
2. In case of yes above, which task became too large or too small?
3. Some tasks had a surprisingly high score. Can you give more information to what they consisted of:
   * PDM handling
   * Hardware/Software problems
   * R3/AS 400
   * ECM: (what is the problem?)
4. What is your opinion on the support on the tools (Pro-E)?
5. How efficient do you think the **department** is compared to similar activities in other places at Tetra and other companies?
6. If different, what is the reason?
7. What do you think about the necessity to increase the efficiency of the **department?**
8. Do you have any suggestions on how this should be accomplished?
9. How efficient do you think **your** work are compared to similar activities in other places at Tetra and other companies?
10. If different, what is the reason?
11. What do you think about the necessity to increase the efficiency of **your** work**?**
12. Do you have any suggestions on how this should be accomplished?

The complete result of the interviews is listed in appendix 4, sorted by questions to protect the anonymity of the subjects.

The interviews were scheduled to take about half an hour and lasted from 15 minutes up to an hour depending on the amount and intensity of the subject’s views. I opened the interview by presenting the result of the observation and with a general discussion about efficiency in order to make sure that a wide enough definition was understood. Thereafter I let the subject be in control and lead the discussion in whatever direction he or she wanted. The previously distributed form was enough to set the topic without any need for me to step in and ask direct questions. Instead I was busy taking notes into the form in a corresponding space to the immediate subject of discussion. However, I asked follow-up questions in order to ensure that I had understood correctly and taken the appropriate notes.

The result of the interview was very varied and there was not complete unanimity on any of the questions. This was to be expected and is not a cause to worry. The subject’s positions in the company are not the same and therefore a number of different views are represented in the study. There was also a big difference in the individual interest to talk about either inner or outer efficiency. Still, it was not hard to derive some conclusions from the collected information.

- Training had been highly over represented during the measured period but otherwise duties had been as usual.
- Some software for documentation is used so infrequently that the manual has to be used every time and it is very time-consuming.
- Poor hardware (computers and network) that breaks down and/or give responding time.
- Inability to focus on one task due to constant interruptions.
- Parallel systems result in the same task having to be performed several times.
- Specialisation of duties would give opportunity for becoming better and more efficient at fewer tasks.
- More time and opportunity are desired for testing and verification.
- To much time is spent on copying and distribution of non-released drawings to suppliers.

As a direct result of the interviews I contacted the department responsible for network at Tetra to see if they were aware of the problems the engineers were having with long responding times. It turned out that they were but that the reasons for the problems were different from what mechanical engineers believed.

The mechanical engineers were called to a meeting in which they were informed by representative from network about the reasons for delay, what was being done about them and the schedule for these actions. They were also informed about the plans for updating the computers. The immediate result of this meeting was to decrease the frustration in front of computers due to the engineers knowing that improvements were on the way. At the meeting I also took the opportunity to inform the engineers about the results of the study.

5 Analysis

By comparing the theoretical foundation and the empirical information gathered in the study at Tetra Top, the way things are done at Tetra Top can be analysed and advantages and disadvantages of alternatives will be discussed in this chapter.

The following map will provide a guide through this chapter and also symbolises the connections between the different sub chapters in the theoretical foundation, the study and the derived conclusions in the next chapter.

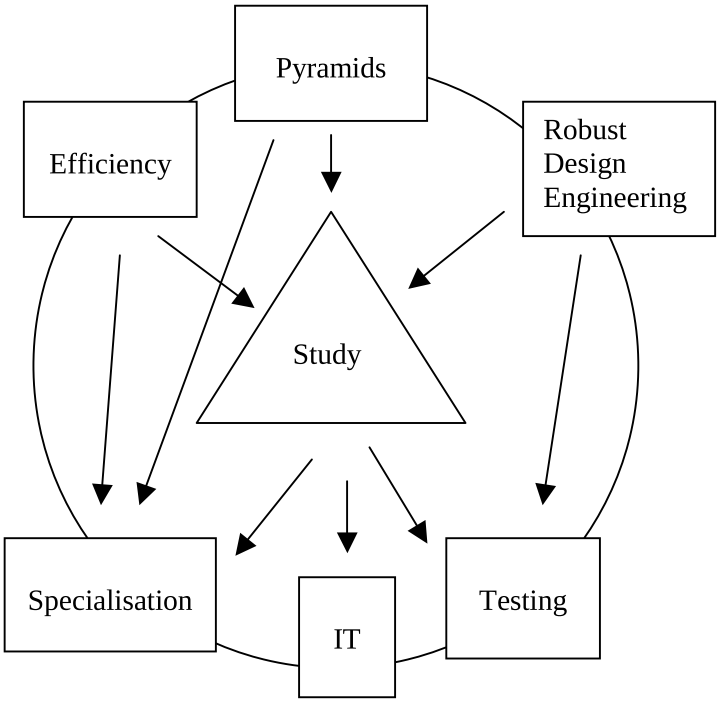


Figure 9, Map of the Analysis

The following text is structured according to the map starting at the top. Every arrow in the map equals a chapter in the analysis and the reader should recognise the boxes as sub-chapters in either the theoretical foundations or conclusions.

5.1 Pyramids → Study

As illustrated by the organisation chart for Tetra Top there is hierarchy in the system unit. Even though there are only two levels shown there is also a third level including the people participating in the study. For an organisation of 130 people this is a fairly flat organisation and the level of hierarchy must be regarded as low. Of course, one must be aware that organisational charts only give the formal structure and the reality might be more complex due to personal qualities and interests of the individual worker. All the people in operations being at the same level implies that people here have to divide their time into several different tasks with different levels of complexity and requiring different talents. The result is obvious but was also found in the study. Much of the working hours are spent on tasks that were very far from the expectations of the staff before they entered the profession. It can be argued that people should not be too narrow in their work but instead broaden their view with several different tasks in order to spark their creativity and also become more versatile. I seriously doubt that the tasks that the mechanical engineers find themselves doing outside their primary and secondary activities have this effect.

The study also found that people are frustrated over having to split their focus too much and over never being able to concentrate on one task in order to perform in line with their own expectations. The solution to this is not necessarily to increase the level of hierarchy in the department and to go back to the way of the past with first designer, second designer and draughtsman all doing the same job but at different levels of complexity. Several alternatives can be suggested and some have come from the interviews with the people involved: Extended use of consultants, because the mechanical engineers feel that this duties are so boring that no one would stay at a job which was based on duties they are not qualified or overqualified to do. Increased involvement of suppliers who can take over responsibility for a project once it reaches a stage where creativity is no longer involved and a administrator is more apt for leading and managing it. The way projects are managed could also be altered to decrease the amount of administration and paperwork (done on computers). The development, however, is rather going in the other direction, and for good reasons.

5.2 Efficiency → Study

When we first started talking about efficiency at the introduction meeting with the people involved in the study it became obvious that efficiency is a word that does not have a clear meaning. Is it how many hours are spent in front of the designing tools, the quantity of drawings or details that are produced, how well they work or how satisfied the customers are? Even more important, how do you measure efficiency? I suggested a definition in the messages calling to the interviews which aimed to broaden the participants thoughts on efficiency and to possibly spark ideas rather than to once and for all decide what efficiency should mean for everyone. It became customer value / resources used. It does not give any clues on how it should be measured.

I have in this thesis also made a synthesis of what different influential people have said or written about efficiency and also added people who have made contributions to the subject. It still does not help us to a method of measuring it in the activities we are dealing with in this thesis. Does this mean that efficiency is an abstract phenomenon and that it is pure *muda* of the second type to even discuss it? The fact that the word “Lean” has entered the stage gives a clue to the answer of this question. I don’t think that it would be a very bold prediction to say that we will see new words in the future that will be used in place of efficiency to create an illusion of novelty.

Sometimes it will only take on a narrow part of the much wider meaning of the word efficiency and thereby justify its existence. Other times it will not.

Will these new words provide better tools for us in our struggle for everlasting increasing efficiency? I actually think they will. The illusion of novelty that might seem to be a very negative way to describe recent contributors has a very important function. It prevents us from forgetting about efficiency and sometimes provides a new view or a new approach to the subject. To be efficient is to be able to compete in on the market and it is by no means *muda* to strive for improvement. In some other activities from the ones we are dealing with here, it might be possible or even easy to measure efficiency and future development might even make it practical to measure the efficiency of design activities. For now we have to settle for subjective opinions about the efficiency of the mechanical engineers. This is not necessarily a bad thing. Usually, opinions, intuitions and "gut feelings" take more factors into the equation than the most sophisticated of measuring methods. There is a drawback, however, if it is important to put an exact number to the level of efficiency or to compare different departments with each other. Using subjective opinions does not provide the same credibility as an exact measurement would.

It is important to talk about the industry that Tetra Pak is involved in to establish the importance of different types of efficiencies. On the global liquid market, Tetra Pak has one percent and on the global packed liquid market, nine percent. As a contrast the industry of fibre based packaging for liquid food was invented by Tetra Pak who since has dominated the market. The packages are mass-produced in a scale that few other companies or industries can compete with. But Tetra Pak does not produce or sell the packages even though packaging material is provided to the customers. This is done by the customers and their customers in turn are at Tetra Pak referred to as consumers. Some of the mechanical engineers who participated in the study are involved in design of new openings for the package, but this is the exception to the rule. The business of Tetra Pak is to develop and market machines for bottling and distribution of the bottles. Last year Tetra Top sold and installed less then 30 bottling machines so it is very far from being a mass production.

For Tetra Pak's customers competition is fierce and both bulk and specialisation is used in various combinations in order to be favoured by the consumers making their choices in front of the shelves in the supermarkets. For them, the inner efficiency is the most important. But for Tetra Pak, with only a few competitors offering a similar service, focus must be on outer efficiency, to do the right things. This is something that the individual mechanical engineer has next to no control over. Decisions on strategy are taken at a level in the company that engineers rarely have contact with. This has always been the way in Tetra Pak. If we go back to the matrix in figure 6 we find the Fast Expanding Company and that is exactly what has taken place. Nowadays the world has been conquered and Tetra Pak is found all over the world. The increase of sales is no longer as impressive as in the past. Staying in the same box in the matrix, Tetra Pak is now instead the Under performing company. To move into the box of champions and become the Successful Company, inner efficiency needs to be improved, but having said that, it is far more important to stay high at outer efficiency.

5.3 Robust Design Engineering → Study

To be able to design a machine that is only supposed to be used in a dairy and nowhere else might seem to be a simple task. That is, for someone who has never been to a dairy or only to one, perfectly kept dairy. The reality, however, is something completely different. As I mentioned earlier, I was involved in the introduction of the TT/3 and I was appalled by this machine's consistency of not working. Since my experience now has passed its "best before" date it was important for me to not let this affect the result of the study or this thesis. Nevertheless, I soon found that nothing had changed. The machine works better now, that is true. But things are still done in the same way. A quick look down history lane also revealed that this is the way things have always been done. With the exception of the TR7, but that was not by intention. When I bumped into a former colleague in the office and told him what I was presently doing, his immediate response to describe the Tetra way was "quick but wrong". At many stages in the development of Tetra Pak, this way of working was necessary. In order to calm nervous creditors and to convince them to extend their credits they had to be shown something whether it was robust or not. That reality is no longer present but it seems like that way of working has become part of the culture firmly built into the walls of the offices and foundations of the company.

5.4 Pyramids → Specialisation

The use of metaphors is sometimes a good idea in order to get your message across to an audience who is otherwise not prepared to accept your view. It can open people's minds and unlock their opinion that things are best the way they always have been. In the example of Jan Carlzon's pyramids they did just that. However, it can also have the effect that to much focus is put on the metaphor instead of the underlying message. The pyramids have been endlessly discussed and there has been a hype consisting in that every pyramid must be flattened and everything only remotely reminding of a pyramid should be done away with. It is a wonder that the original Egyptian pyramids are still standing, that they have not been dismantled and the pieces spread evenly across the dessert. In almost every organisation level after level has been taken out and the people in the organisation have had to learn and perform the duties that were done before by people on levels above or under them.

I must say that Jan Carlzon was misunderstood. He never had anything against pyramids. They were just such a perfect symbol for something old-style that he could not resist using the metaphor. The goal, however was never flatness, it was efficiency and focus on the customer. – How do you make sure that the customer, the one that pays all our bills, is happy? Carlzon's solution was that it was by making sure that the customer's problems could be solved quickly by SAS's personnel. The personnel could do this if they were allowed to make decisions for themselves and had the right attitude. He started by making this possible and found that middle management was left with nothing to do. If flatness would have been the goal, middle management would have gone first and people would have continued to work in the same way as before. They could no longer go to their nearest boss and ask permission, since he was no longer present, but instead to a higher level, to one further away with responsibility for more people. The result would undoubtedly have been a decrease in efficiency and customer satisfaction.

Job rotation, flexibility and being able to do each others' work if someone calls in sick sounds very nice and it has enriched the employment for many people. Like those who had boring monotonous jobs. Mechanical engineers are not to be found in this category. It is a creative work for people with talent for technical solutions and for solving problems. The flatness hype has meant for them that they today spend very little time designing and solving problems and instead find themselves filling in endless documentation. But, at the same time, it has given young mechanical engineers, who often before were producing drawings from sketches made by a senior engineer, more responsibility and opportunities to make their own designs.

One question could be hence: Which form of organisation is better, the old-style or new-age? I don't think this question is very interesting. Both have their advantages and disadvantages and it would be like comparing apples and pears. A much more interesting question would be - How can we organise to get the advantages of both systems without also getting the disadvantages. The answer is easy enough for a child to understand but at the same time it might be hard to implement because it requires some new ways of thinking. Allow people to specialise in whatever they have a talent for and are interested in and don't force them to spend time on other things. Make sure that you have a mixture of talents in your department so that all duties are performed by a motivated worker. That was the easy part, now it becomes a bit more difficult. All the different specialised tasks must have the same value in the minds of the staff in order not to build hierarchy. Team spirit must be developed so that sub-optimisation and the "not on my desk" syndrome is not developed.

5.5 Efficiency → Specialisation

As mentioned before outer efficiency is the more important one but that is no reason to ignore the inner efficiency. Especially since the engineers have more control over how things are done, or at least they should have control. People work in different ways, some are contented with doing what they have always been doing, and others seek constant change for change itself. Hence it is not enough to give people control over their workplace and time to reflect on it. Depending on the people and the mix of people, development can go in any direction. Having said that, giving people a mixture of duties they are not motivated to perform at and no time to reflect on them will definitely not result in increased efficiency. But enough said about what not to do. It has been found that people in general excel when they do something they find motivating (1), are in control of how they should do it (2), have direct responsibility for what they do (3) and have a goal to strive for (4).

The first requisite is currently not met in engineering design at Tetra Top. The amount of administration, documentation and all the different systems and tools that are involved with it is frustrating for the mechanical engineer. The same can be said for the second one. Engineers have expressed that frequently changing priorities and never being able to focus on one task long enough creates a feeling of lack of control. Finally, an ambiguous goal of increasing the efficiency with 20% means nothing to the individual worker and does not provide a goal to strive for.

If a person or group with different talents and interests offloads mechanical engineers so that they can focus on their primary activities their motivation should increase. The time they don't have to spend on doing these offloaded activities can also give the mechanical engineer the opportunity to not have to jump between projects so much but instead work in a more organised manner and increase the feeling of control. The feeling of control would also increase if the mechanical engineers were allowed to set their own measurable goals. These goals could be set both for the individual and for a group and there are already a number of available measures to choose from. These include different times that can be shortened, approval rating to be increased and to reduce complaints from customers or people involved in service.

The ten Lean rules provide a guide to the long-time work in improving efficiency. At first glance they might seem to have little to do with specialisation. But focusing on activities that are motivating for the individual give an improved chance for not only first-loop learning (how can I do this better?) but also learning of the second-loop type (is there a different, better way to do this?) and maybe even third-loop (is there something better to do?).

Finally, it is interesting that at the same time as development for the working staff in most companies have been going towards less specialisation for purposes described in the pyramids theory chapter, the same companies have been going in the opposite direction. Outsourcing and to focusing on the core competence of the companies has been the fashion for some time now. Ok, it is true that what is good for the goose isn't always good for the gander but in this case I think it is.

5.6 Robust Design Engineering → Testing

Dairies provide a hostile environment to machinery and the difference between them when you think globally is vast. Food products and water is splashed everywhere and several different chemicals; detergents, acid, caustic etcetera are used. In other words, plenty of noise is present. On top of this, dairies like to use a workforce on the lower end of the scale of education and pay them as little as possible. To ensure that a machine will work under these conditions, it is not enough to briefly test it in nice laboratory conditions and by people who are highly trained and skilled engineers. To elucidate, there is nothing wrong with using a laboratory for testing if you make sure that the purpose of the laboratory is to expose the machinery to noise. The problem will appear when perfect conditions are provided, the prototype is developed to fit these conditions and will later only run under those conditions.

One way of performing tests that will provide some noise is to try the machinery in a real dairy without the normal commercial demands that a customer has on equipment that is purchased in a normal manner. This is also frequently used by Tetra Pak and is called a Field-test. Experience has shown that this is not enough and that commercial production often starts before robustness is obtained. It is important to mention that the best and most cost-efficient way to reach robustness is not to just use endless test until, by chance, something happens to work to satisfaction. Instead, robust design engineering should start at the drawing board and in the minds of the design engineers.

5.7 Study → Specialisation

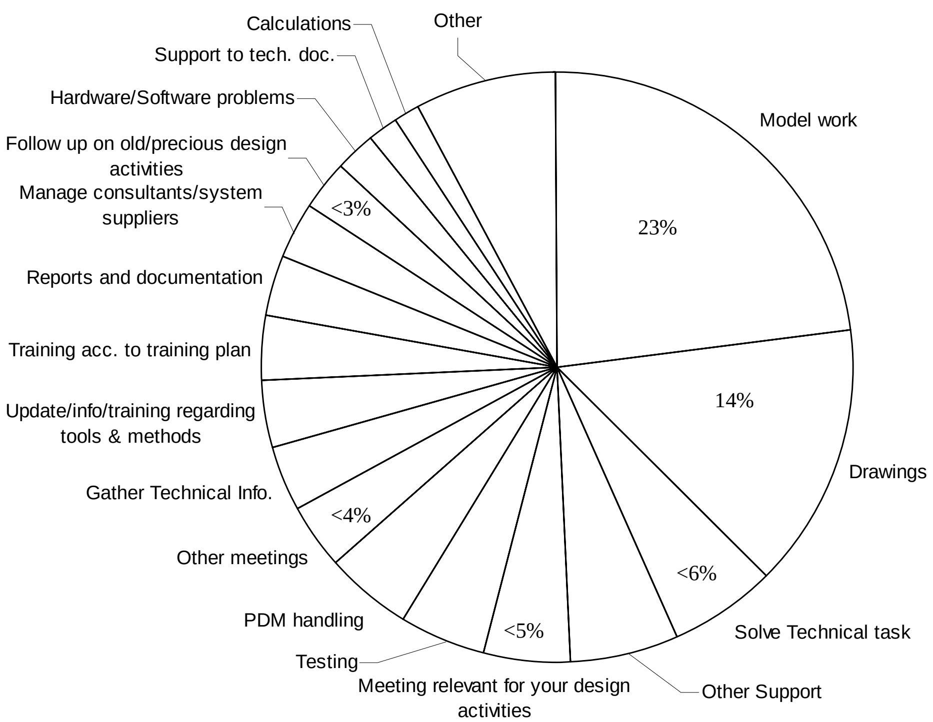


Figure 10, Proportions of activities for the mechanical engineer after adjustment

It was found in the study that not only do mechanical engineers spread their time on a vast range of often very infrequent activities; they also find some of these activities less than motivating. To make a choice to have a career as a mechanical engineer means being creative and having a talent for solving technical problems. It does not necessarily mean that one also has the talent or interest in activities of a more administrative nature. If those duties were to be performed by someone else with a more appropriate talent and interest they would be executed in a fraction of the time that it takes for the mechanical engineers to perform them. It would also mean more time for the mechanical engineer to do tasks that are in line with his training. If one would change the size of training to a normal level in the original pie-diagram and remove tasks of administrative nature the working day of the mechanical engineer would get proportions according to figure 10

The primary activities for the mechanical engineer would increase 10% from 32 to 42 and the secondary 3% to 14. Of course, it cannot be guaranteed that the proportions of the tasks will grow equally when other tasks are taken out of the duties. Rather it can be guaranteed that there will be individual differences in how this new time will be utilised. Nor can it be guaranteed that more drawings of better designs will be produced. However, it is reasonable that work satisfaction will increase, that people will get better at using the design tools and efficiency will increase.

The second matter to consider after categorising the duties according to whether a mechanical engineer has to do them or not is: if the mechanical engineer does not do them, who should do them instead? There are some good experiences when consultants have been used at the department[28]. Since these consultants don't have a lot of old projects and other disturbances to keep them from focusing on their primary and secondary activities they are much more skilled at using the tools and thereby more efficient. So use of consultants could be one way. Another one could be to integrate suppliers further and give them responsibility for a project once it has passed its creative-intensive stages. But that would only be to throw the problem in someone else's lap. To throw your problems at someone else might be a good idea sometimes, but it can hardly be called to solve the problem unless of course this someone is a specialist at handling these kind of problems, or in this case, duties. The suppliers of Tetra Top hardly qualify.

What is the difference then, between offloading the mechanical engineers within the department and to do it to another company? Well, if you give your supplier the problem and he is not able to solve it, he will want to be compensated for it and you are still left with the consequences of poor efficiency. But if you can have things done, efficiently within your department, by the right mixture of people, then the problem is solved. If a person, lets call him Technical Assistant, was to be hired to do these tasks, his working day would be filled as shown in figure 11. Of course it would be essential to make sure to get hold of a person that is suited for these tasks. A suggestion for a job advertisement can be found in appendix 5.

During the study, the tasks mentioned above took 13% of the time for the engineers. After doing the adjustments to the numbers because of the measured time period not being representative to average work it becomes 16%. Sixteen per cent of 16 people

[28] Göran Andersson, Mechanical Designer

equals over two and a half full time Technical Assistants. The fact that focusing on these duties only and having talent and interest for them will result in increased efficiency means that it will be sufficient to hire one. The immediate result of this is that the costs of over one and a half employee are saved. On top of this will come the increased motivation, efficiency and job satisfaction of the mechanical engineers.

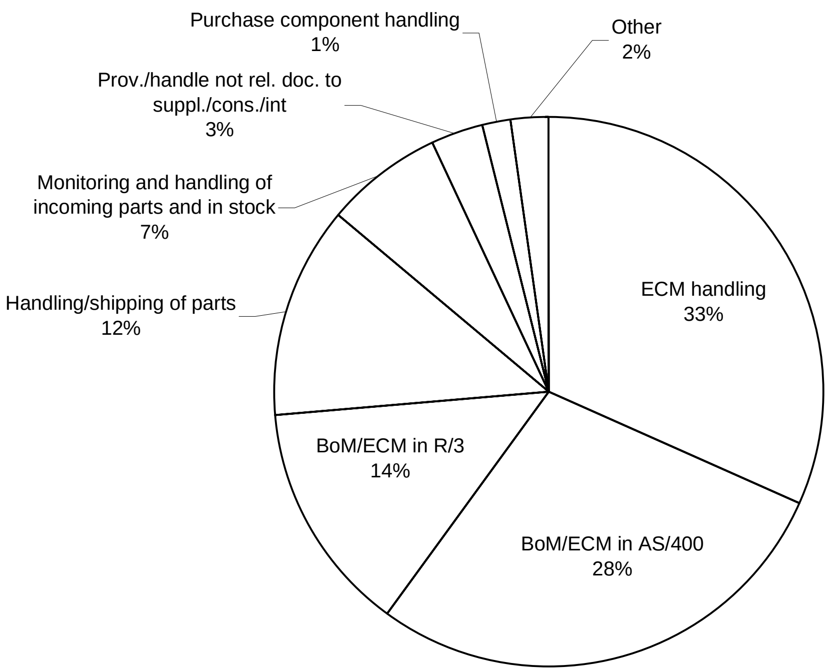


Figure 11, Proportions of activities for a Technical assistant

If we calculate, the payback time for the investment of hiring a Technical assistant is only two months. The standard recruiting cost at Tetra Top is 75 000 SKR[29] and the standard cost of an employee is 65 000 SKR per month[30]. Before the person can perform, some training has to take place. It can be done in-house and would probably take one month of full time training and another two where time will be split between training and working.

*75' + 1(month) * 65' + 2(months) * 65' / 2 = 2(months) * 1,56(saved posts) * 65'*

[29] Birgitta Andersson, Secretary, Personnel.
[30] Mats Andersson, Manager, Product Development

It cannot be guaranteed that training will not take longer and other costs might also add on to the cost of the investment. But rather than to give an exact date on the payback time (which is not the most exact way of calculating investments anyway) the ambition was to show that it was short. The real gain of hiring the Technical assistant will be in the results of general specialisation in the department.

5.8 Study → Testing

Since the Innovation Network is supposed to be applied to all development activities it has to be written in a general way. This means that it gives little guidance towards what level has to be reached in order for a project to pass through a tollgate and enter the next step. Hence, TPIN will not likely, on its own, lead to increased testing and verification. The interviews showed on the other hand that the mechanical engineers are aware of the importance of thorough testing in order to reach better results. But since they are not in control but instead frustrated over lack of opportunity to get access to a machine for test purposes, it can not be expected that the awareness of the engineers will, on its own, guarantee proper testing and result in robustness. Complaints were also heard about the machines not working during a test. This might seem to be a situation close to the reality at the customers' site and perhaps providing some noise. Sometimes that is probably true and the situation could have been taken advantage of if the part of the machine not working properly was the one being tested at the moment. In reality, badly working machines for testing, under the current routines for testing only result in tests not being completed, tests being rushed or in other ways being less then satisfactory.

5.9 Study → IT

Both hardware and software is continuously updated to the satisfaction of the mechanical designers. This is sometimes seen by people with little understanding of the work being performed as "getting new toys". It is true however that engineers quickly adapt their routines to use up the available capacity given by new equipment. By doing this, the designer becomes more efficient at doing his work. The spiral of improved software requiring improved hardware giving designers opportunity to work more efficient and demanding improved software has been developing for some time now. As I mentioned before, I worked as a mechanical designer ten years prior to making this thesis and I don't even recognise the profession due to the development. I think this development is good but in any case it is not possible to stop it. If a company would try they would most likely find it impossible to recruit mechanical designers.

What you use the new technology for and to what extent is an area where there is more choice. The paperless society has been possible for some time now but many, the mechanical designers at Tetra Top included, find themselves drowning in paper, not just paperwork. When all the drawings and assemblies are printed and distributed physically even the latest version of the most modern CAD system becomes nothing more then a complicated pen. Using the Internet and intranet, software like ECnotify and Productview make it possible to stop transporting paper between the different people at Tetra Pak and also to suppliers. This would not only rid the mechanical designers of the work of producing the physical paper version of his work. It would also speed up the distribution of information.

Some people will always print everything anyway because they are not used to read information from a screen. I am of the opinion that this will happen less frequently as time goes by. Not only will people get used to screens but the screens will also get bigger and better. In any case, the receiver always has the choice to print if he already has the soft version. Another advantage with working with soft versions is that it can be assured that it is the latest version that is being viewed. A drawing on paper does not vanish just because it has been replaced.

6 Conclusion

6.1 Specialisation

Tearing down the pyramids has given flat organisations with possibilities of fast decision-making. The culture has remained “old-style” and has not followed the progress in organisation. This has resulted in the case that in order to cut down on hierarchy and levels in the organisation, everyone is doing everything themselves. This is because of status of the employee following his tasks. For a mechanical engineer the result is that he or she is performing duties that he or she is not trained for and which are not in line with the choice of profession. The time spent on these duties is also making it harder for the engineer to excel in his or her profession.

When a new position is introduced in the organisation it is essential to ensure that it does not become a step backwards in the development of the organisation. Instead efforts have to be made to change the culture so that it is possible to have a flat, efficient and fast working organisation that allows people to specialise according to their individual talent.

I recommend that a Technical Assistant is hired to offload the mechanical engineers from duties that are not in line with their talents. The duties I am talking about are of the administrative type including documentation and are listed as activities not adding value for the mechanical engineer in The Study chapter. Of course it is important that the person doing these tasks is different from the mechanical engineers. They find these tasks boring and would never consider performing them full time. The Technical Assistant must be someone with talent and interest in administrative duties. Failure to this will result, yet again, in poor efficiency and short term of employment for the Technical Assistant.

To assure that the time spent earlier on tasks that are made by the Technical Assistant actually leads to increased efficiency in engineering design, the mechanical engineers should be allowed to set their own goals of efficiency that they should work for. These goals should change at intervals so that they are not forgotten and can be set individually, for a group and with or without help from management.

6.2 Testing

It is a misconception that fast equals efficient. If Time To Market is measured to the point when a design is presented to the customer the whole business is in jeopardy. This will give incentive to design and release components faster and using fewer resources. One way of doing this is to skip meetings, tollgates, testing and verification. If time is instead measured to the point when the customer accepts the design, a completely different way of working is called for.

Steps have to be taken to ensure that the engineers have the correct concept about efficiency and quality to promote Robust engineering. To some degree this is already being done at Tetra Top but it is not enough. The ambitions of the quality of products being released must be increased and this ambition must be communicated thoroughly. More important, opportunities to make adequate testing of products during realistic circumstances must be provided.

6.3 Information Technology

I recommend Tetra Top to take full advantage of the tools, equipment and networks that are already present. To always produce hard versions of the work of mechanical designers and distribute them is not just a waste of environmental recourses; it also wastes time and work hours. To instead distribute soft versions through intranet and Internet is faster, less expensive and the risk of old versions being used is reduced.

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Birgitta Andersson, Secretary, Personnel

Mats Andersson, Manager, Product Development

Rune Berg, Senior Technical Adviser

Peter Ericsson, Support, Development Tools

Anders Kristiansson, R&D Manager

7.5 References Contacted by Electronic Mail

Anna-Lena Mårtensson, Design Technology Manager

Jane Wickwire, Technical Administration Manager

8 Appendix 1: Participants in the study

Name:	Title:	Department:
Bo Åkesson	Module Manager	Technical Platform
Mats Åkesson	Development Engineer	R&D
Göran Andersson	Mechanical Designer	Package Section
Anders Delen	Development Engineer	R&D
Gunnar Dike	Project Manager	Openings
Johan Elgebrant	Development Engineer	Openings
Teodora Kodiar	Mechanical Designer	Package Section
Bo Larsson	Mechanical Designer	Openings
Göran Larsson	Mechanical Designer	Package Section
Jan Lövgren	Purchaser	Supply
Leif Olsson	Mechanical Designer	Openings
Bertil Persson	Module Manager	Package Section
Kent Persson	Mechanical Designer	Filling Section
Ingemar Sjövall	Mechanical Designer	Filling Section
Lennart Stillerud	Mechanical Designer	Openings
Olof Westerhult	Module Manager	ASU/Carton Section

9 Appendix 2: Result of the observation

Mechanical Engineer No 2

Record number	7	16	37	40	52	73	82	89	118	124	145	146	Sum
Model work	5		5	2	3	2	2	6	3	2			30
Meeting relevant for your design activities		5				4	2						11
Drawings			2	1					4	3			10
Gather Technical Info.	0,5			2	2				0,5				5
Other Support	0,5					2	2						4,5
Travel time to visit supplier		4											4
PDM handling			0,5	0,5	0,5	0,5		0,5	0,5	0,5			3,5
Other meetings							2			1,5			3,5
Testing				1	2								3
Solve Technical task			1	1									2
BoM/ECM in AS/400				0,5				0,5	0,5				1,5
Follow up on old/precious design activities	1												1
BoM handling in excel			0,5										0,5
Other											8	8	16
Total working hours	7	9	9	8	7,5	8,5	8	7	8,5	7	8	8	95,5
Number of Records													12
Average time spent on task													2,17

Mechanical Engineer No 3

Record number	13	19	31	39	68	69	86	94	95	96	151	155	Sum
Model work	7,5	4,5	7	5,25	5,25	5,25							34,75
Training acc. to training plan									7	7			14
Drawings	0,5					0,25	3	5,75			3		12,5
PDM handling		0,5	1	1		0,5	0,5	1			1,5	1	7
ECM handling											3	3,25	6,25
Update/info/training regarding tools & methods							4						4
Hardware/Software problems	1			0,25	1,25	0,25		0,5			0,25	0,25	3,75
Other Support				1		0,25		0,5			0,5	0,25	2,5
Vacation/holiday/illness		2,5											2,5
BoM/ECM in AS/400		0,75									1		1,75
Other meetings												1,5	1,5
Support to tech. doc.					1								1
Reports and documentation	0,25				0,25	0,25							0,75
Solve Technical task	0,25					0,25							0,5
Purchase requisition	0,5												0,5
Gather Technical Info.												0,25	0,25
Total working hours	10	8,25	8	7,5	7,75	7	7,5	7,75	7	7	9,25	6,5	93,5
Number of Records													12
Average time spent on task													1,948

Mechanical Engineer No 4

Record number	9	10	23	30	44	59	66	80	90	98	Sum
Model work	2	3	5	5	5	4	6		6		36
Update/info/training regarding tools & methods								8		8	16
Drawings	2	2	1		1	1	1		1		9
PDM handling	2	1	1	1	1	1			1		8
BoM/ECM in R/3	1	1		1			1				4
ECM handling	1		1			1			0,5		3,5
Hardware/Software problems				1	1,5	1					3,5
BoM/ECM in AS/400	0,5	1	0,5	0,5							2,5
Meeting relevant for your design activities		1									1
Total working hours	8,5	9	8,5	8,5	8,5	8	8	8	8,5	8	83,5
Number of Records											10
Average time spent on task											2,09

Mechanical Engineer No 5

Record number	4	5	15	25	28	46	58	76	77	99	100	121	Sum
Update/info/training regarding tools & methods	4	5	4	3	3	3	3	3		7		7	42
Other Support	1	1	2	2	5	1	1	1	1				15
Other meetings	1								1		8		10
Follow up on old/precious design activities		1	1	2		1	2	1	2				10
Hardware/Software problems	1	1		1		1							4
Meeting relevant for your design activities									3				3
Model work	1		1										2
Solve Technical task						2							2
PDM handling							1						1
Other							1	3	1	1		1	7
Total working hours	8	8	8	8	8	8	8	8	8	8	8	8	96
Number of Records													12
Average time spent on task													2,23

Mechanical Engineer No 6

Record number	8	20	29	61	62	63	Sum
Testing	1,5	5	6,5	0,5			13,5
Drawings				4		3	7
Solve Technical task	3,5	1,5			1		6
Model work	0,5	0,5		2	1,5		4,5
Calculations					4		4
Gather Technical Info.	2			0,5			2,5
Reports and documentation	0,5		0,5		0,5	0,5	2
BoM/ECM in R/3						2	2
Other Support		1		0,5			1,5
Handling/shipping of parts					1		1
PDM handling				0,5			0,5

Prov./handle not rel. doc. to suppl./cons./int						0,5	0,5
Retrieval of information from standards/guideline	0,25						0,25
Total working hours	8,25	8	7	8	8	6	45,25
Number of Records							6
Average time spent on task							1,676

Mechanical Engineer No 10

Record number	***11***	***26***	***34***	***47***	***71***	***72***	***84***	***92***	***142***	***143***	***Sum***
PDM handling	1,75	2	1	3,5	2	1	3	2			16,25
Update/info/training regarding tools & methods									7,5	3	10,5
Model work	2	2	1	0,5			1,5	1			8
Drawings	1	2	1				1,5	2			7,5
Solve Technical task	1		1		1	2					5
Vacation/holiday/illness										5	5
BoM/ECM in AS/400	0,5	0,5	0,5			1		2			4,5
Other Support	1				1	2					4
Hardware/Software problems			2	1	1						4
ECM handling					2	0,5	0,5		0,5		3,5
Other meetings			2				1			0,5	3,5
BoM/ECM in R/3		1				0,5		1			2,5
Monitoring and handling of incoming parts and in stock					1	1					2
Retrieval of information from standards/guideline	1	1									2
Meeting relevant for your design activities				0,5							0,5
Handling/shipping of parts				0,5							0,5
Prov./handle not rel. doc. to suppl./cons./int							0,5				0,5
Purchase requisition								0,5			0,5
Total working hours	8,25	8,5	8,5	6	8	8	8	8,5	8	8,5	80,25
Number of Records											10
Average time spent on task											1,459

Mechanical Engineer No 12

Record number	3	14	32	33	41	74	75	83	113	114	125	126	Sum
Manage consultants /system suppliers	2,5	1	1,5	2	0,5		2,5		0,5	3		2	15,5
Handling/shipping of parts		0,5		2	2			1	2,5	2	1,5		11,5
Other Support	1	2	1,5		2		1	0,5	2				10
Other meetings	2	0,5	1,5	1	1,5			1				2,5	10
Meeting relevant for your design activities	0,5					6			0,5		1		8
Testing		4,5		3,5									8
Solve Technical task			1	0,5	0,5		1	0,5	1,5	1,5			6,5
Follow up on old/precious design activities	1,5						2				2	1	6,5
Update/info/training regarding tools & methods								4		1,5			5,5
Reports and documentation		1						0,5	1		1	2	5,5
Support to tech. doc.	1		0,5		1,5		2				0,5		5,5
Travel time to visit supplier						5							5
Gather Technical Info.		0,5	0,5		1					0,5	0,5		3
Prov./handle not rel. doc. to suppl./cons./int			0,5								0,5	1	2
Request of new article										1,5	0,5		2
Drawings			1								0,5		1,5
PDM handling	0,5										0,5		1
Monitoring and handling of incoming parts and in stock	0,5										0,5		1
Purchase requisition			1										1
Incoming doc. Control	0,5												0,5
BoM handling in excel					0,5								0,5
Provide released doc. To suppliers										0,5			0,5
Total working hours	10	10	9	9	9,5	11	8,5	7,5	8	10,5	9	8,5	110,5
Number of Records													12
Average time spent on task													1,381

Mechanical Engineer No 13

Record number	42	43	133	134	135	136	137	138	139	Sum
Update/info/training regarding tools & methods	2	3	4		3			8	8	28
Solve Technical task	2	2	2		3	3	2			14
Meeting relevant for your design activities				8			2			10
Calculations	2	2	2		2					8
Hardware/Software problems						3	4			7
Gather Technical Info.						2				2
Travel preparation (money and ticket…) and reporting	1									1
Other	1									1
Total working hours	8	7	8	8	8	8	8	8	8	71
Number of Records										9
Average time spent on task										3,09

Mechanical Engineer No 15

Record number	12	21	35	53	112	117	120	127	147	150	154	Sum
Model work	3,5	5	1	2,75			5	4	3			24,25
Training acc. to training plan			1	1	8						8	18
Drawings	2,5	2		2		4,5			1,5	4		16,5
PDM handling	0,5	2	1	0,5		0,5	0,5	0,5	0,75	1,5		7,75
Gather Technical Info.			3	0,5		0,25	0,25		1,5			5,5
Solve Technical task			2									2
BoM/ECM in R/3	1,5					0,5						2
Other meetings	1							0,75				1,75
BoM/ECM in AS/400						0,25				1		1,25
Follow up on old/precious design activities							0,25	1				1,25
Reports and documentation						0,5	0,5					1
Meeting relevant for your design activities						0,75						0,75
Other Support										0,5		0,5
Testing				0,5								0,5
Update/info/training regarding tools & methods						0,25						0,25
Hardware/Software problems			0,25									0,25
Other	1	1	1	1		1,25	1,25	1,25	1,25			9
Total working hours	10	10	9,25	8,25	8	8,75	7,75	7,5	8	7	8	92,5
Number of Records												11
Average time spent on task												1,682

Mechanical Engineer No 17

Record number	24	60	67	79	97	115	122	123	131	148	Sum
Other meetings	1	2,5		4		1		1	3		12,5
Reports and documentation		0,25	2	1	3	1		1			8,25
Update/info/training regarding tools & methods										7,25	7,25
Drawings						1	4	2			7
Gather Technical Info.	2	1	1		0,5	1		0,5			6
Other Support		1	1	1	1		0,5	0,5			5
BoM/ECM in AS/400	0,5	0,5	0,5	1	0,5	0,5		0,5	1		5
Manage consultants/system suppliers	0,5		0,5		0,5	0,5	0,5	0,5	0,5		3,5
Prov./handle not rel. doc. to suppl./cons./int	2,25							0,5			2,75
Model work						0,5	1	1			2,5
PDM handling							1	0,5	1		2,5
Meeting relevant for your design activities	1,5					1					2,5
Follow up on old/precious design activities		1	0,5		0,5				0,5		2,5
Handling/shipping of parts		0,5							2		2,5
Support to tech. doc.	0,5		0,25	0,5	0,5						1,75
Incoming doc. Control			0,5		1						1,5
ECM handling							1				1
Monitoring and handling of incoming parts and in stock		0,5									0,5
Purchase requisition	0,5										0,5
Other		0,5	1,5	0,75	1,25	2,25	0,75	0,25	0,75	1	9
Total working hours	8,75	7,75	7,75	8,25	8,75	8,75	8,75	8,25	8,75	8,25	84
Number of Records											10
Average time spent on task											1,09

Mechanical Engineer No 18

Record number	102	103	104	105	106	107	108	109	110	111	Sum
BoM/ECM in AS/400	1	4	3	2	1	1	2	1	1	2	18
Drawings	1	3	2	3	2	1	2			2	16
Model work			1	2	1	2		1	6	2	15
PDM handling						2		4	1		7
Gather Technical Info.		1		1	1		2	1			6
BoM/ECM in R/3		1	1		3			1			6
Follow up on old/precious design activities	4										4
Meeting relevant for your design activities										2	2
Solve Technical task						1					1
Testing						1					1
Manage consultants/system suppliers			1								1
Support to tech. doc.							1				1
Request of new article							1				1

Other	2										2
Total working hours	8	9	8	8	8	8	8	8	8	8	81
Number of Records											10
Average time spent on task											1,8

Mechanical Engineer No 19

Record number	***2***	***18***	***27***	***48***	***64***	***65***	***88***	***128***	***129***	***130***	***Sum***
Update/info/training regarding tools & methods							8		8	8	24
ECM handling	3	0,5		7	2,5	1		3			17
BoM/ECM in AS/400	1	0,5	2		2	1		3			9,5
PDM handling	1	2	2		3			1			9
Training acc. to training plan											0
Support to tech. doc.		2	2			1					5
Vacation/holiday/illness						4					4
Manage consultants/system suppliers	1										1
BoM/ECM in R/3		3									3
Drawings			1,5					1			2,5
Other meetings											0
Reports and documentation											0
Tutorship for new empl./consultant	2										2
Other Support			0,5	1							1,5
Hardware/Software problems						1					1
Follow up on old/precious design activities											0
Prov./handle not rel. doc. to suppl./cons./int											0
Provide released doc. To suppliers					0,5						0,5
Total working hours	8	8	8	8	8	8	8	8	8	8	80
Number of Records											10
Average time spent on task											2,42

Mechanical Engineer No 20

Record number	***6***	***17***	***38***	***50***	***85***	***140***	***141***	***149***	***157***	***Sum***
Update/info/training regarding tools & methods					8,5	8,5				17
Model work	4	2		2				2,5	4	14,5
ECM handling	1,5	4,5	2,5	1			4			13,5
PDM handling		2	5	1			2			10
Monitoring and handling of incoming parts and in stock			1	4,5						5,5
Drawings	3								2	5
Manage consultants/system suppliers								3	1,5	4,5
Meeting relevant for your design activities							2,5		1	3,5
Hardware/Software problems								2		2
BoM/ECM in AS/400								1		1
Total working hours	8,5	8,5	8,5	8,5	8,5	8,5	8,5	8,5	8,5	76,5
Number of Records										9
Average time spent on task										2,94

Mechanical Engineer No 21

Record number	22	54	55	56	Sum
Model work	2	2	1	6	11
Drawings	6	4	1		11
Solve Technical task	2	1	1	1,5	5,5
Other Support			5		5
Travel time to visit supplier	5				5
PDM handling		0,5	0,5	1	2
Gather Technical Info.	2				2
Hardware/Software problems		1			1
Total working hours	17	8,5	8,5	8,5	42,5
Number of Records					4
Average time spent on task					2,36

Mechanical Engineer No 22

Record number	36	49	57	78	87	93	116	Sum
Drawings	7,3	4,75			2	4	1	19,05
Update/info/training regarding tools & methods				8,3				8,3
ECM handling			2		3	1	1	7
PDM handling	1	0,5	2		1	1	1	6,5
Hardware/Software problems		3	2					5
BoM/ECM in AS/400			0,2		1	1	0,8	3
Request of new article			1,6				1	2,6
BoM/ECM in R/3			0,5		0,5	1	0,5	2,5
Model work					0,8	0,3	1	2,1
Solve Technical task							1	1
Purchase component handling							1	1
Total working hours	8,3	8,25	8,3	8,3	8,3	8,3	8,3	58,05
Number of Records								7
Average time spent on task								1,759

Mechanical Engineer No 24

Record number	1	45	51	70	81	91	101	119	132	144	152	153	156	Sum
Model work		6,5		2	1,5	6	1	0,5	2		1	3		23,5
Testing	5		6	4						1		1		17
Update/info/training regarding tools & methods							6,5	6,5						13
Reports and documentation						0,5			1	3	5	1	2	12,5
Solve Technical task	1,5			1	2,5	1						1		7
Drawings	4	0,5								1		1		6,5
Other meetings					4				2,5					6,5
Handling/shipping of parts									1	1	1		3	6
ECM handling		0,5	0,5					1		1				3
Monitoring and handling of incoming parts and in stock				1					1	1				3

Other Support	0,5												2	2,5
PDM handling	1,5	0,5												2
Manage consultants/system suppliers											1		1	2
BoM/ECM in R/3		0,5	1											1,5
BoM/ECM in AS/400	1													1
Meeting relevant for your design activities												1		1
Gather Technical Info.									0,5					0,5
Hardware/Software problems		0,5												0,5
Follow up on old/precious design activities							0,5							0,5
Calculations						0,5								0,5
Other			0,5											0,5
Total working hours	13,5	9	8	8	8	8	8	8	8	8	8	8	8	110,5
Number of Records														13
Average time spent on task														1,873

10 Appendix 3: Questionnaire

Frågeformulär som uppföljning till Design audit.

- Formuläret skickas ut i förväg till de intervjuade för att själva intervjun skall bli effektiv.
- Frågorna är av allmän typ för att inte vara ledande.
- Syftet med intervjun är att utröna den allmänna inställningen till effektivitetsarbetet samt om det redan finns åsikter om hur det skall bedrivas.
- Då ingen exakt definition på effektivitet har angivits föreslår jag: Kundnytta / utnyttjade resurser.
- Feedback på undersökning med intervjuer kommer att ges vid ett möte efter semesterperioden.

1. Hände det något utöver det vanliga under den uppmätta perioden eller var de inmatade värdena representativa för ditt vanliga arbete?

2. Vilken punkt blev i så fall för stor eller för liten?

3. Vissa punkter blev förvånansvärt höga. Kan du ge mer information om vad de bestod av:
   * PDM-hantering

   * Problem med hårdvara/mjukvara

   * R3/AS 400

   * ECM: (vad är det för problem?)

4. Vad är din uppfattning om hur supporten fungerar på verktygen (Pro-E)?

5. Hur effektiv tror du att **avdelningens** verksamhet är jämfört med motsvarande verksamhet på andra håll inom Tetra och i andra företag?

6. Om det skiljer sig, vad beror det på?

7. Hur upplever du nödvändigheten av att effektivisera **avdelningens** arbete?

8. Har du förslag på hur detta skall gå till?

9. Hur effektiv tror du att **din egen** verksamhet är jämfört med motsvarande verksamhet på andra håll inom Tetra och i andra företag?

10. Om det skiljer sig, vad beror det på?

11. Hur upplever du nödvändigheten av att effektivisera **ditt eget** arbete?

12. Har du förslag på hur detta skall gå till?

11 Appendix 4: Interviews

Below are all the answers to the questions in the interviews. Because of the interviews being performed in Swedish the answers are only given here in Swedish in order not to be distorted by me during the translation.

The synthesis, however is given in English in the chapter The Study, Interview.

Sammanställning av intervjuer

1. *Hände det något utöver det vanliga under den uppmätta perioden eller var de inmatade värdena representativa för ditt vanliga arbete?*

- Jobbar med samma saker under längre perioder och en undersökning blir därför aldrig rättvisande när den än skulle ha utförts.
- Representativt x3

2. *Vilken punkt blev i så fall för stor eller för liten?*

- Utbildning var högre än normalt. Den bedrevs i egen regi.
- Mycket modulering
- Utbildning högre än normalt
- 2 hela dagar utbildning vilket är högre än normalt
- Mer tid än normalt lades på R3, ECM och utbildning och något mindre på konstruktion.
- Mycket Ritjobb
- Mycket Pro-E
- Mycket träning bedrevs på egen hand i Pro-mechanica med hjälp av nätbaserad ”tutorial”
- Mycket utprovning
- 3 hela dagar utbildning samt mycket ÄM, ECM på grund av konsulter.
- Mycket utbildning samt konstruktionsblocket
- Mycket PDM och problem med hårdvara/mjukvara.

3. *Vissa punkter blev förvånansvärt höga. Kan du ge mer information om vad de bestod av:*
   ** PDM-hantering*
   långa väntetider på grund av att bara en kan vara inne i systemet åt gången.
   Flyttning av flera hundra ritningar.
   Programmet är slött med mycket väntetider
   Långa svars- och väntetider (16.3 h)
   Programmet hänger sig vilket innebär omstart av antingen bara PDM eller hela datorn. Det är även frustrerande och tidsödande att brist på behörighet gör det omöjligt att ändra status på ritning från prototyp till released.
   Programmet är långsamt och klumpigt
   Väntetider utan möjlighet att bedöma hur långa dessa skall bli vilket gör att man frustrerad sitter och stirrar på skärmen.

På dagtid är det långa väntetider mellan varje kommando
Trögt. Lång tid för att ladda hem (PIV EC-check)
Det är ett mörker, på B-gruppsnivå kan det ta en timme för ett kommando.
Tunga sammanställningsritningar ger väntetider på upp till 40 minuter. (hpgl->PIV)
** Problem med hårdvara/mjukvara*
Ny mjukvara med många buggar (Pro-E 2001)
För liten hårddisk.
Dator hänger sig -> omstart, väntetid på morgonen för uppstart av dator.
Användning av nya 2001-releasen gav mycket strul.
Kommunikationskabeln till 314 är underdimensionerad och rutinerna för att hantera köer är egendomlig.
Blir utslängd ur programmen och måste starta om.
PIV:en fungerar aldrig på morgonen.
Ibland helt oförklarliga väntetider.
** R3/AS 400*
R3 är ett jävla pissprogram, det skulle vara till hjälp om det fanns en mall i ett excelblad som man fyllde i och som R3 läste in.
Mycket ÄM-släpp samt har inte bra kunskap om R3
R3 är ett nytt, svårt, ologiskt, användarovänligt program. Det skulle vara bra om det fanns ett script för enklare inmatning.
R3 är nytt men med tiden lär man sig
Ovan vid R3
Dubbelt arbete vilket är onödigt
R3 är ett gammalt tyskt, stort, tråkigt system.
** ECM: (vad är det för problem?)*
Problemet är R3 med alla hemliga koder som man glömmer bort mellan varje gång. EC-check tar lång tid om man har stora sammanställningsritningar.
Ovana
Det kan ta flera dagar att få rätt plottfiler.
EC-check tar lång tid.

4. *Vad är din uppfattning om hur supporten fungerar på verktygen (Pro-E)?*

5. *Hur effektiv tror du att* ***avdelningens*** *verksamhet är jämfört med motsvarande verksamhet på andra håll inom Tetra och i andra företag?*

- Lägre, något efter i utvecklingen men med liknande ramp nu.
- Samma x3 +(som Tetra i stort)
- Låg på grund av dålig historik
- Samma men på annat sätt.
- Hög x3
- Låg x4

6. *Om det skiljer sig, vad beror det på?*

- Det har förut helt saknats prototypfas i projekten vilket gjort att ändringarna har blivit dyra.
- Datorernas kapacitet matchar ej storleken på de verktyg och de modeller som används vilket ger långa väntetider, ibland upp till 90% av tiden (genomsnitt 50%)
- Ingen kontroll förrän detaljer är i produktion vilket gör att det blir långa loopar som är både tidsödande och kostsamma.
- Fler grejer blir gjorda på kortare tid men med lägre kvalitet.
- Hög kompetens hos de målinriktade medarbetarna
- Det finns en medvetenhet om effektivitet på avdelningen.
- Företagets storlek gör att mängden dokumentation drar ner effektiviteten.
- Det finns en kultur inom bolaget som gör att tid prioriteras före kvalitet. Den tid som vinns genom ett snabbt genomfört projekt förloras med råge vid alla ändringar för att uppnå kvalitet i ett senare stadium. Testutrustningen är svår att komma åt och fungerar dåligt vilket gör att tid går åt till att få maskinen att fungera tillfredsställande så att testet kan genomföras. Otillräckliga testspec gör att det inte går att gå tillbaks och kontrollera alla indata vid ett test. Testen utförs under ideala förhållanden vilket inte säkerställer robusta konstruktioner.
- Nya i verktygen. Vertikal kommunikation har inte alltid fungerat så bra.
- Mindre företag har nog mindre brus som stör och slösar tid.
- Kortare loopar ger snabbare beslut men också fler ändringar
- För många olika system (R3/AS400) samt modultänkande (suboptimering)
- Det är dålig styrning vilket innebär en massa avbrott och att arbetet blir hoppigt. Resurserna utnyttjas dåligt på grund av otydliga rutiner och bristande prioritering. Utvecklingsprocessmodellen följs ej på grund av tidspress.
- Mindre firmor har inte samma mastodontprogram. Här registrerar vi på multipla ställen (ECM-objekt/R3/AS400)
- Det finns dubbla system som blir en felkälla förutom att det tar tid att fylla i. R3 finns dessutom i två versioner och beroende på vad man skall göra så måste man var i rätt version.
- Det är för stort fokus på tid. Dubbla system ger fel.

*7. Hur upplever du nödvändigheten av att effektivisera **avdelningens** arbete?*

- Hög x2
- Målen är fåniga och ej mätbara.
- Nödvändiga både för företaget och den personliga tillfredsställelsen och kompetensen.
- Det pratas mest. Det händer ibland att beslut tags som sedan omedelbart kringgås vilket sänder negativa signaler om prioriteten.

8. Har du förslag på hur detta skall gå till?

- Dela upp uppgifter, specialisera, hyr in konsulter för att utföra detaljkonstruktion och ändringsförfarandet under sluttid på projekt. Ha ej samma projektledare vid olika faser under utvecklingsarbetet. Det nya systemet med TPIN, Idea Generation Network, TAD.

- Uppgradering av datorer
- Prova att lämna över detaljkonstruktion på konsultfirma.
- Prioritera och lägg resurser på att underlaget skall vara rätt från början
- Specialisera. Nu gör alla allting och det vore bättre om kompetensen ökades på smalare område. Arbetsprocesserna är för bökiga och följs därför ej, ej troligt att det skulle bli bättre efter en inkörningsperiod men det beror på hur man tolkar det som står.
- Bättre utprovningsmöjligheter så att det blir lättare att komma till maskiner.
- Man skall inte vara med i för många projekt samtidigt utan istället fokusera sig på max 2.
- Dokumentation och underlag bör tidigt hållas så komplett som möjligt.
- Öka första ledtiden i början av ett projekt så att det kan bli korta loopar istället för långa dyra lopar när konstruktionen är releasad.
- Prova och verifiera innan release.
- Ta bort dubbla system (R3/AS400). Konstruktörer skall konstruera och inte slösa bort sin tid med administration. En anställd administratör skulle kunna ta hand om dokumentation/R3 mm.
- Gå tillbaka till den specialisering som fanns förr i tiden då verktygen blir mer komplicerade och det blir svårare för varje konstruktör att vara bra på allt. Denna specialisering kan åstadkommas genom att dela upp arbetet inom befintlig avdelning
- Det är frustrerande med många olika system för samma sak. Om R3 användes på rätt sätt skulle man direkt vinna på att inte behöva använda AS400. Det skulle dessutom kunna användas direkt av inköp utan översättning till Excel och även bättre användas av Parts. Vidare skulle Finans direkt kunna ta fram de uppgifter som levererats osv som annars måste sammanställas varje kvartal.
- Slopa dubbelsystemen då det förutom slöseri med tid även är en felkälla. Specialisering, prioritering och fokusering samt flytta ner chefen på modulansvarsnivå och gör dem helt ansvariga.
- Det skulle finnas en supportman/kvinna som tar hand om möten och annan administration med stöd från C-grupps-ansvarig för snabba frågor mm. Det framtagna processerna borde följas bättre.
- Bara ett system för varje typ av information.
- Den information som finns i Pro-E i bom-tabellen borde räcka. En specialist på dokumentation skulle med hjälp av dessa kunna fylla i informationen i de övriga systemen.
- Beslut som har tagits skall också följas. Informationen som redan finns i bom-tabellen skulle kunna läsas av fler istället för att informationen skall behöva föras in i flera system.

9. *Hur effektiv tror du att **din egen** verksamhet är jämfört med motsvarande verksamhet på andra håll inom Tetra och i andra företag?*

- Samma som 5:an

10. *Om det skiljer sig, vad beror det på?*

- Det är tidsödande att praktiskt hantera ej ”releasade” ritningar till leverantörer i prototypfasen.
- R3 är tidsödande och förbättrar ej konstruktionen, lämna över åt någon annan att utföra.
- Många olika programvara som ej används så ofta – svårt att jobba snabbt i alla.
- Man är tvungen att agera godsmotagare och avsändare utan smidig tillgång till lådor och packningsmatreal. Det tar lång tid att spåra och hitta gods som ankommit till fel ställe på Tetra.
- Det är svårt att komma åt maskin för att kunna testa konstruktioner och långa väntetider för assistans vid maskinen.
- Snabba beslut kan tas och TT har påverkat leverantörerna till att vara flexibla.
- Väntetid på datorerna
- Väntetid från leverantör (verktyg till lock)
- Felanvända resurser, jobbar på fel sätt. Ingen kontakt mellan grupper. Ingen tid till personlig kompetensutveckling. Brist på prioritering gör att man hoppar hela tiden. Dålig vertikal kommunikation (båda riktningar). Organisationsfrågor har låg prioritet.
- Halvbra på många olika system.
- Det går för lång tid mellan gångerna man är inne i olika system och man måste därför spendera tid på bläddrande i manualer.
- För mycket tid (90-95%) läggs på dokumentation.

11. *Hur upplever du nödvändigheten av att effektivisera **ditt eget** arbete?*

- Samma som 7:an

12. *Har du förslag på hur detta skall gå till?*

- Se ovan
- Utvecklingsarbete skulle bli lättare om det fans möjlighet att bygga prototyper på modeller för att kunna se detaljerna i verkligheten
- En sekreterare skulle kunna ta över många sysslor som det ej behövs en konstruktör för att utföra.
- Ordentliga fälttester innan konstruktioner släpps så att tid inte behöver spillas på evinnerliga ombyggnadskittar
- Viss dokumentation och R3 skulle kunna göras av någon annan men tveksamt om det skulle ge någon vinst.
- Slippa större delen av R3. Syssla mer med direkt utveckling och bli bättre på det och mindre på administrativa göromål.
- Kraftfullare datorer samt möjlighet att via nätverket använda processorkraft på andra datorer som ej utnyttjas på grund av semester mm. X2
- Användandet av TPIN ger bättre styrning.
- Hårdvaran och rutinerna för PDM måste förbättras.
- Man skulle kunna dela upp arbetet beroende på vilken fas det är i och specialisera sig. T.ex. projekt/detalj/släpp

- Bli av med all sidoverksamhet. En konstruktör skall modelera och rita, det övriga arbetet kan man anställa någon annan för.
- En mer traditionell uppdelning med konstruktörer och ritbiträden.

12 Appendix 5: Job advertisement

Tetra Pak Carton Chilled AB

Business System Tetra Top

söker

”Technical Assistant”

Tetra Pak Carton Chilled AB, Business System Tetra Top tillhandahåller konsumentvänliga förpackningssystem baserade på unik Tetra Pak kompetens inom marknadssegmentet flytande livsmedel för kyldistribution. Vi är representerade på ett stort antal marknader i Asien, Europa, Mellanöstern och Amerika. Tetra Pak Carton Chilled AB har ca 130 medarbetare, är lokaliserat till Lund och är lagom stort för att kunna erbjuda var och en utvecklingsmöjligheter.

Till vår Utvecklingsavdelning inom System Tetra Top söker vi en person som är servicemedveten och har talang för administrativa uppgifter.

- Du kommer att ha ett övergripande ansvar för dokumentationen rörande framtagandet av nya konstruktioner inom System Tetra Top
- Du kommer att ge support till konstruktörer
- Du kommer att medverka i projekt för att ta fram nya tekniska lösningar

Du skall ha en teknisk utbildning samt ha vana av att arbeta självständigt.
Om du har tidigare erfarenhet administrativt arbete är detta ett plus.

Arbetet ställer höga krav på handlingskraft, flexibilitet samt att du är ansvarsfull, drivande och lyhörd för konstruktörernas krav och behov. Vi förutsätter att du har goda kunskaper i det engelska språket såväl muntligt som skriftligt.

Vill du veta mer om tjänsten och företaget är Du välkommen att ringa X X, tel 0708-xxxxxx. För facklig information kontaktar du SIF, tel 046-361490 eller CF tel 046-362475.

Din skriftliga ansökan med meritförteckning sänder du till Tetra Pak Carton Chilled AB, System Tetra Top, att: Birgitta Andersson Ruben Rausings gata, 221 86 Lund, senast den Xx XXX 2001. E-mail birgittau.andersson@tetrapak.com.