Empirical cost calculation:

Why do cost variations occur in the car manufacturing process?

A behavioural case study at Volvo Cars Body Components in Olofström

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Preface

This dissertation is the final step of our studies at the department of Business Studies at Kristianstad University. We wish to dedicate our most sincere thanks to the school and the teachers for all knowledge and experience we have gained during our three and a half years of studies.

We would like to dedicate a warm thank you to our tutors, Christer Nilsson and Annika Fjelkner, for all help, criticism and new ideas concerning our dissertation. Christer Nilsson has encouraged us to develop our work and Annika Fjelkner has helped us develop our English language.

We would also like to dedicate or thanks to the employees at VCBC in Olofström and in particular the Project Economists for their time. Without their participation, this dissertation would not have been possible to create.

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Abstract

Volvo Cars Corporation is a large multinational company known worldwide. The competition is constantly increasing as well as the demands and the expectations from the customers. As in most companies there are possibilities to improve performances, at least in certain areas. One part of Volvo Cars Corporation is Volvo Cars Body Components situated in Olofström. During their process of the New Car Program, where a new car model is developed, cost variations occur. Our aim in this dissertation is to identify the important factors causing cost variations and find possible ways to reduce them.

The research is conducted with mainly two sources, qualitative interviews and secondary data. The empirical findings are then combined with the theoretical framework in order to achieve an understanding of the processes and the effect on the cost variations.

In the behavioural case study several possible factors for cost variations are identified. The most important are Product Change Request's in combination with Change Orders as well as Process Change Requests. Our main suggestion to reduce the risk that these variations occur is that more emphasis should be put on the first part of the New Car Program.

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Chapter one

1. Introduction

In this first chapter the reader is introduced to the dissertation, the problem, the research questions, the purpose and limitations. Finally, a vocabulary of common abbreviations is presented as well as an outline of the dissertation.

1.1 Background

One of our group members is currently working at Volvo Cars Body Components (VCBC) in Olofström. VCBC constructs and manufactures body components to Volvo's passenger cars. They assemble their articles in the factory in Olofström but some parts are also shipped to other factories, such as Gothenburg and Gent, for further assembling.

We found a great opportunity for writing our dissertation in cooperation with a large multinational corporation like Volvo. Therefore, a visit at the company to discuss possible topics for our dissertation with the Finance Manager, Bengt Strömberg, was conducted. According to him, there were several topics that could be interesting for us to look closer at. After considering several suggestions, our group decided that the most interesting area was the cost variations that occur in the New Car Programs.

The New Car Program is a process where a new car/model is created and developed during a period of four years, from the first draft to full production. Before the manufacturing process begins the cars manufacturing cost is calculated and decided. However, too much variation occurs although it should not according to these calculations.

Cost variations are very important to keep track on because they affect the company's economical performance, mostly in a negative way. For instance, assume that each car costs 5,000 more to manufacture than calculated. Due to the large volume of cars produced the effect on the total

costs will be enormous. Today VCBC has limited control over these fluctuations and wants to know more about them.

1.2 Problem

Via interviews with personnel within VCBC, it was obvious that there exist some problems during the New Car Programs. We chose to focus on the cost variations that negatively affect the economical result during the New Car Program and want to look deeper into this area.

At a specific time before the production of the car, each cost that should occur during the manufacturing process is calculated. These costs should then be unchangeable during the whole process but in reality these costs are almost always higher than calculated when the components are manufactured.

1.2.1 International connection

Since Sweden is a rather small country with limited number of inhabitants, much of the goods that are manufactured and developed here are sent abroad. If we are unable to control these negative cost variations that occur in the Swedish industries, as in our case with VCBC, Sweden will loose in the fierce competition that exists in the market today.

1.3 Research questions

Our dissertation will focus on the following research questions:

- Which are the important factors affecting negative cost variations?
- What can be done to reduce these variations?
- Are there any learning effects in lean manufacturing processes at VCBC?
- Which obvious factors occur that indirectly affect cost variations in a negative way during the New Car Program?

With obvious factors we refer to factors that have arisen during the field study and affect costs negatively to a larger extent.

1.4 Purpose

The purpose with this dissertation is to create deeper knowledge about how the New Car Program functions. With deeper knowledge of the process we hope that we will be able to help VCBC to identify factors that might lead to negative cost variations. Further on, our intention will be to give VCBC some ideas about how to minimise these cost variations.

1.5 Limitations

Due to limited time we have chosen to focus on factors that occur between gate -1, where the car concept is decided, up to and including gate 10 where full mass production have begun and the New Car Program is completed. The gate system will be thoroughly explained in paragraph *4.2.2 "The gate system"*. Furthermore, we will only focus on negative cost variations. It might be possible that benefits occur from these variations but they will be left for further research.

Moreover, we want the findings to be generally applicable so that they can be implemented by other production facilities. However, since this research

is closely linked to VCBC this might not be possible without complications. Further, this dissertation will have more focus on qualitative data and will therefore not include any quantitative calculations on the cost variations.

1.6 Disposition

A short summary of the different chapters covered in the dissertation is presented below.

Chapter 1 *Introduction: The reader will be introduced to the problem areas in the dissertation. Furthermore, limitations are stated as well as the purpose of the dissertation.*

Chapter 2 *Method: Information concerning choices we have made when it comes to how the research should be performed is presented in this chapter.*

Chapter 3 *Theoretical framework: The reader is introduced to the theories used in the dissertation. Communication theories, Kaizen and Just-In-Time are presented.*

Chapter 4 *Result of the empirical studies: The background of the situation for our research object is presented, as well as the findings from our research.*

Chapter 5 *Analysis: In this chapter we combine our findings from the field studies with the theoretical framework and an analysis of the results is made.*

Chapter 6 *Conclusions: The conclusions we have been able to draw are presented in this chapter. Suggestions for further work are enlightend.*

1.7 Definitions

Some of the most common words and abbreviations in this essay will be explained in the following paragraphs. For further explanations see attachment “Appendix I”.

Internal PCR	*An Internal “Process Change Request” is a procedure used by the appropriate employee when there is a wish/need to make a change in the production process.*
New Car Program	*The name of the process conducted when a new car model is brought to life.*
PCR	*A“Product Change Request” is a procedure used by the appropriate employee when there is a wish/need to change a product/product feature.*
VCBC	*“Volvo Cars Body Components”; situated in Olofström, Sweden.*
ÄO	*A ”Change Order” (ändringsorder) is used when a PCR is approved. An ÄO is written as a certificate for implementation.*

Chapter two

2. Method

In this second chapter the reader is introduced to the methods used. Research approach, research philosophy and empirical approach are described. Continuing, information concerning data collecting is presented.

2.1 Research approach

Our dissertation is written in cooperation with VCBC and together we selected an area for us to study. This implies that we start from a problem and will try to solve it by looking at different theories and models. From this we have an indication of inductive approach, which according to Mark Saunders, Philip Lewis & Adrian Thornhill, (2007) is the approach used when theories are created to try to answer the findings from the reality.

A different way of conducting our research could have been to use a deductive approach. This approach means that you start with already existing theories and models and then test them empirically (Saunders et al, 2007).

Research can also be defined as qualitative on the one extreme, and quantitative on the other. In reality however, research is to be found somewhere in between these extremes. In a quantitative research the data collected consist of quantifiable variables, and the findings are often presented in statistics. Our research is more qualitative than quantitative which means that most of our data can not be quantified. When performing qualitative studies the focus is to collect data that describe the reality. It is more important to understand the entirety than the isolated parts alone. (Christensen et al, 2001)

2.2 Research philosophy

When it comes to research philosophy, there are three different ways of looking at it, a positivistic, interpretivistic or realistic view.

The positivistic philosophy means that you will be able to generalise your findings and you are able to draw general conclusions from the findings because you as a researcher is more of an objective viewer of the process. The interpretivistic view means that it is not possible to draw any general conclusions at all because the complexity of the social world is too high. Finally, the realistic view means that you as a researcher believe that different forces can affect people's perception when it comes to interpretations and behaviour (Saunders et al, 2007).

We have adopted a research philosophy that has both interpretivistic and positivistic features. According to Saunders et al (2007), the former research philosophy is preferable when performing research in businesses. This is due to the fact that organisations are unique and therefore it is hard to generalise the findings. Further, since some of our findings to a certain level can be generalised and used in other situations, there is also a touch of positivism.

2.3 Empirical approach

Since we, as mentioned before, write our dissertation in cooperation with VCBC, our empirical approach is quite clear. We started out with small informal meetings with high-ranking staff within VCBC to get some basic information. After this, a field study where we followed the New Car Program and were able to ask questions to the employees was conducted. Information from the person responsible for internal calculations in the New Car Program was also received. The information consisted of statistical data and other relevant documentation.

2.4 Data

2.4.1 Primary data

The dissertation is based on primary data mainly from a few but qualitative interviews with key staff within VCBC. There are advantages using interviews instead of, for example, questionnaires as stated by Christensen et al (2001). These are, for instance, that the respondents have time allocated for the meeting and they are more likely to share confidential information.

We have also collected primary data from other observations than interviews that we have made during our visits at VCBC. Since one of us is currently working at VCBC, we have continuously access to primary as well as secondary data.

2.4.2 Choice of respondents for interviews

The respondents work closely together in the New Car Programs. Even though their work is connected, they all have their own specific area within the program. By choosing to interview people working in different phases of the program we aim to get a wider view of how the work is carried out. We also want to find the respondents' opinions concerning the problem with cost variations. If we succeed with this we will be able to better understand the cost variations and, in extension, to minimise these problems for VCBC.

2.4.3 Interview procedure

According to Andersen, 1998, we have performed partly structured interviews. We had a quite good knowledge of the subject and, therefore, we used an interview guide with questions in our search for answers. The interviewees were told to talk open and general about the subject and we picked up the relevant information needed to answer the questions in the guide. To get a deeper knowledge about some interesting issues we fed the interviewees with follow-up questions. By performing the interviews this way we could see things from the interviewees' point of view and they had

the opportunity to express their own opinions. Somewhere in the middle of the interviews we had a small coffee break to take some fresh air. This turned out very well since the respondents returned with new energy. During the interview we took notes and the following day we structured the notes into concrete text. The complete interview guide can be found in appendix 2.

After the interviews were performed, we were told that any future questions concerning our dissertation would be answered by the respondents. Some of the respondents have answered some complementary questions via e-mail and some other by direct communication.

2.4.4 Criticism of interview procedure

We chose to interview only a limited number of employees. If we had chosen to interview a larger amount of people this could have benefits such as information from respondents working in other departments. In the extension this could lead to a wider view and explanation of the work conducted in the New Car Program. The reasons why this was not done are twofold. Firstly, we believe that a few, but qualitative interviews with the staff working closest to the New Car Programs have the information needed for us to understand the process. We also believe that they will give us some ideas about where to start the search for factors that cause the cost variations. Secondly, it is very hard for the workers to find time in there schedule for interview appointments.

Another criticism is that two of our respondents were interviewed in one group because their work at VCBC is closely connected to each other. We considered this to be the best way to perform the interview even if there may be a risk that one of the respondents affects the other in a negative way. A positive effect of interviewing these two persons at the same time was that they could complement each other.

2.4.5 Secondary data

We have used a variety of secondary data during our work with the dissertation. The information is primarily derived from literature such as books and articles but also the internet and Volvo's intranet. The existence of Product Change Requests, PCR:s, and Process Change Requests, Internal PCR:s, as well as, the need for extra transports between the factories have been compared with internal sources within VCBC. Different deviations exist but due to business secrecy we are unable to present the exact data in this dissertation. When these data are mentioned in the text we will make the reader aware of the public limitations.

Chapter three

3. Theoretical framework

The theoretical framework is presented in this third chapter. The theories that are used concerning communication, Kaizen and Just-in-time are described and criticised.

3.1 Introduction

As stated in the second chapter, we began our research at VCBC to later continue with the theories. Therefore, we have been able to focus on a limited number of theories with connections to the research object.

3.2 Communication

3.2.1 Background

Communication between people is a very important part when working in teams or projects. When communicating, the sender takes for granted that the receiver understands the message and views it in the same way as the sender does.

According to John Fiske (1998) there are two schools of how to look at communication. The first, called process school, sees communication as a process and the second, called the semiotic school by Fiske, views communication as meanings and how these are created, exchanged and understood in the context of culture. Fiske (1998, 2) defines semiotics as *"the science of signs and meanings."*

3.2.2 The theory of communication

Communication as processes begins with the sending of a message. The sender has to put together a message in a way that it can be understandable for the receiver. A channel has to be chosen to communicate the message

and this could be in writing, orally etc. After this has been done, the receiver has to decode the message. The decoded message can differ from the sender's intended message due to disturbances. This is why feedback becomes more and more important. Even though the feedback can suffer from disturbances, the sender gets information about if the message has arrived and if the receiver has understood what the intended message was (Bakka, Fivelsdal, Lindkvist, 2001).

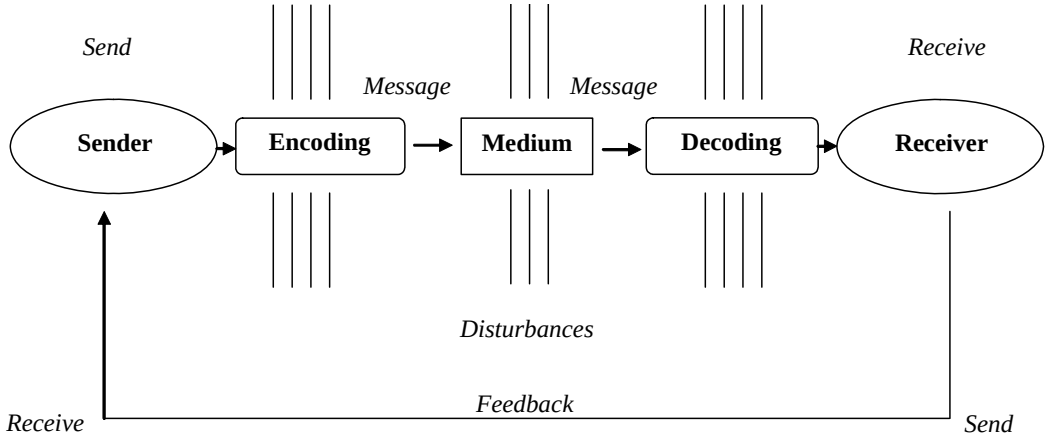

Figure 3:1 *A communication model. Source: Bakka et al. (2001) p 159.*

In the semiotic school communication is seen as something radically different compared to the process view. Fiske (1998) explains that a meaning has to be transformed into a message built on signs. The person, for whom the message is aimed at, has to create his own meaning out of the signs. Since signs are organised in codes, the meaning is not always perceived the same way due to dissimilar cultures and codes. This is a fundamental difference between the semiotic school and the process school since in the process school it is seen as a communication failure when the meaning is not the same for sender and receiver (Fiske, 1998).

Communication is, as mentioned before, crucial for all organisations, and in organisations implementing lean manufacturing the communication is partly improved according to an article by Worley and Doolen, 2006. They performed a field study and analysed the role of communication in organisations implementing lean manufacturing. The study was made at a

manufacturing company in the north western part of USA. Continuing with their findings they declare that, even if communication is improved in some areas, there are still parts that have not been positively affected by the implementation. Amongst other things, the communication between departments was said to be poor. Further on, the management did not communicate enough to the employees about the implementation and what it really would mean for them.

Their conclusion from the study was that there are many variables affecting the success or failure of a lean manufacturing implementation. Communication was one of them. The authors continue to say that the examples of poor communication found at the study site are not only due to the lean manufacturing implementation. Communication is a variable strongly correlated with other variables such as management support and positivism towards lean implementation. According to the authors, all variables have to point in the same direction for everything to succeed.

3.2.4 Criticism of communication theory

The core theory of communication is not that difficult. There is actually nothing in particular to criticise. When it comes to the article by Worley and Doolen, some critics must be mentioned. Since their study was performed in a company that was implementing lean manufacturing at the time, it is hard to draw general conclusions out of there findings. They are strictly bound to the company in question and have not looked at what the effects will be in a few years time. On the other hand, the field study is performed in a manufacturing company similar to VCBC and therefore it might be suitable in our research.

3.3 Kaizen

3.3.1 Background

One of the questions that arose during one of the interviews was why the organisation does not benefit from any learning effects. The problem for VCBC, as we mentioned before, is that their real costs mostly are higher than budgeted. Why is it so?

3.3.2 The theory of Kaizen

Kaizen is a theory of constantly improving performances. The organisational performance could be improved in many different ways. Newer, more effective machinery or a new way of structuring your organisation could be one way. Another way could be to improve your use of materials to eliminate waste. Imai (1992) tries to explain these improvements activities with an umbrella construction to show that they all help to develop Kaizen within the company.

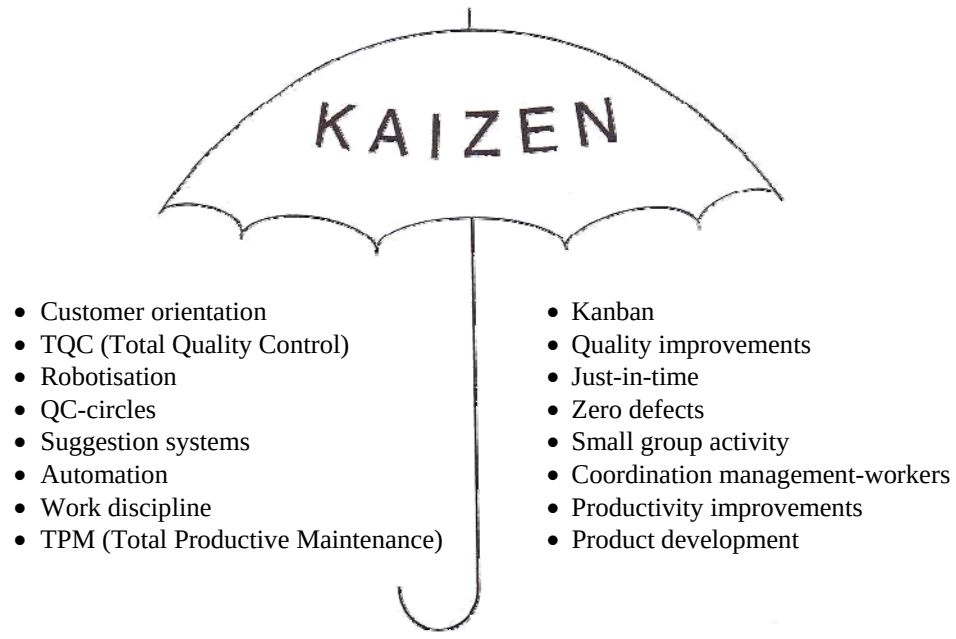

Figure 3:2 *The Kaizen umbrella translated into English from Imai (1992) p 23.*

As we can see from the figure on the previous page, several parts are included in the Kaizen process. We will explain some of these parts in the following paragraphs.

The idea of Kaizen originates from Japan and is their word for improvements. Japanese rarely think of Kaizen because it is more about a lifestyle and not something with a “label”. Several attempts have been made to implement some of the ideas in western companies more or less successfully (Imai, 1992).

How is then Kaizen performed in Japan? Since all organisations are different from each other, the way of performing Kaizen differs between them. However, according to Imai (1992), the core processes that have their origin from Japanese management systems are all part of the Kaizen concept. Each company chooses by themselves how much and what parts of Kaizen they want to implement. Brunet and New (2003) reinforces the differences of implementation stated by Imai and says that there is not a clear answer to how a company should implement Kaizen. Brunet and New compared several Japanese companies and their way of performing Kaizen within their organisation. Their main findings consist of both differences and similarities.

As examples of similarities, Brunet and New (2003) found that the set targets for the teams should all be achieved with Kaizen. If it was done in groups or individually differs between the companies. They also found that the companies had different programmes to make the staff continuously participate in the work with Kaizen. Further, most of the production personnel were guaranteed lifetime employment so that they could feel safe even if they came up with ideas that would rationalise the production and lower the amount of necessary staff. However, some differences were noted between the different companies in the study when it comes to the amount of temporary labour (Burnet and New, 2003).

Brunet and New continues with more differences. First, the group size for Kaizen work differed a lot. One company developed Kaizen during sessions of up to 25 persons and another had no common arrangements at all but depended more on the individuals instead. A second thing that differed between the companies was the level of voluntary participation in the process and payment in accordance. Thirdly, a number of companies mixed shop floor workers with scientists and engineers to find improvements. A few companies used their Kaizen time on product development which could have implications due to the lack of competence in the particular area of the shop floor workers. Some of the companies paid more attention to suggestion systems so that ideas really would come from the grass root level up to the management level.

To summarise the findings when it comes to similarities and differences, Brunet and New try to shape a kind of conclusion. The authors state that there are many differences but some general guidelines could be drawn when it comes to Kaizen. The Kaizen process can be divided into three levels that are found within all companies. The first level, the level of high Kaizen, is when companies have a well functioning system that deals with and saves all ideas, analysis and reports connected to the Kaizen process. A lot of time is allocated to the Kaizen projects. Other things than Kaizen could be discussed such as the overall production development. The second level is when problems are solved by the shop floor personnel without delay. They implement solutions to the problem and afterwards write a shorter report on what has happened and what was done to avoid the problem. The third and last stage is not reported within the organisation according to Brunet and New. This could for instance be when workers take accurate decisions on how to temporarily increase their performance to get back on track when delays or disruptions have occurred during the manufacturing process (Brunet and New, 2003).

Imai (1992) claims that the main cultural difference between Japan and western companies is that the Japanese organisations view their performance in terms of the process. Accordingly, western countries are

more focused on the economic results. However, Imai thinks that it is possible to implement the Kaizen processes also in western factories. Berggren (1994) reinforces these cultural differences. He claims that several attempts have been made to try new organisational designs within Volvo factories in Sweden with small or non existing economical successes. According to Berggren the managers have not been patient enough to see the result of the new and different factories. Swedish workers are unlikely to accept working conditions similar to those in the Japanese industries. Japanese workers are more like a platoon. When the workday begins the group of workers is gathered and they receive information concerning the targets of the day. After the work is finished for the day they are gathered again for debriefing. The working style is also divided into small cycles. This means that every worker is doing one thing a repetitive number of times. Due to low unemployment and advantageous social benefits Swedish companies, such as Volvo, had to make it more favourable to work at their factories. Since they were unable to use the salary as a motivation factor due to tight union regulations, the factories had to use other motivational factors such as making the factories more worker friendly (Berggren, 1994).

3.3.3 Criticism of Kaizen

The above mentioned theories are primarily based on the book of M Imai and an academic article by New and Brunet. Some ideas are brought from Berggren. Regarding the book of M. Imai there are only a few things, if any, to criticise. The author is convinced that Kaizen is the key to success for companies of tomorrow, even if there is a gap in culture between Japan and western countries. The cultural differences are stated in the book “The Volvo Experience” by Christian Berggren and shows that it is not as easy to implement Kaizen in Swedish industries. Berggren also concludes that there is a gap between Western countries.

Concerning the article by Brunet and New, the authors clearly state that their findings are not generally applicable on all companies. This is because they have performed research on one particular industry, the steel industry.

The amount of companies investigated is not enough if you want to be able to draw general conclusions. Our own concern is that the article only investigates Japanese businesses. Mr Imai tries to show applicability to western countries but focuses most on Japanese industries. When interpreting these theories and models we have to be aware of the weaknesses and that they are not directly generally applicable to Volvo in our dissertation.

3.4 "Just-in-time" and "kanban"

3.4.1 Background

According to one of the interviewees, VCBC had to ship parts from the factory in Olofström to other factories at other times than planned. This could be caused by disruptions in the production either in Olofström or some other factory. How does this affect cost variations?

3.4.2 The theory of "Just-in-Time"

One part of the Kaizen process described above in 3.3 "Kaizen" is the "Just-in-time", JIT, delivery system which is also called lean manufacturing. We will continue this dissertation with the use of the term JIT.

The main idea of JIT is that everything should be delivered at the predetermined time. However, there are many ways of defining the JIT concept. According to Shingo (1999) the interpretation should be narrower if we want to come closer to the truth. The Toyota interpretation, the ones who invented the concept, is that the exact amount of specific articles should be delivered at the exact time.

How is the concept of JIT achieved then? The first developer of this system was the Toyota Motor Corporation. Their way of performing the JIT system was to give every manufactured part a small note, called *kanban* in Japan. A worker could collect a specific amount of articles and attached to them was a *kanban* that stated what had been taken and how many. When these

articles had been used in the production the note was sent back to the place of origin and was then seen as a new order of more parts (Imai, 1992).

To be able to implement this system in the reality it is necessary to completely change the way of thinking. The ordinary way of working would be that when one workstation has made one article ready, they would ship it to the next station. However, the procedure in Toyota is instead that the station that needs the particular part goes to the previous station and takes the exact amount of parts necessary for continuing the production. As a positive effect, the stock of articles dramatically decreases and the required capital for inventories is also considerable reduced (Ibid).

There are many benefits with JIT. First of all, the delivery time is shorter. Secondly, the workers focus more on their real work at the work station and no time is lost during transportation. Thirdly, it is not necessary to keep large stocks which leads to less capital bound in the inventories. Moreover, the ability to see problems in the processes increase and this leads to better balances between the different work stations. Furthermore, there is more space available in the factory which makes it easier to get an optimal overview (Ibid). Taking the JIT-system one step further, the companies could try to incorporate their suppliers into the system to make them both more competitive.

3.4.3 Alternatives to "Just-in-time"

According to Berggren (1996), Volvo has tried to implement alternative ways to lean manufacturing in Sweden. Berggren believes that assembly line production is not optimised for the wellness of people. However, this problem is solved in different ways depending on which country the problem occurs in.

In Sweden, two Volvo factories have developed alternatives to lean production. Much of the new ideas were developed because the conditions of the Swedish labour market, such as low unemployment, made it hard to

keep employees in trying environments when the staff could not be motivated with higher salary. This is because of a strong union requiring equal salaries. Nevertheless, a high personnel turnover does not necessarily mean a negative effect on the production but when the need for quality and team performances increases, the demand for a greater amount of attendance among the ordinary staff also increases. To minimise the high personnel turnover, Volvo built two factories as trial facilities (Berggren, 1996). In these factories the ergonomic environment was improved, the team structure was elaborated and new more flexible transport technology was implemented to meet the overheated labour market.

The first trial factory was established in Kalmar 1974. This factory was almost completely designed by the management without influence by the workers themselves. The difference between Kalmar and a traditional factory was mainly the design of the building which put much emphasises on the workers. Each team that manufactured a car should have a workplace with windows and access to a lounge. This design resulted in better psychical surroundings with bright and airy rooms. Furthermore, the noise level could be kept low due to the layout of the factory (Ibid).

The second trial plant, Uddevalla, which opened 1981, was built in cooperation with the union. This new factory was a compromise between the Kalmar plant and a traditional assembly line. The economic result of the factory was good the first years but declined after a while. Explanations to this according to Berggren (1996) are that the product line became broader and more complex at the same time as the labour market became tighter which lead to increased personnel turnover. Since the work process at the new factory was based on teams manufacturing one car at a time, the changes in the group environment strongly affected the work performance. To straighten the problem out, the management introduced stronger supervision without abandoning the teamwork process.

When times got harder and the financial result of Volvo declined, the need for rationalisation became more and more evident. In comparison to other

factories, the economic results of the new reorganised factories were still lower than the old ones. In combination with a decreased personnel turnover due to the economic situation in Sweden, the decision was made to abandon these new organisational ideas and to focus on the previous methods with a traditional assembly line. Accordingly, managers stated that shop floor workers preferred a moving assembly line with repetitive work. Workers can then keep their mind at other things like what to do on the holidays or what they should do this weekend. Thus, the managers also say that they do not share these beliefs themselves. Managers need a more stimulating working environment than shop floor workers. According to the author's research performed at the Volvo factories, this is not true. Most employees like variations in their working conditions. According to the research, the workers do not prefer the moving assembly line principle at all. However, because of the household situation, the shop floor workers do not always see any other solution than to stay at the work place to earn their livings.

3.4.4 Criticism of "Just-in-time"

Since the idea about "Just-in-time", JIT, is implemented in many companies today the advantages seem to outweigh the disadvantages. Nevertheless, there are some drawbacks of the JIT system. First, the manufacturing process is very dependent on a smooth structure where all parts really are manufactured and transported at the right times. Even though there is some security stock, this tends to be emptied rather quickly when problems arise and this can cause economic damage. According to Berggren, the employees have to work harder due to tougher working conditions caused by the JIT-system and this could also be seen as a disadvantage.

Chapter four

4. Results of the empirical studies

The fourth chapter presents the information received through our field study. The background of VCBC is presented as well as a presentation of the gate system.

4.1 The background of VCBC

The history of Volvo in Olofström begins in the early 1920's. Two visionaries, Assar Gabrielsson and Gustaf Larsson, met of a coincidence during a party and started to discuss ideas about manufacturing cars in Sweden. In 1927 the first car left the production line as the first line produced car at the Volvo factory in Gothenburg. This was the official start of Volvo. In the small town of Olofström in the north-western part of Blekinge, a company called "Svensk Stålpressning AB" started to manufacture and supply parts to Volvo all ready from the beginning. In the late 1960's Volvo decided to buy the factory and so they did. The old name was changed into "Volvo karosskomponenter". In the two factories in Olofström; the upper and the southern, components such as doors, interior details and bonnets to the car body are pressed. Some assembling is also conducted here. The manufactured parts are shipped to the factory in Gothenburg and Gent, in Belgium, for final assembling (Volvo 1).

In 1999, Ford Motor Company bought "Volvo Car Corporation", the part that manufactures passenger cars and the factory in Olofström receives the name Volvo Cars Body Components, VCBC. Today VCBC consists of three factories and the head quarters are also situated here with the department of construction as well as the department of finance (Ibid).

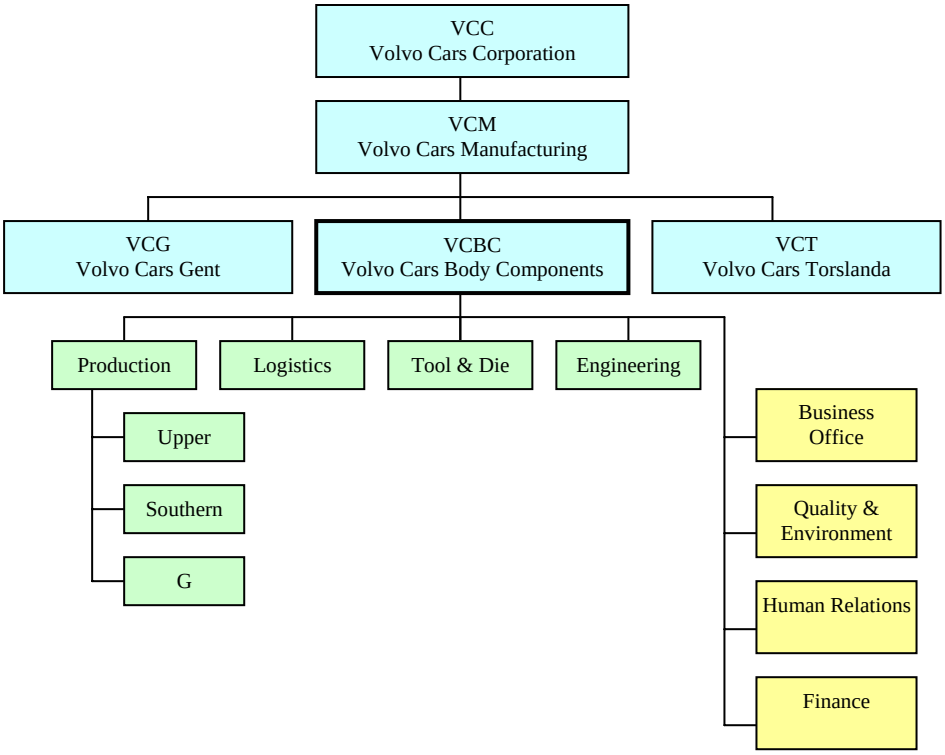

Figure 4:1 *A simplified organisational chart of Volvo Cars Corporation. (Source: Volvo 1).*

As could be seen in the organisational chart above, Volvo Cars Manufacturing is dived into three different business units. Our research object VCBC consists of several sectors, of which one is production. Three different production units exist: the upper, the southern and the "G"-factory in Gothenburg. As also shown in the chart, there are more manufacturing sites within Volvo Cars Corporation. These others sites are situated in Torslanda and in Gent (Belgium).

We have only conducted visits and interviews at VCBC in Olofström and our research is primarily based on investigations and interviews with personnel from the Business Office, the Finance department and the Engineering sector.

4.2 Background of the New Car Program

To get an understanding of the process of the New Car Program we tried to gain as much information as possible concerning our research area during the interviews. During the interview with the Project Control Manager we were given an explanation of how VCBC works with, for instance, their process timeline.

To get a wider picture we connected the different respondents to their particular role in the process to cover as many steps as possible in the gate system. Over time we developed a comprehensive picture over different parts of the New Car Program which we will describe in the following paragraphs.

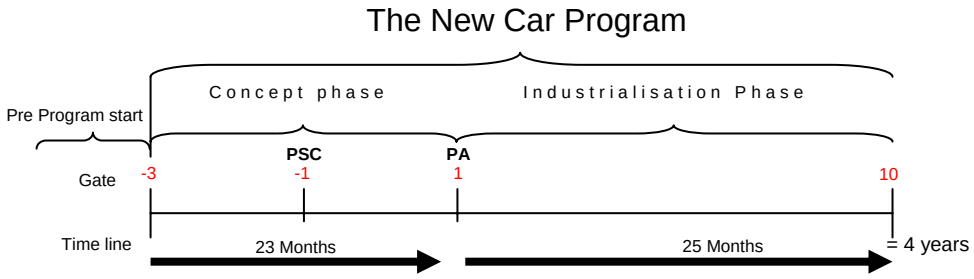

Figure 4:2 *A model over the New Car Program with the different phases and timelines.*

The figure above describes the gate system used in the New Car Program, its different phases and the timeline. The program starts before gate -3 in the so called “Pre Program Start”-phase. Following, the Concept phase is introduced between gate -3 and 1. Thereafter, the industrialisation phase begins and ends first when the New Car Program is completed at gate 10. During the program a period of four years has passed. A deeper explanation of the gate system will be presented in paragraph 4.2.2.

4.2.1 The Business Office and the business plan

To develop a new car requires enormous planning resources. To keep track of all things that are necessary, a business plan is created.

The business plan contains a layout for the near future. The business plan describes the models of today, as well as the forthcoming models. There are specifications of an overall picture of the car, that is to say, for instance which shape and preferences the body should possess. The plan also contains information about when new models should be introduced to the market and when older ones should be withdrawn. Continuing, there is information about which segments that should be covered with the new coming models. As an example, three car models, C 30, C 70 and S 80, have been released this year. Each model has its own target group: C 30; young people that have received their first employment, C 70; a convertible luxury car for people who enjoy a certain lifestyle, S 80; an upper class family car with high performance and safety utilities. To be competitive in the global market, it is necessary to have a wide segmentation process to reach many different customers. As mentioned above, the information is collected in the business plan. Since there are constant changes depending of the world market situation which is influenced by the intensive competition between car brands, the document must be living. The information is vital for Volvo and must therefore also be kept highly confidential.

4.2.2 The gate system

The gate system is used to get a comprehensive overview of the New Car Program and at the same time have full control over the different steps in the process. The New Car Program begins with the initiative to start up a new car model which is taken by VCC in Gothenburg and based on the Business Plan. They follow a model called the Global Process Develop System (GPDS), which describes what targets, who has the responsibility for each process and what criteria should be fulfilled in the different steps before the entering of a new step is possible. When the GPDS-model is worked out thoroughly in Gothenburg it continues to, amongst others, VCBC. In Olofström they transform the first model into a simplified version to fit their organisation. The simplified version is called Volvo Production

Development System (VPDS). This model is the same as the gate system which is used through the New Car Program.

Below a figure that describes the gate system is shown. As could be seen, the focus area of our dissertation will be between gate -1 and 10. The X_1 to X_6 illustrates the main factors which could effect the cost variations during gate -1 to 10.

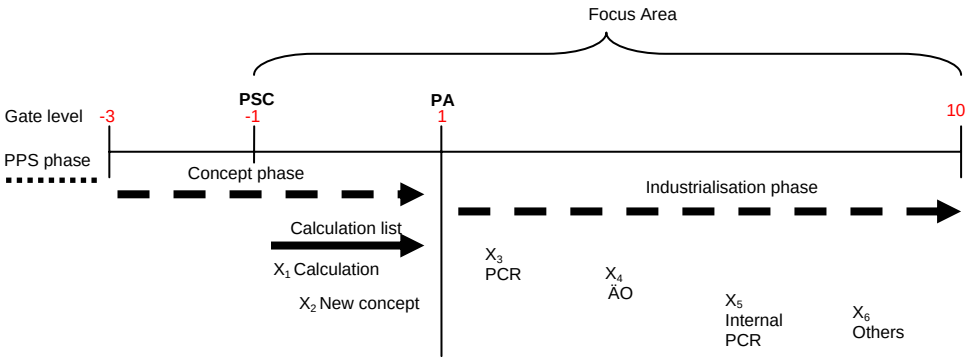

Figure 4:3 *Gate system model with possible factors that affects cost variations.*

The New Car Program begins before gate -3 and ends at gate 10. At the first phase, before gate -3, also known as the Pre-Program Start (PPS) phase, VCBC gets the first information and a decision from Ford to start up the development of a new car. The Ford Management, together with the design team in Gothenburg, decides what kind of car it should be; sedan, estate car or perhaps a sports car. It is also decided in which price range and segment the car should be placed. When these basic conditions are clearly stated the Volvo Management starts to distribute roles to the different plants, for example VCBC in Olofström.

The Business Concept Management consisting of core employees within Volvo is responsible for establishing the project plan which contains information about available resources that can be used in the New Car Program and also establish how the workload should be distributed between different areas. This should be concluded in the Pre Program Start (PPS) phase, before entering gate -3 where the Chief Executive Officer at Volvo takes the decision of which project should continue and which should be

dormant. If the project should continue, a project team is put together by the Business Concept Management. The project team starts to work with the project and they get responsibility for implementation of the new car model into the gate system.

The time between gate -3 and -1 is a long process of creating and testing different scenarios to be able to put all pieces of the car together and fulfil the criteria set for entering gate -1. At this gate the business targets of the Program Start Confirmed (PSC) phase should be established, that is to say what volume should be produced, what the design ought to look like and what level of safety the car should possess.

Between gate -1 and 1 the calculators at Volvo begin to work. With help of the established specifications made in earlier stages in combination with earlier calculations on similar details, the calculators are able to estimate the cost of different details. This means, in extension, that they are able to estimate the total cost.

When entering gate 1, all targets have to be confirmed and the framework for the project has to be established. The car model should be fully developed; the specifications and system solutions should be fixed. The economical frames which contain the total price for a complete car should be approved by Volvo's management before forwarding it to Ford. If all these requirements are achieved the project hopefully gets approval by Ford. If the project is approved the New Car Program will enter gate 1. Volvo then executes all the tenders to the subcontractors and requests them to start their process according to agreements between them and Volvo.

Continuing in the process, we enter the industrialisation phase that starts at gate 1. Between gate 1 and 8, a considerable amount of time passes by. The time is used to make sure that the equipment follows the set specifications. It is also used to put together the assembly line and the tools for the press line. The tools and the assembly line are tried out, adjusted and coordinated for maximum optimisation. When entering gate 8 the product line and the

press tools are installed and ready to start up mass production. At this time a lot of tests are necessary to secure the process for full production. The full mass production begins at gate 9 when the product is ready to be released on the market. The cars also get approved for delivery to customers. Gate 10 is reached when an appropriate level of stability and capability of the production process is shown and have been verified. The project is also very well documented so that the knowledge and experience created easily can be transferred to forthcoming projects. The New Car Program for the model is finished and the full scale delivery of cars can now begin.

4.2.3 Product Change Request (PCR) and Change Orders (ÄO; Ändringsorder)

Before the manufacturing of cars begins all price information and all decisions on how the different sheets of metal should be bent are established. The utopia would be if no changes of products were needed to be made after that the car model has reached the manufacturing stage, but in reality it is seldom this way. It can be seen in figure 4:3 on page 32 that PCR's occur in the industrialisation phase. These modifications can be very costly if they affect the product in a way that forces the particular tools to be reshaped or replaced.

Sometimes a department with authority, such as the design team, decides that a change of the product needs to be done. This could be due to safety regulations that were not evident from the beginning or that the design is not fully up to date. When these problems are identified, a Product Change Request (PCR) is written, which states what changes are needed and why they are necessary. Then a decision is taken and it is determined if the change should be carried out. If this is the case, a change order (ÄO) is written and it is possible to implement the change in the process. If the PCR is not approved it can either be dormant until it can be implemented together with another PCR or rejected.

4.2.4 Process Change Request (Internal PCR's)

The Internal PCR, also called "Internal Process Change Request", occurs when there is a wish/need to change the production process. A change in the process can occur when, for example, it is necessary for the press line to increase efficiency. Due to the extent of the change, the number of steps that are affected differs.

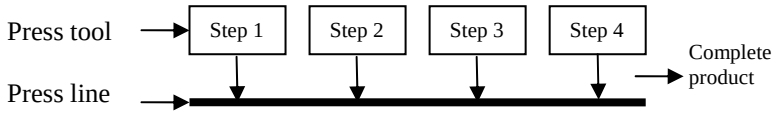

Figure 4:4 *An example of a press line process.*

The figure above describes an example of a process for a press line with different steps. The details have to pass through all steps to become a complete product. A change could, for instance, consist of an additional step which results in a longer process.

4.2.5 How is the price of the articles calculated?

The Business Office at VCBC in Olofström compiles the information concerning the prices of the different articles used in the production. Much of the calculations consist of empirical data even though the new car model never has been in production.

When calculating the price, the calculators go back in the price history of the particular part they are interested in. If the new part looks almost as the previous one, the Business Office is able to estimate the price of producing this article with an accuracy of more than 95 %. During the concept phase between gate -3 and -1, the Business Office usually looks at what the company has manufactured before. When they bring forward a new model it is easier to use information from older parts because a car is always a car. The Business Office uses the old structure as a base and then starts to look at the differences when it comes to, amongst other things, the amount of

bending that is necessary for the sheet of metal to be transformed into the right shape and how much material that is needed. Continuing through the developing process, we reach the gate -1. At this gate the historical data is excluded and a framework for further calculation on a new article price has emerged.

All the price information is, as mentioned before, collected by the staff in the Business Office. Several persons are working with the article prices by calculating how big impact the changes from earlier units will have on the new article price. The calculators then come with these new figures to the Business Office representative who is the person responsible for implementing the price calculations in a consolidated list. The representative then challenges the calculators with comments and questions concerning the calculations and price/cost suggestions. Since the representative has worked within Volvo for several years he has built up a lot of experience and a large network around the calculation process. This is of course used and needed during the calculating process.

4.3 Findings of the field study

4.3.1 Introduction

Depending on whom we interviewed we received different answers on the question of what was causing the cost variations. The personnel within the Business Office saw some problems while the engineering staff saw other problems. During our interviews we tried to find particular areas concerning cost variations where we could begin our investigation.

We wanted to triangulate the data received during the interviews as much as possible in order to make our results more reliable. To do this we looked up internal data from VCBC and compared and complemented the interviews with the results from the data. The accumulated result of the interviews and statistics are presented in the following paragraphs.

4.3.2 The communication process at VCBC

We started to look at the communication processes at VCBC. The internal communication suffers from some disturbances. This can, for instance, be seen in the occurrence of Internal PCR's. When it comes to the external communication, we have observed that there sometimes are disturbances in the process. As an example, the factory in Gothenburg might need some extra doors because they want to work one extra shift to catch up on previous production disturbances. According to one interviewee, problems occurred since the requests for extra doors did not reach VCBC in time which led to disruptions within their own factory in order to be able to deliver to the Gothenburg factory.

4.3.3 Kaizen-processes at VCBC

During our interviews we have found that the process of Kaizen with constant improvements is performed at VCBC. According to the interviews, the calculators take the learning effects into consideration when fixing new manufacturing costs for particular pieces. The calculators consequently assume that the workers become more and more effective which reduces the cost of manufacturing the particular pieces. The use of PCR's could also be seen as a use of Kaizen in order to improve the car.

Other tools from the Kaizen concept are also used in the daily work within VCBC but since we have not found any evidence that they, at least in the short run, affect the cost variations we will not present this more in detail in this dissertation.

4.3.4 Product Change Requests (PCR's)

During the interviews, a factor for the cost variations often recurred, namely the Product Change Requests (PCR's). We compared statistics received from VCBC to see how many PCR's which had actually been made until the start of full mass production at gate 10. We found that a larger amount of

PCR's concerning a particular car model were made. 80 % of these PCR's were transformed into ÄO's and implemented in the manufacturing process. Due to non public information, we are unable to present exact figures concerning the number of PCR's.

It has also come to light during the interviews that the amount of PCR's depends on which platform the car is built. More PCR's are made if the platform is new and no cars have been built on it before. The longer period a platform is in use, the fewer changes are required since they already have been made in earlier stages.

4.3.5 What happens with the PCR's, ÄO's and other gathered information?

We have seen above from the collected data that many change orders (ÄO's) come up during the working process, yet even more PCR's occur. We wanted to know if this information was saved and used in the forthcoming process with bringing a new car model to the market. According to the respondents in our interview very little information was saved. The main argument for not saving this information was that the car models are very different from each other and therefore the PCR's are not generally applicable to all the models.

4.3.6 The Just-in-time process at VCBC

As most modern companies of today, VCBC uses the principle of the "Just-in-time"-system (JIT). Storages are kept as low as possible in order to release capital. As described in the example in 4.3.2 where the communication process failed and the order for extra details did not reach VCBC in time, this also affected the lean manufacturing process. Since only a few extra parts are kept in storage as a security precaution, disruptions occurred within VCBC. In this particular case VCBC ran out of parts, both in the ordinary production and the security storage, causing delivery delays to the Gothenburg factory. As another example, one of the respondents

stated that some of the parts have been flown with helicopters from their factory in Olofström to the factory in Gothenburg due to similar disruptions!

We searched for figures that could show with which frequencies these extra transports were carried out. We also looked for figures showing how great these costs are and how they affect a particular car model. We retrieved information from VCBC and the cost of these extra transports are particularly high. The total number of extra transports was not recoverable. Due to non public information we are unable to show the exact figure.

Further information retrieved was that these extra transports costs are not charged to the particular car model but instead taken as a once-for-all cost in the result sheet for VCBC in Olofström. As a result of that, this does only indirectly affect the cost variations on the particular car model.

4.3.7 Internal PCR's (Process Change Requests)

Process changes requests or Internal PCR's are changes in the production process. As an example, lack of communication between the process designer and the shop floor workers, when the process was created, might result in need for changes since the way of work was not optimally designed from the beginning. Still, there might be other reasons for that these changes occur, such as that the products/details that are manufactured are somehow changed and therefore requires an improved working process.

We have found through internal data that a minor amount of Internal PCR's were made concerning a specific car model. Due to non public information we are unable to present the exact figures.

4.3.8 Personnel turnover

As discussed in section *4.3.3 Kaizen*, learning effects occur within the organisation. However, the learning effects could be even greater if the sickness rate of the workers is as low as possible. We have found through

internal statistics that the sickness rate of the shop floor workers is somewhat alike in the different factories within VCBC.

	Short-term absence for illness	Long-term absence for illness
Olofström: Southern	3, 69 %	3, 52 %
Olofström: Upper	4, 61 %	4, 66 %
Gothenburg: G	5, 30 %	3, 10 %

Table 4.1 *The sickness rate among employees in the factories of VCBC.(Source: Volvo 2)*

As seen above in the figure, we can also verify that the sickness rate seems to be rather low in all factories within VCBC. The sickness rate in healthy industries of this kind is normally 2 – 4 % according to Nilsson (2006).

4.3.9 The calculation list

The gathering of calculations ends up in a particular calculation list. This list has a rather complex structure and contains more than just numbers and figures. Experiences and knowledge created during earlier projects are collected in the document. All this information is of course very valuable to VCBC and have restricted access. Only one employee is responsible for putting the figures into the calculation list.

4.3.10 Currency fluctuations

Many tools and materials used in the production are bought outside Sweden. Of course currency fluctuations occur between the calculations and the execution of tenders. However, these fluctuations are not taken into consideration when calculating because the calculators use a fixed exchange rate during the whole process. Therefore, these fluctuations have no impact on the cost variations at this level.

Chapter five

5. Analysis

Chapter five presents the analysis where the empirical findings are connected to theory. Further on, we give VCBC some possible suggestions for improving their performance.

5.1 Introduction

We will connect the theories with the findings in this chapter. When integrating theory with the empirical findings it is necessary to consider the weaknesses that we have emphasised in chapter three. Sometimes only limited parts can be used in the analysis of the problem.

5.2 Communication

Communication is important in all organisations and is crucial for organisational success as we stated in the theory chapter. During our interviews with personnel at VCBC - Olofström, we realised that some communication flows function well and some not as well. There exist rigorous communication flows between the different areas in the New Car Program. For example, when article prices are to be calculated, there are several employees that make the calculations and then communicate this to the Business Office representative. As stated by Bakka et al (2001) the use of feedback in the organisation is vital to secure communication without disturbances.

5.2.1 Internal PCR's

During the interviews we found that there were some changes in the working processes during the development of a car. These changes could consist of an additional bending which requires more steps in the process and more steps lead to increased costs. An explanation might be, as mentioned in the empirical studies, the lack of communication between the

process designer and the shop floor workers. This can result in working processes that do not function and therefore a change might be needed. Other factors that can make changes necessary in the working processes could be PCR's and ÄO's which results in a modified product.

When a process is changed there is a need for awareness that the change can lead to complications. A process change could be tougher and cause greater impact on costs than a change of the product in itself.

During our case study, it has been hard to find tangible information concerning Internal PCR's. Ordinary PCR's go through different steps in order to be approved as an ÄO. The difference when it comes to Internal PCR's is that these kinds of criteria for approval and implementation do not exist. Since there is less documentation it makes it harder to save any information concerning the Internal PCR's and, in extension, to see how big impact they will have on the costs.

5.2.2. The calculation list

According to the interviews, miscalculations exist when a new car model is developed. Some details become more expensive than expected while some become cheaper. However, the total difference is not that big and on a particular car model it is usually not that many Swedish crowns that differ. It is not possible to calculate the exact cost but the miscalculations that occur are within the targets set by the management of VCBC. However, feedback is used by the Business Office representative during the calculation process and in particular when he questions the figures that are used as input to the article price calculations. We can therefore conclude that the communication processes concerning the calculation list seem to work rather well.

Via the interviews we have found that all data concerning price calculations are collected in one particular list, made in Microsoft® Excel. There are several risks with the data collection performed in this way. One risk that

might affect the calculated price and make a difference in comparison with the outcome is the calculation document that contains many cells with a lot of depending formulas. One error in this complex document might result in huge miscalculations. Though, the experienced personnel working with these calculations are unlikely to make this error and if it occurs they will notice it quickly and are able to respond to it.

Furthermore, there are more disadvantages of collecting data this way. Even though, this is not within our main focus area, we feel that it is important to visualise the risks for VCBC and therefore this will be presented in the following paragraph. Firstly, collecting this type of data in just one document might cause severe damage if it is lost. Therefore it is very important that the document is saved in more than one location and that several backups are made. Secondly, if only one person is responsible for the data input difficulties can arise if this person is absent. Thirdly, if it is only one person that makes the inputs, it is not certain that the other employees with access to the document can understand the information in it.

5.2.3. External communication

Continuing to the external communication we can also see that it suffers from disturbances as well as total lack of communication as described by Bakka et al. Earlier in our dissertation we have given examples of how the problems with extra transports have caused economical losses. To keep track on what is happening and to be sure that sent messages are properly received, the use of feedback is invaluable.

5.3 Kaizen

5.3.1 Learning effects

Learning effects could be seen as a constant improvement of working processes and is therefore connected to Kaizen. According to one of the

interviewees there are no, or at least few, learning effects at the two factories in Olofström since cost variations occur in a negative manner in New Car Programs. Our analysis of the result from the statistical data and from the interviews presented in the chapter of theory and empirical studies make us believe that this is not entirely true. Through our research we have found that Kaizen, as defined by Imai, occurs within the organisation. This is, for instance, stated during the interviews with the Business Office representatives. When they calculate the prices for new components they take into consideration how much the new article differs from the old ones. If the articles are somewhat alike the calculators assume that it is possible to achieve learning effects and set the article price lower than the previous one to encourage the workers to cut costs.

5.3.2 PCR's

The PCR's that occur during the New Car Program could also be seen as a kind of Kaizen process since the requests are made to improve the car. It is also the view of the employees that the PCR's should occur and be implemented as early as possible in the process. In this way, the cost of implementing the changes is lower. The use of one platform for several cars is also a sign of the Kaizen process. The experiences from previous cars are reused and this lowers the costs of producing the new model. This also enables economies of scales.

We can see that these Kaizen-processes functions rather well. Yet, it would be even better if the PCR's and ÄO's occur and are implemented as early as possible in the New Car Program in order to avoid extra costs.

5.3.3 Personnel turnover

If we go back to the part of learning effects as discussed in section *5.3.1 "Learning effects"* there are more contributions to positive learning effects. One of these contributions is the employees them selves. If the personnel turnover is high, much of the knowledge created and collected during their

time in production is lost when the personnel leaves. Lower productivity could also occur if a high sickness rate exists within the company, which leads to that staff needs to be borrowed from different parts of the production. This could mean that they do not have the specific skills required.

From the internal statistics presented in *4.3.8 "Personnel turnover"* we can see that the sickness rate today is rather low. None of the factories within the responsibility of VCBC exceeds a short-time sickness rate of 5, 30 % and the long-time sickness rate is not above 4, 66 %. According to Nilsson (2006), the normal rate of sickness in healthy industries of this kind is between 2 and 4 %. Therefore, the sickness rate is perhaps in the upper region but not anything that needs immediately attention. Thus, a sharp eye should be kept at the figures in order to respond if they start to increase.

On the other hand, newly released statistics showed that the number of available jobs has experienced a substantial increase in comparison with the same period last year (Swedish Labour Market Administration 1). The increase has occurred in most areas but in particular in the workshop industry. This could in some time result in higher personnel turnover at VCBC and valuable knowledge might be lost. How likely this increase in turnover will be is unknown. If VCBC considers a higher personnel turnover as a problem they should think about possible solutions on this matter as soon as possible. If the work at the shop floor is made in a traditional way an increase of personnel turnover might not be a big problem. New staff will be taught the work specifications fast and can soon be implemented in the production. Nevertheless, the long term effect will probably be that learning effects decreases over time.

5.4 Just-in-time

5.4.1 Extra transports

VCBC uses the JIT system. As mentioned in the interviews, disruptions occur every now and then, and cause problems in the factories, both in economical terms as well as production wise. One issue that we identified as an indirect obvious factor for cost variations was the extra transports caused by the disruptions.

According to internal statistics the cost of these transports are particularly high. We are unable to present the exact figure due to non public information. We have not compared if these costs exceed the benefits of the JIT-system since we have not been able to collect figures of the savings. Still, since many companies today use the JIT-system, we assume that this system is the superior. However, considerable savings could be done if the amount of transports is possible to reduce.

Since these extra transport costs are not charged the particular car model but instead as a once-for-all cost, the affect on the cost variations, as defined in our research, are only indirect. Nevertheless, they have a great impact on the overall performance of VCBC.

5.8 Suggestions for further work within VCBC

Of these factors stated in the previous paragraphs, we can conclude that the most important factors that cause cost variations are PCR's combined with ÄO's as well as Internal PCR's. Still, through our research we have been able to see that all areas would benefit from some attention in order to reduce cost variations. Therefore, we suggest that employees within Volvo look at the following areas to see if anything is possible to do in order to improve the overall performance.

5.8.1 PCR's

The amount of PCR's that occurs strongly affects the cost of manufacturing the particular car model. The later the change is implemented in the process the more expensive it will be. Therefore, it is important that the car model is worked through thoroughly before entering the industrialisation phase.

5.8.2 Internal PCR's

Since none, or at least very little data, about Internal PCR's are available at VCBC the first step should perhaps be to document these changes when it is possible. If documentation is established the costs could be identified and also be closer connected to the particular car project and further research can be conducted.

5.8.3 Personnel turnover

Due to the labour market situation it is not possible to exclude that the personnel turnover may increase at VCBC. In the future, VCBC could therefore start to look for ways to increase the motivation among their staff. The first idea that comes up is to increase the salary of the employees but according to Berggren (1996) there are also several other ways of motivating the staff. Berggrens main point is that factors such as the work environment and its conditions, participation in meetings and ways to influence the workers own situation at the company could strongly affect staff motivation. However, this is not within the main focus area of this dissertation and we have not looked for any suggestions for improvements. Therefore, we suggest that VCBC investigates this matter and makes an analysis of how an increased personnel turnover would affect the production cost and production efficiency.

5.8.5 The calculation list

Since the miscalculations do not exceed the expectations from the management there are little, if any, need to revise the way of the calculating

process. Yet, it is important that there is an open and secure communication process to avoid miscalculations. Therefore, the use of feedback between the concerned employees is vital and should be maintained. The main focus should instead be moved to other areas where greater effect on savings could be made, such as reducing PCR's at a late stage in the gate system. Thus, if the fact of the vulnerability of the list is taken into consideration, some steps could be taken to minimise the risks. First, the calculation list should be stored in a satisfactory way with more than just one copy. Second, more staff should be able to understand the document of the calculations in case of, for instance, illness.

There might also exist a more secure way to make the calculations than to use an extensive Excel® document. For example, a database could be connected to a program. The benefits of this are that when an update or change in the article price occurs, the update will be incorporated into the program automatically.

5.8.6 Extra transports

In our work we have seen that there is a lack of communication between the different factories within Volvo Cars Manufacturing when it comes to, for instance, giving notice in time for extra deliveries. To avoid these extra transports to the greatest extent possible, it would be a good idea to create strict realistic guidelines for how and when these extra orders are allowed to be made. A review of the number of articles required in security stock could also be useful.

The cost for the extra transports that are caused by disruptions within the production are not charged to a particular car model but is instead taken as a once-for-all cost for VCBC. If this is the right way, is debatable. On one hand, these extra transports can be caused by factors within the control of VCBC. This could be caused by a high level of absence due to illness or that an assembly line breaks down. On the other hand, these costs can occur because the particular car model is causing the problems in the production.

Therefore, it is hard to say which way is the right one when it comes to where costs should be charged. However, our opinion is that the costs to a larger extent should be charged to the specific area causing the cost. We also suggest that a considerable work effort are put into this matter in order to reduce these costs, no matter were the costs are charged.

5.8.7 Overall suggestion

In order to be able to reduce as many factors as possible that cause cost variations, we believe that an adjustment of the New Car Program is necessary. Therefore, our overall and most important suggestion to VCBC is to put more emphasis on the concept phase in order to reduce the amount of factors causing negative cost variations. If the car model is work through thoroughly before the industrialisation phase begins, several factors could perhaps be avoided. However, the total length of the New Car Program should not be extended, since customers' demands are constantly increasing which results in a need for more rapid model development.

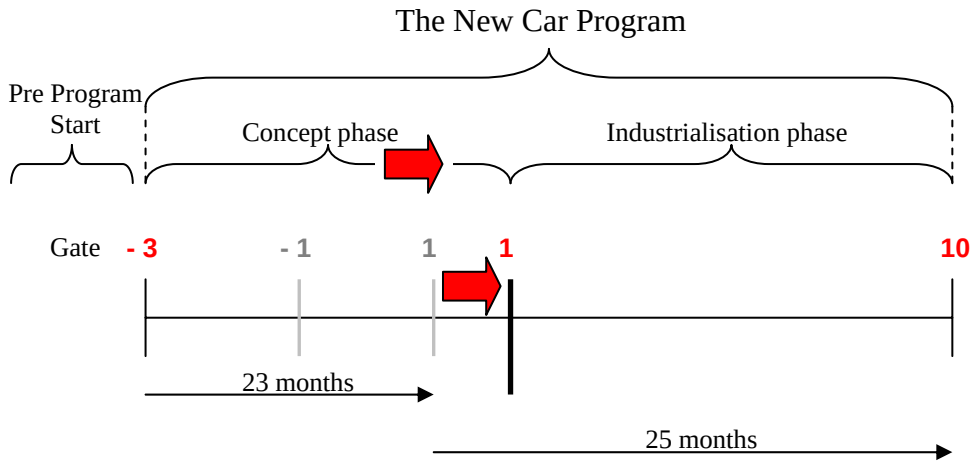

Figure 5:1 *Suggestion for improvement of the New Car Program.*

Chapter six

6. Conclusions

The sixth chapter summarises the dissertation and presents our conclusions. Suggestions for further research are also presented.

6.1 Summary of the dissertation

Volvo Cars Corporation is a large manufacturing company. Even though they are of considerable size, they still have to improve areas to increase their overall performance. Today it is not possible to live on earlier performances since the competition is constantly increasing. The durability for a car is decreasing since the design and technical attributes are developing rapidly because of the customers' increasing demands.

In order to survive in this highly competitive environment, a larger amount of models are required, with the high quality as Volvo Cars Corporation is known for. In order to achieve the objectives, the New Car Program has to be more efficient in order to keep track of all costs that occur during the process. The Finance Manager, Bengt Strömberg, identified this as an important area and we decided to conduct research in cooperation with VCBC to analyse the process during the gate system in order to find possible factors that cause cost variations.

Our research was primarily performed by qualitative interviews with employees that represented the different steps of the gate system. To verify the findings from the interviews we compared them with internal data. The findings were then connected to theory and we tried to see if there were some possibilities of using these in the reality. The theories we found appropriate for this dealt with communication, the Kaizen process and the Just-in-time system.

The theories contributed to several explanations. The different communication models identified the process with communication as an important factor for success. The Kaizen theory emphasised continuous improvements and the Just-in-time system put focus on the issue of having the right things at the right place at the right time.

Further more, we wanted to visualise our findings in order to give VCBC a clear picture of the whole process with the cost variations during the New Car Program. We hope that our dissertation achieves this and will give VCBC some guidance in order to reduce cost variations.

6.2 Summary of findings

We have identified several factors that cause the cost variations. The most important are the PCR's in combination with ÄO's and Internal PCR's. Some extra attention should be given to the Internal PCR's since it seems that there is not much information registered concerning them. Other factors identified as minor problems that could cause cost variations are the internal calculation document in combination with miscalculations. Thus, this is not any major problem but when it comes to risks, this document can become a problem if only one person can use the information in it and if the document is not stored in a satisfactory way.

Communication is also a part that needs to be improved to decrease unnecessary costs. Extra transports cause costs but they do not affect the particular car model, they only affect the cost variations during the New Car Program indirectly. Still, we believe that considerable savings are possible to make and this will improve the overall performance of VCBC.

When it comes to personnel turnover and learning effects we have not been able to establish that these cause cost variations in our case. Nevertheless, we think that is important to keep a close track of the health statistics in order to prevent an increased personnel turnover.

6.3 Suggestions for further research

When we have worked with this research we have been forced to investigate some areas less thoroughly than we had wanted due to limited time. Some ideas have also arisen during the research process that do not really fit in our dissertation, although they would have been interesting to investigate.

Therefore we suggest the following topics for further research:

- Do the benefits and savings of lean manufacturing exceed the benefits of the “Just-in-case” system in all types of organisations?
- Extra transports stand for huge costs. Is there any possibility to reduce the amount of extra transports? Are there any differences between countries?
- How can internal process changes be controlled in different companies?

References

Literature

Anders, I. (1998). *Den uppenbara verkligheten*, Lund: Studentlitteratur.

Bakka, J., Fivelsdal, E. & Lindkvist, L. (2001). *Organisationsteori-Struktur, Kultur, Processer*. 4th ed. Malmö: Liber Ekonomi.

Berggren, C (1994). *The Volvo Experience – Alternatives to lean production in the Swedish Auto Industry.* Chippenham: The Macmillian Press Ltd.

Christensen, L., Andersson, N., Engdahl, C., Haglund, L. (2001) *Marknadsundersökning – en handbok.* 2nd ed. Lund: Studentlitteratur.

Fiske, J. (1998). *Introduction to communication studies.* 2nd ed. Great Britain: The Guernsey Press Co Ltd.

Holbeche, L. (1998). *Motivating People in Lean Organizations.* Northampton: Biddles Ltd, Guildford and King's Lynn.

Imai, M. (1992). *Kaizen – Att med kontinuerliga, stegvisa förbättringar höja produktiviteten och öka konkurrenskraften.* Kristianstad: Konsultförlaget AB.

Milgate, M. (2001). *Alliances, outsourcing and the lean organization.* Westport: Quorum Books.

Saunders, M., Lewis, P. & Thornhill, A (2007). *Research Methods for Business Students*. 4th ed. London: Pearson Higher Education.

Shingo, S. (1999). *Den nya japanska produktionsfilosofin.* 7th ed. Stockholm: TQM Produktionsskolan AB.

Øiestad, G. (2005) *Feedback.* Kristianstad: Liber.

Academic articles

Brunet, A.P., New, S, (2003). Kaizen in Japan: an empirical study. *International Journal of Operations & Production Management.* (23/12). 1426-1446.

Worley, J.M., Doolen, T.L, (2006). The role of communication and management support in a lean manufacturing implementation. *Management Decision.* (44/2). 228-245.

Dissertations and miscellanous

Ericsson, J. (1997). *Störningsanalys av tillverkningssystem – Ett viktigt verktyg inom lean production.* KFS i Lund AB: Department of Production and Materials Engineering, Lund University.

Electronic sources

Volvo 1
VCBC
Retrieved (n.d.) from VCBC Intranet (not an open source to the public).

Volvo 2
VCBC
”Sjukfrånvaro för perioden 2006-01-01 – 2006 – 10 -31 Arbetare”
Retrieved 2006-11-20 from VCBC Intranet (not an open source to the public).

Arbetsmarknadsstyrelsen 1
Swedish Labour Market Administration (2006-10-26).
Retrieved 2006-11-20 from http://www.amv.se/Go.aspx?a=70324

Oral sources

Personal interviews

Project Control Manager, Tony Jeppson, 2006-09-19.

Finance Manager, Bengt Strömberg, 2006-09-21.

Business Office representative, Roland Larsson, 2006-10-25.

Project Economics, Leif Johansson, 2006-10-25, continuously.

Personal communication

Finance Group Manager, Anna Minders, 2006-09-21, continuously.

Tutor, Christer Nilsson, 2006-11-27.

Definitions

GPDS	Global Product Development System
JIT	Just in Time
PA	Project Approval
PPS	Pre Program Start
PSC	Program Strategic Confirm
VCBC	Volvo Cars Body Components
VCC	Volvo Cars Corporation
VCG	Volvo Cars Gent
VCM	Volvo Cars Manufacturing
VCT	Volvo Cars Torslanda
VPDS	Volvo Product Development System

Appendix 2

Interview guide

The interview guide is the base used when performing the interviews with key staff within VCBC in Olofström.

- Background
- What is your role in the New Car Program?
- When/How are you initiated in the New Car Program?
- What are your specific assignments?
- What kinds of expectations are there on your work?
- What is the procedure when calculating article prices?
- What dissimilarities exist between old and new articles/article prices?
- How is the data collected?
- How is the data compiled?
- Is there a great deal of repetition from previous projects?
- Can earlier experience be used in new projects? (How much?)
- What articles/categories usually differ from the pre calculations?
- Does any kind of follow up exist when it comes to set article prices?
- How is this information used in the next/coming projects?
- Other comments?