Could suppliers take greater transport and owner responsibility?

Evaluation of changed Incoterms at GKN Aerospace

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Preface

This thesis has been performed at the procurement department at GKN Aerospace Engine Systems in Trollhättan during the spring of 2013. The thesis is the final part of my studies in business administration at University West.

I would like to thank everyone who offered their time to answer my questions during the process of my work. Specially to commodity manager at GKN Agneta Aglund who ordered the thesis and to Sean Tobin who was my supervisor at GKN. I would also like to thank Bengt Kjellén at University West.

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Simon Andersson
Abstract

GKN Aerospace Engine Systems acts as supplier to the original equipment manufacturers of aircraft engines and is one of the largest component manufacturer in the aerospace industry. They purchase raw material from suppliers all over the world. The components are big and heavy which means that transport cost could be saved with ship transport. But since GKN Aerospace Engine Systems use Free carrier agreement as incoterm they tie up capital during the transportation. The capital tied up could instead be used in other investments. To overcome the problem with tied up capital during transport the incoterm agreement has been evaluated. The incoterm Delivery at place means that the supplier owns the material and thereby also the capital cost during the transportation.

A production stop due to lack of raw material is expensive and to minimize the risk it is important to evaluate all possible risks. The purpose with this thesis is to identify potential risks.

The concept with DAP makes it possible for the suppliers to use their own freight carrier, that could lower the prices, but it also increase the inbound transport to GKN Aerospace Engine Systems. The administration cost in the goods receive tends to increase with a DAP solution. It is also necessary to change place where the delivery precision is measured. The supplier also needs some knowledge in export transportation and have competence in transports.
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Appendix  A-E Interview guide
1 Introduction

This chapter gives a short background to the aerospace business, GKN as a company. I discuss the problem for GKN with capital efficiency and the positive effects of positive cash flow. The problem discussion leads to the research question and main purpose.

1.1 Background

During the last decades the aerospace industry has changed structure towards fewer but larger international actors. The industry has faced several recessions and several airlines have gone bankrupt. To face the global competition actors in every step of the supply chain need to optimize their production. Also during these crises the airplane fleet has to be updated. Many of the airplane models on the market are developed during the seventies. Construction and testing of airplanes and the subsystems is expensive. Few companies can manage to take the economical risk and responsibility to develop a complete engine by themselves. To solve that problem several actors have started partnership in developing of the engine risk revenue partnership (RRPS). RRPS could be preferable when it is a long time from start of a project until the engine is in the air and generates money, the payback time is long. To be able to participate in RRPS, free capital is important.

During the production of a product there is value added activities during the value chain, which could be seen as capital flow (Lumsden, 1998). In a perfect world all activities in a value chain and in the supply chain work smoothly, unfortunately there are always sources of errors that occur. There could be delivery problems from suppliers or machine problems on the shop floor. To reduce the risk of being without material to send to production or to customer, a firm has different kinds of stocks. On raw material level the worst case is that there are zero inventories that result in the production system stands still (Oberminner & Donhauser, 2012). It is difficult to find the balance between cost and uninterrupted production. Each level of stock ties up capital, the later in the value chain the more capital is tied up. Lumsden (1998) argues that reduce inventories is one way to get free capital. The greatest effect is to reduce the finished goods stock, since that carries the greatest value, but also activities in the stocks lower in the chain gives effect. If tied up capital could be released, money could be spent on research and development instead (Mattson, 2002). One way to overcome the issue with the risk of low inventories is for supplier and customer to take more equal share of the working capital (Lumsden, 1998).

In the automotive business just in time is used to keep the tied up capital as low as possible. Just in time means that the goods is being delivered nearly at the same time as it is needed in the production. It’s a form of optimization since the production start is delayed in the value chain (Obermaier & Donhauser, 2012). If just in time could be used also within aerospace supply chain that could help reduce inventories, though since the lead time in supply chain is quite long there are obstacles to overcome.

GKN Aerospace acts as first or second level supplier in the aircraft industries supply chain. The main suppliers to GKN are located in USA where GKN purchases most of the goods required. The goods are mainly owned from the suppliers loading dock and GKN takes the risk during transportation. Of GKN total product cost the purchased material is more than 50 % of the total value. Since some of the goods are sent over sea
with ship the transport lead time is quite long, in terms of that every dollar saved in the supply chain is preferred.

The goods in transit between suppliers and GKN Aerospace systems are among others forgings and castings. These types of goods carry a lot of weight and value. GKN always aims to find the most profitable solutions, and thereby the logistic solution should be evaluated. The agreement with suppliers today gives GKN long payment terms, but they carry the responsibility for the goods when they are shipped from suppliers.

The effect of long payment time is good cash convention cycle (CCC), but tied up capital in goods in transit is high. Low CCC days are something that many companies value highly to generate positive cash flow. Even though GKN has been a profitable company the last years, the cash flow could tend to be problematic. When there is a boom in the economy, the cash flow tends to get negative at GKN. This is due to high turnover of products, which leads to high volumes in products in production and stock and that tie up capital.

As an effect of the changed ownership the CCC performance measurement has lower importance and the return of assets is a financial ratio. This makes it possible to give and take in the negotiations with suppliers. If they own the material for a longer period, the payment days could be reduced.

1.2 Problem

GKN Aerospace Engine Systems (GAS) in Trollhättan currently uses the FCA incoterm for all inbound transportation. This means that GAS carries the responsibility, ownership and cost for transportation of all goods and instead negotiated longer payment terms from suppliers. It has been questioned if there is a bottom line saving effect for GKN to get the suppliers to manage the transit and ownership of the parts until the parts are needed in production.

For GKN to have FCA arrangements the costs needs to be evaluated and compared to other possible incoterms that give the effect of reduced tied up capital. In the study organizational questions must be raised, the effect for internal departments at GKN. This means that not all questions will be answered in terms of money, but also evaluate risks that occur when the incoterm changes. Even though GAS already has a close relationship with their greatest suppliers it is always possible to make improvements in the procurement process. With a Delivery at Place (DAP) arrangement there could perhaps generate positive effects for both GAS and suppliers. The security inventory held at both parts might be able to be reduced. The difficulties in the supply chain today are long lead time and cycle time. The optimal solution gives a win-win situation for the suppliers and GAS.

Worst case scenario is lack of material in pre-production stock, which means that the production at the shop floor is jeopardised. Each lost production hour is costly so even if material control is an expensive activity, that is preferable to ensure the supply of material to production. The GAS strategy is to keep control of the material since it is an important part of the activity to secure delivery to the customers.
Recently GKN Aerospace launched a new custom handling system. The new way to work means that the warehouse at GAS works as a custom free area. A product that should be import decelerated and pay tax and customs fee could instead be produced without the declaration if the customer is located outside the European Union. The new process is preferable for GAS to use, why this process should consist as is.

Materials from two forgings suppliers in the inventory before production take up 38% of the total stock. If the ownership terms change, that could release tied up capital for GKN, but also it raises questions.

1.2 Objectives
The objective is to evaluate the DAP incoterms and how it affect the identified evaluation criteria. I will investigate how changed terms would affect GKN with an example from suppliers.

1.3 Research question
In what way do changed incoterms from suppliers affect GKN on a bottom line effect compared to FCA agreements that is used today?

What risks could be identified when the incoterms change?

1.4 Purpose and limitations
The purpose with this thesis is to evaluate the effect of changed Incoterms. Describe why the solution is to prefer or why not to change the current agreement with suppliers and distribution partners.

I will only include GKN plant in Trollhättan GKN Aerospace Sweden (GAS) in my research.

I will take in to consideration how a new solution will affect custom requirements, current transportation contracts for the purposed logistic solutions. To propose a logistic set-up we need to evaluate the cost drivers in the logistic flow from supplier to GKN stock, including transportation, packing, receiving inspection, custom handling and cost of capital.
2 Method

This chapter explains my approach for this research. I describe the scientific basis and method of this thesis. I also discuss the scientific reliability and validity out of a scientific approach.

2.1 Scientific basis

In this study I have chosen to apply an interpreting qualitative approach, this approach is about interpreting and understanding what I am investigating, rather than describing the context and seek explanation from this (Gustafsson, 2010). According to Gustafsson (2010) hermeneutics process consists of four main elements, these elements are interpreting, pre-understanding, understanding and explanation. Johansson (2011) argues that if you want to achieve understanding it requires interpretation. He believes that no interpretation process starts completely unbiased, but the interpreter approaches the understanding through a certain understanding. This pre-understanding comprises a number of conscious or unconscious assumptions. These assumptions are called a horizon of understanding. This horizon of understanding is the explanation of the phenomenon. Thurén (2007) writes that in hermeneutics, empathy is an important criterion in order to comprehend the phenomenon being studied. He means that in addition to the five senses used to understand, empathy must also be part of the understanding to comprehend and having a deep understanding of what is studied.

2.2 Research Approach

According to Alvesson and Sköldberg (2008) induction, deduction and abduction are used as research attempts to explain the relationship between theory and practice. The deductive research approach is based on a general rule, and claims that this explains a particular case of interest. The inductive research approach is based on a variety of cases and maintains a connection between them. Furthermore, they also claim a general connection between these observations. This makes the approach more risky since the collected observations transformed into a general truth.

I have chosen to use a deductive research approach. What causes the choice of this approach is that the starting point for a deductive study is the theories. These theories are said to be predictions of empirical data (Björklund & Paulsson, 2003). I’ll use the theories as foundation for my case study to find relevant inputs to the problem and get relevant evaluation criteria. The economic preferences described in theories are a good base to start in the evaluation of my research question.

Different types of studies require various forms of research strategies. The choice of research strategy is of great importance for the study to be as relevant as possible. Examples of different strategies that are available for the collection of empirical data are experiments, surveys, source analysis, historical studies, and case studies.
I have chosen to use a case study. This strategy aims to provide in-depth knowledge of what the author is investigating. A case study approach is used when you want to penetrate the surface of the problem and create an understanding, significance and meaning. The author wants to understand "what is happening", "how it happens" and "why it happens" (Christensen, 2010). In this type of study, a few cases can be studied, either at a specific time or over time where both primary and secondary data of qualitative and quantitative characteristics can be used. This means that statistical results are not possible to determine. Instead the general patterns are highlighted and this leads to understanding and describing complex relationships as analytical generalizations implemented.

2.6 Data collection method

In a study, one can make use of primary data and secondary data to obtain relevant information about the underlying problem. Primary data is new information that is collected with the help of various fundraising techniques (Christensen, 2010). Merriam (1998) describes the primary data information that the researchers collect to achieve the purpose of the survey. It is only the raw data I used to come to my results in this study. In order to collect primary data, and interviews to collect my empirical facts and this is how my survey results have emerged.

Secondary data is data previously collected and compiled in a different context and this applied to build a basic knowledge and understanding of what we intend to investigate (Christensen. 2010). I have used the literature and scientific articles to get the basic knowledge.

In the study I have also used internal documents at GKN as a secondary data source. The internal intranet at GKN has been a source that I have used. The documents at the intranet are not published data but together with the interviews, the reliability is high. The intranet has a search engine to find relevant documents. All documents are not published, but it has given me a chance to quickly find documents and information to find primary data. The intranet together with interviews is the main source for the description how it works at GKN today. I have spent a lot of time on site. The data together with direct and indirect observations are the underlying sources for the GKN description.

All respondents were informed of the purpose with the interview not only from the author of this paper but also from intern information from their closest supervisor. The interviews except two were carried out in a conference room, chosen by the interviewer. The other two were held at the respondents´ offices. All respondents were recorded and later transcribed. I believe it helps me to understand and remember the respondent’s answers. This method is supported by Bryman & Bell (2011).

2.4 Choice of method

In this report, I have used a qualitative approach, in order to get a deeper insight into the problem of my problem. A survey can be qualitative or quantitative in its nature, the
Quantitative studies are explanations about connections between the different aspects, and qualitative studies are aimed to understand and interpret the problem. Merriam (1998) argues that the main difference between these methods is that the qualitative research creates a holistic understanding of a phenomenon, while the quantitative method focuses on specific parts of a phenomenon.

I believe that through the qualitative method, I can create the necessary understanding of my problem on GAS. According to Merriam (1998) the qualitative research method focuses on the entirety of a context, how the different parts of a phenomenon creates a whole by interacting together. This means that the collection methods to be used must be able to observe the underlying data. In the qualitative method, interviews, observations and analyzes key aspects, this researcher has the greatest opportunity to discern the underlying information.

According to Christensen. (2010), one interview differs a lot from another. The interview can be formalized and structured with standardized questions, it can also be unstructured, where the interview is like a casual conversation. To collect my empirical material, I have in my case study chosen to carry out semi-structured interviews on-site at GAS. The interviews characterize a semi-structured interview, they have a list of topics and issues to be discussed during the interview, called an interview guide. In a semi-structured interview, the interviewer has the opportunity to ask follow-up questions so the respondent can explain, clarify and develop their responses (Christensen, 2010).

2.5 Selection

There are two different types of selection that can be used. There are probability samples and non-probability samples. In a probability sample, all respondents have equal chance to be included in the study and they are also chosen randomly. When using a non-probability sample respondents are selected according to criteria used by the authors. This type of selection is mostly used in qualitative studies where it is important to select respondents who have knowledge of what is being studied. I have chosen to use a non-probability sample in the form of a strategic choice which means I have strategically chose my respondents to the survey (Christensen, 2010).

The choice of using a case study approach is based on obtaining a deeper understanding and insights into the internationalization patterns are formed and how they work. The purpose of this study is to give insight and understanding how a logistic set up carries capital flow and the possibility to reduce the tied up capital. GKN Aerospace is a producing company in the aircraft engine business. Characteristic of firms in this industry is that there is capital-intensive. Since I want to examine how reduced inventories affect a company bottom line effect and what can be done to achieve the goal, GAS is a good example and they also purchase products with a great value.

Based on my research question I have chosen respondents with relevant knowledge in the area. Since the nature of the research question includes several organizational areas I have chosen respondents with key competence in each area. Since the thesis is ordered from a manager at GAS I had the strategy not to include this manager among the
respondents. Since I would like to identify risks I have also included respondents with knowledge in quality and contract issues. For my understanding in the logistic flow to GKN I interviewed staff with competence in logistics.

2.7 Criticism

Since the qualitative method has to be interpreted, this of course affects my result and my research’s credibility. Important to add in this discussion is the fact that the author of this thesis is employed at GAS thus on another department. Bryman and Bell (2011) argue that qualitative research can be difficult to replicate. They mean it is too subjective. They state that the criticism against the qualitative research mostly is based on the fact that the investigator relies too much on what he/she thinks is significant and important. Not to forget that the researcher often develops a personal relationship to the interviewees.

The authors mentioned above, also mean that the main instrument of data collection, is the investigator him/herself and therefore, what the investigator chooses to focus upon is very much a product of his/her predilections. This issue might be a risk, especially since the thesis was order from GAS with a purpose, but the awareness of the issue hopefully helps the investigator to stay open minded.

Bryman and Bell (2011) tell us more about criticism against the qualitative method. They mean that the given responses of the participants might depend on and/or be affected by the characteristics of the investigator, such as the investigator’s personality, age, gender etc. Because of this, it is difficult (impossible even?) to replicate qualitative data.

Furthermore, Bryman and Bell (2011) state that the findings you get when doing a qualitative interview are limited. The investigator only talks to a few people and it is impossible to know how the findings can be placed in other settings. Is it even possible that only a small number of cases are representative of all cases? I have tried to overcome theses matters, by interviewing a large number of respondents.

Another thing that needs to be taken into consideration is how the participants have been selected, for example do they know the investigator? Are they randomly chosen? Has the investigator chosen people in different ages and/or of various gender? Bryman and Bell (2011) also discuss that the outcome of the interview may depend on different factors. The factors discussed by the authors were quite difficult to consider since I have chose respondents depending on what knowledge they have in their roll at GAS.

On the other hand, qualitative research can give the result high credibility since you talk to the participants and you have the opportunity to ask them if there is something you do not understand. Because of this you get a wider understanding compared to if you only had used a quantitative method. Quantitative methods give you a rich number of answers, but if you misunderstand some of the participants’ answers the result is deceptive. This and the pros and cons of qualitative versus quantitative methods are discussed in Bryman and Bell (2011).
2.7.1 Source criticism

There has been a lot of research made in this field, and that makes sense. Given that all companies want to make a profit, they have big interests in optimizing stock control. Although, a lot of research can be beneficial and of big help for me, it can also be difficult to decide which sources are reliable and which are not. There is also a risk that the research might be ’out of date’ and therefore not trustworthy anymore.

To minimize the risk of choosing unreliable sources, I have chosen to use as new literature and sources as possible. It is my belief that new research often is more reliable than older (mind you, I know this is to simplify. There are many other factors involved when you decide whether a source is reliable or not and I will discuss them further down). Although, it is not certain new literature is more suited to use than older. I have used some research that is not new. The reason I did this is because I think this research is still of importance.

As I said earlier, there are other factors involved when choosing literature and sources. To reach as high credibility as possible, I wanted to use research of respected specialists from respected institutions. I am of course aware of the fact that unknown specialists can provide great research, but since my time was limited I felt I wanted to choose sources I already knew were trustworthy. Had I been given more time, I definitely would have read the research of more unknown specialists. In order to make my result as believable as possible, I have tried to use two sources (independent of one another) under each headline in my theory part.

2.8 Validity

In every study the authors need to reflect upon the question whether the result is valid and transferable. The term reliability is concerned with issues of consistency of measures (Bryman & Bell, 2011). Myself as the author to this thesis must take into consideration whether the study can be repeated or if the result is a result on my research method. Since I have chosen qualitative research approach it is likely that if someone else performs this study the outcome will differ. Reliability is mainly an issue with quantitative research. In this study I need to take into consideration the internal and external validity. The internal validity raise the issue of cause and effect, is there a relationship between two or more variables. Bryman & Bell (2011) describe it as if x causes y how I can be sure that x is responsible for variations in y and not something else. That type of question is important in my study where there are different actors that will be affected.

External validity refers to whether the result of the study can be applied to other organizations and the degree of possibility to generalize the result. Since I have chosen a qualitative approach it is not given that the study can be representative to other organizations.
3 Theory

This chapter includes a short description of the supply chain to be followed by description of different incoterms. In the end I present the evaluation criteria that I use during the evaluation process.

3.1 Supply chain management

The supply chain is a system with all actors to provide the final product. Possible actors could be raw-material manufacturers, processing recourses, distributors and costumers all connected via a product flow and information flow. In the supply chain information from customers flows through the chain in forms of sales activity, forecasts and orders. The information flows from the final customer and down to the first supplier. The inventory flow has the opposite direction. It starts at first supplier and after every single value added step it finally reaches customers (Bowersox, Closs & Cooper, 2002).

Traditionally each actor in the supply chain act quite unattached to each other and decisions have been taken without consideration on how other affects. According to Mattson (2002) the traditional supply chain makes it easy for the buyer to negotiate low prices since the suppliers could be replaced. The effect becomes a poor relationship between supplier and customer, and long term relationship tends to absent. The collaboration in these type of relationship is low or absence and the parts provide their own forecasts. Of course different business has greater or lower integration in their relationship. The automotive business has a lot of suppliers which gives a greater ability to switch suppliers. In the aerospace business where there are a few suppliers of castings and forgings, there is lower ability to switch suppliers. Nowadays the information exchange in the customer – supplier relationship tends to be better (Mattson, 2002). The ability to change information has almost exploded the past years. Communication with email and systems like web Electronic Data Interchange (EDI) have made it easier to communicate. The new information technology makes it possible to exchange information in a fast and secure way which makes it easier to have effective information flow.

3.2 Bullwhip effect

The Bullwhip effect also known as Forrester effect is the result of when every actor in the supply chain tries to optimize their own business without any consideration to other
actors in the chain. Zotteri (2012) means that it’s rarely changes in the final consumers demand that makes fluctuations in the supply chain, he argues that’s rather generated within the supply chain. The Beer Game (Sterman, 1989) is a good example of the bullwhip effect. Sterman has developed a game that describes a situation where a local shop sells beer. For some reason the demand for a special beer suddenly rises. The participants in the game will face a classic bullwhip effect. The retailer orders more beer from the wholesaler and the wholesaler from the distributor and factory. This game gives knowledge about the bullwhip effect and visualizes the effect one small change in the beginning of the supply chain. The problem is that small changes reinforce and develop upstream in the supply chain. Yungao et al (2013) mean that the bullwhip effect is a phenomenon of exaggeration because as ordering information upstream a demand fluctuation downstream leads larger fluctuations in upstream orders and inventories.

Fluctuation increases and uncertainty becomes greater when information flows upstream in supply chain.

Lee et al (2004) argue that there are four main reasons for the bullwhip effect, demand signal processing, the rationing game, order batching and price variations.

The demand signal processing is when the supplier upstream base their forecasts on the orders downstream in the supply chain the connection to what the final customer ordered is lost. When a retailer experiences high demand for one period, he or she will place a larger order to meet the predicted increase in demand.

Order batching occurs when the orders are placed in some kind of periodic interval, with systems like Material planning requirement (MRP) that is updated on weekly or monthly basis. This generates that large orders arrive in the last week of a period. For a supplier in the supply chain this phenomenon leads to insecure demand, they might have to start their production without any order to secure to be able to deliver when the orders are placed at the end of a period. (Lee at Al, 2004)

In the beer game (Sterman, 1989) the rationing game is symbolized by the retailers order more beer than they sell just to secure a future demand. When the demand exceed the retailers order more beer, the factory can’t produce to satisfy all retailers orders so they deliver a little to everyone, the effect becomes that the retailers order more than

![Figure 2](Free after Disney & Towill (2003) p.629 see Stalk & Hout, 1990)
they had done if there were unlimited access to the beer. When the producer can satisfy the beer orders, then there is too much produced and the retailers will cancel their orders. This is what Lee et al (2004) call the rationing game.

Price variations can generate the bullwhip effect, when the price of a good is low it generates higher demand. Not only to satisfy the current demand but also there is a risk that customers buy more and store. This will give an effect on increasing demand during the time of the lower price but when the price goes back to normal the demand will decrease to a point that is lower than the actual demand, because of the inventory held at customers (Zotteri, 2012)

Yungao et al (2013) state that the bullwhip effect on product orders mainly contributes to upstream costs, while the downstream inventory costs. That’s the result of the bullwhip effect. When the orders fluctuates the orders cost a lot upstream but when the suppliers have produce the orders business late in the supply chain tends to get a large inventory.

3.2.1 Reduce bullwhip effect

It can be crucial for a supply chain to reduce the bullwhip effect to get an effective supply to all actors in the chain. Lee et al (2004) mean that sharing information of inventory, sales data, coordinate orders, share prices and marketing information can reduce the effect. Shared information on lead time in all activities helps the actors to understand the procedure and gives opportunity to control the own business better (Lee et al, 2004). In a perfect world all actors get the same information at the same time to reduce fluctuations in the supply chain.

3.3 Incoterms

Incoterms is also known as International Commercial Terms and they are standard contractual conditions for international trade. The Incoterms are issued by the International Chamber of Commerce (ICC) which published the first version in 1936, with several updates until the latest version 2010 (Lane, 2012). The Incoterms help traders avoid costly misunderstandings by clarifying the tasks, costs and risks involved in the delivery of goods from sellers to buyers. They regulate the cost of the goods and the responsibilities transport, insurance, custom clearance (Glitz, 2011). If the Incoterms is used it helps to avoid misunderstandings between the parties with regard to trading. If the agreed Incoterms is stated in the contract the risk of misunderstanding is minimized, if something happens that effect the delivery one can always refer to the Incoterms.

3.3.1 FCA

Free Carrier (FCA) is a common Incoterm that can be used for any transportation mode and when several modes of transports are used. FCA means that the seller is responsible to deliver the goods to the carrier or others by buyer decided. The loading is by the seller location or other agreed place. The seller is responsible for export clearance but the buyer is responsible for import clearance and customs declaration. The ownership of the goods transfer from the seller to the buyer when goods have been loaded at the by seller provided transport. The buyer carries the risk during the transport (ICC, 2010).
3.3.2 DAP

Delivery at place (DAP) is like FCA an Incoterm that can be used for any transportation. DAP means that the seller delivers the goods to the buyer to a given destination. The seller carries every risk during the transport to the given delivery place. The seller is responsible for export clearance but has no duty to import clearance or customs declaration. The seller shall deliver the goods at a given delivery place and ready to be unloaded (ICC, 2010).

3.4 Logistic efficiency

Every business has the dilemma to find the most effective logistic solution. According to Lumsden (2006) the efficiency could be described in three terms service, logistics cost and working capital. The dilemma is in these three areas. When one area is optimized, the others are affected in a negative way. One example could be transportation. To lower the transportation cost business can lower the amount of shipment, the effect will be higher levels of inventory before a shipment is ready to be sent. This increases the working capital and the service to customer will risk becoming worse. The dilemma described is sometimes called the logistic target mix. It’s the ability to overview the three components as good as possible.

![Figure 3 Logistic target (Free after Lumsden, 2006, p.259)](image)

3.4.1 Delivery service

In the process order to delivery in the supply chain there are various number of performance metrics. Depending on what kind of business different, performance metrics could be preferable. In the supply chain to secure the delivery from suppliers the
stock availability performance together with delivery precision is common performance metrics.

The stock availability measures the ability to deliver ordered goods to the customer (Lumsden, 2006). The stock availability could be used as measurement to final customer or between material handling and production. Mattson (2005) mean that the stock availability is a measurement on how material in stock could be delivered to the customer. It is interesting to measure the stock availability since it’s direct connection to the safety stock calculation. The safety stock acts as security against material stock out during the lead time for the material. The problem for companies with long lead time is to dimension the stock for unexpected orders. The stock availability could be defined as:

\[ Stock \text{ availability} = 1 - \text{probability of stock out} \]

The relationship between the stock availability and the safety stock is visualized in the graph.

One common performance metric for the supplier’s ability to deliver is the delivery precision. It measures that the delivery is made at the time agreed. Even though delay is worst also too early delivery is measured, a delivery before schedule ties warehouse space and inventory carrying charge, while late delivery could stop the production (Jonsson & Mattson, 2011).

3.4.2 Logistic cost

The logistic costs involve the cost that incurred for material supplied, not only the cost for transportation but also administration costs that come with the transport activity. The activities related to transport of goods are loading, shipment and unloading.

The administration cost could be referred to planning, operational control, material control, purchase of transport service, invoice costs. It is common that the
administrative cost is assigned to separate orders to visualize the cost each order carries and it is called ordering costs. The ordering cost carries four components, material handling, order handling, set up cost and cost of capacity loss. If the ordering cost takes into consideration when logistic decision is taken it gives a better opportunity to overview all components that are affected.

3.4.3 Tied up Capital

The term working capital contains several financial categories that come under current assets and current liabilities on the balance sheet. Pass & Pike (1984) argue that working capital may be regarded as the balance between current assets and current liabilities. In the working capital term the components involved are inventory (raw material, WIP, storage of finished goods), debtors, credit from suppliers, cash in hand and short terms securities. This definition could be seen as the working capital definition, although each business has their own components into the working capital term (Pass & Pike, 1984) I will further on in my paper evaluate the inventory part of working capital and name it as tied up capital.

Inventory tie up capital in forms of raw material, work in progress (WIP), and finished goods. Raw material could be broken down to goods in transit, and inventory pre production. The tied up capital in inventory could be seen as the cost of alternative return on invested capital (Pass & Pike, 1984). If tied up capital in inventory is released it could be used to something else that generates profit to the company. The tied up capital could be evaluated in three terms, absolute, inventory turnover rate and lying time (Mattson, 2002).

Absolute tied up capital is the value of the inventory in a set currency. One can calculate the tied up capital during an ordering cycle. To get the absolute tied up capital then multiply average stock (AS) in quantities (Q) with the goods value of each quantity. The AS is calculated as safety stock (SS) added to the cycle stock:

$$AS = SS + \frac{1}{2} Q$$

Inventory turnover rate (ITR) makes it possible to compare the tied up capital between different cycles in the inventory cycle. ITR is a measurement on how many times a year the average stock is replaced (Lumsden, 2006).
\[ ITR = \frac{Turnover}{Average\ tied\ up\ capital\ in\ stock} \]

The turnover should be calculated as the cost of sales, although it’s important to remember that tied up capital in goods in transit often is calculated based on the purchase price of the material.

Lying time is the average time the material lays in stock set in days.

\[ t = \frac{360}{ITR} \]

The tied up capital during goods in transit is calculated based on the average value of purchase material and the days in transit.

\[ Tied\ up\ capital\ in\ transit = \frac{Purchased\ material}{360} \times Days\ in\ transit \]

3.4.4 Warehousing cost

Another aspect that is important to take into consideration is the warehousing cost, it’s the cost that comes with having a warehouse. The warehousing costs consist of two components, storage cost and risk cost. The storage costs are the costs that come with owning and managing a warehouse, intern transports, labour and material handling tools. There is also a risk cost of uncertainty due to inventory shrinkage or scrap. The goods in inventory could suffer of technology development, when it should start in production a new issue of the drawing is applicable.

Products in stock can be loaded with it’s own cost for inventory time by inventory carrying charge. According to Mattson (2002) the inventory carrying charge ICC is calculated as:

\[ ICC = \frac{Cost\ of\ capital + Storage\ cost + Risk\ cost}{Average\ storage\ value} \]

3.5 Consignment stock

A consignment stock is an inventory held at the customer but is owned by the supplier. With a consignment agreement the supplier gets paid when the customer release the detail until the shop floor. Valentini and Zavanella (2003) mean that consignment stock is based on two rules.

First the suppliers guarantee that there is material in stock. The level is set to a minimum and maximum level. The stock will be stored at the customers location.

Second the company can draw material from the consignment stock on daily basis depending on the needs. The supplier is paid for the material depending on the agreement, either on a daily basis or other agreement. The consumption is constantly refreshed and transferred to the supplier.

Braglia, Gabbrielli & Zammori (2013) argue that consignment stock minimize the overall cost of supply chain due to optimization of shipments. Instead of sending several shipments the suppliers can hold a stock at the customer. The idea to achieve a win-win
situation is that the customers cost of stock is greater since the value increases as it moves downstream in the supply chain.

Valentini and Zavenella (2003) identify four benefits with consignment stock that they mean occurs immediately.

1. The customer always has raw material available
2. The customer pays for raw material consumption only when the material is used.
3. The supplier saves storage cost and gives the opportunity to reorganize their production in different ways.
4. The collaboration between customer and supplier increases and when stock holding levels reveal it gives an opportunity to trust each other on a new level.

3.6 Cash flow and CCC

Cash flow management has become a popular method during the past years to release capital to make new investments. Business cash flow is the real outflow and inflow of liquid assets during a fixed period of time. One common way to describe business cash flow during a fixed time of period derives from three areas, operational, investment and financial.

Cash flow from the operational activity involves the business transactions in purchase and sale, inventory, short term debt and account receivable. These payments and pay out generate either a positive or negative cash flow. The goal is to generate a positive cash flow that can be used in the investment activity to acquire e.g. fixed assets and invest in new technology. The financial activity contains posts as debts, amortization and dividend. The investment and financial activity generates cash flow thru sale of assets and new loan or issue new share.

A positive cash flow means access to liquid assets and greater ability to finical the daily operations with own capital and there is a lower need for financial by own or capital loans. This gives the positive effect that the intern investment ability becomes greater and also the business will not be as dependent on external financing that impose costs on interest rates and the cost of return on equity. Another aspect on positive cash flow is that the capital market believes it is positive, which means that it may be easier to gain access to venture capital, if necessary.

The operational activity cash flow is affected by payment to suppliers and from customers, the amount of account receivable and accounts payable and also the tied up capital. The ability to lower the tied up capital gives a direct effect in the cash flow.

3.6.1 CCC

Cash conversion cycle (CCC) is a tool that helps analyzing the ability to lower the working capital. The CCC helps to determine why and when the business needs more cash to sustain it’s activities and when it will repay the cash. Özbayrak and Akgün (2005) state that the CCC has a close link to the business policies and the handling of inventory of raw material, work in progress (WIP) and finished goods. The CCC is a measurement on the number of days it takes to convert the raw material into finished goods and sell them to customers. More precise, it’s the time from when the supplier gets paid to when receiving the money for sold products.
As shown in the figure CCC is from when cash is outlay to cash received. Özbayrak and Akgün mean of define CCC is to calculate the inventory conversion period (ICD), accounts receivables conversion period (ARD), and accounts payable cycle time (APD) give the formula:

$$CCC = ICD + ARD - APD$$

To affect the CCC days these three variables can be changed, either try to negotiate longer accounts payable period or shorten the time for customer to pay ARD. Another way is to reduce the inventory conversion period. Özbayrak and Akgün state that ICD itself is a performance criterion for a business but it is also an important component of the CCC. Depending on what type of business the ICD could be calculated, is it a non manufacturing organization the ICD is very easy to calculate, however, if it is a manufacturing business the inventory is in different forms. The ICD than consist of raw material cycle (RMD), work in progress (WIP) and finished product conversion cycle (FGD). If the each one of these three inventory variables decomposes one can find several aspects that can be improved. That’s why it is necessary to calculate each individual stock forms conversion cycle separately. In this thesis I focus on the inventory before production why I only describe the calculation in RMS. To get the ICD the calculation has the following formula:

$$ICD = RMS + WIP + FGD$$

As shown in the figure the inventory cycle time covers from the purchase of raw material to finished goods delivered. Each part of this cycle effects the tied up capital but in different kinds of business the level of tied up capital is greater or lower in the
value chain. As the manufacturing goes on, the capital employed gets higher as value is added to the product. Therefore it could be natural to make an effort to lower the final product cycle. But for businesses with a high value of the acquired goods it’s a good idea to also lower the raw material cycle (Richards & Lauglin, 1980).

3.6.2 Raw material cycle

The raw material stock conversion cycle measures the period during which materials are kept in stock until they are released until the manufacturing shop. Depending on what incoterm that is used goods in transit could be included in the raw material cycle. With an FCA arrangement the raw material cycle starts at the suppliers dock.

The cost of raw materials on hand as of the balance sheet date appears in the balance sheet as a current asset.

3.7 Return on assets

Return on assets (ROA) is an indicator on how profitable a company is relative to its total assets. ROA depends on how effective the business is convert assets into income. To calculate ROA one can use the following formula (Bodie, Merton & Cleeton, 2009):

\[
ROA = \frac{\text{Net Income}}{\text{Average Total Assets}}
\]

ROA gives a percentage that indicates the productivity to generate money. Since the net income is divided with average total assets accompany that have low value of the inventory has a higher ROA. Greve (2003) argues that assets turnover is a broad measure and if that it is important to evaluate ROA together with inventory turnover. Bodie, Merton & Cleeton (2009) suggest that ROA decompose into the product of ratios of return of sales and assets turnover. If there is a capital intensive company and has low assets turn over but on the other hand has a high return of sales get the same ROA as a company with low return of sales and high assets turnover. Important to remember when comparing companies performances.

3.8 Cost of capital

Cost of capital is a broad term, in the capital market it refers to the markets demand of return on invested capital. In my paper I refer to cost of capital more like capital cost, the cost that comes with return on investment from the owners. That cost is according to Greve (2003) in terms of cost for depreciation and interest rates. The capital cost is the requirement of return that is set on the business. A firms capital cost is interesting when they should invest because it gives the rate to calculate with in the capital budget.

The weighted average cost of capital (WACC) is a way to calculate the capital cost. The formula shows how much return the company needs at minimum to satisfy the owners and lenders return claim. According to Bodie, Merton & Cleeton (2009) the WACC formula is:

\[
WACC = k_e \frac{1}{1 + d} + (1 - t)r \frac{d}{1 + d}
\]
Where

\[ k_e = \text{cost of equity capital} \]
\[ d = \text{market debt to equity ratio} \]
\[ t = \text{tax rate} \]
\[ r = \text{the rate of interest on the debt} \]

According to Greve (2003) a project that can carry its own capital cost and show a positive NPV is positive for the business.

3.9 NPV

The net present value (NPV) is according to Pasqual, Padilla & Jadotte (2012) generally considered superior as criterion for investments, especially by large firms. Since Pasqual, Padilla & Jadotte (2012) demonstrate in their paper that NPV is consistent with other evaluation criteria as internal rate of return (IRR) and net final value (NFV) the NPV criterion could be seen as a good way to measure. To understand the NPV one can define it as “The NPV function measures the increase in net wealth at the moment that would be equivalent to the implementation of the project” (Pasqual, Padilla & Jadotte, 2012 p.206) or in other words, a way to calculate if an investment should be accepted or refused. There is an NPV rule that is used by firm managers “invest if the proposed project’s NPV is positive” (Bodie, Merton & Cleeton, 2009).

To better understand the NPV I will start by describing present value (PV). Calculating the PV is the reverse of calculating future values, how much has to be invested today to have a certain amount in the future. It’s a method to calculate and it takes the interest rate into consideration. The general formula is:

\[ PV = \frac{1}{(1+i)^n} \]

Where 1 is the amount invested with interest rate \( i \) for \( n \) periods. Calculating present values is called discounting, and the interest rate is often called the discount rate (Bodie, Merton & Cleeton, 2009). PV is the base for further calculation with a larger numbers of variables.

The NPV calculation is based on the cash flow in each year as the calculation is based on. To be able to calculate the NPV one need the capitalization rate to use to discount the cash flow, also called the project’s cost of capital (Bodie, Merton & Cleeton, 2009 Pasqual, Padilla & Jadotte 2012). The capitalization rate is the investments requirement to generate profit to the business. The general formula for NPV is:

\[ NPV (k) = \sum_{t=0}^{n} \frac{CF_t}{(1+k)^t} \]

Where \( k \) is the capitalization rate, \( CF \) is cash flow, \( t \) is time for \( n \) periods. Each year’s cash flow is discounted at rate of \( k \).
4 GKN status report

This chapter aims to describe GKN Aerospace current situation against customers and suppliers. I will give a short description on how the supply chain works and what barriers GKN meet. Further on I’ll describe GKN Aerospace suppliers and the procurement process and the internal organization.

4.1 Company presentation

GKN Aerospace engine systems is a company in aerospace business. The main location is in Trollhättan, but they also have affiliated companies in Kongsberg Norway and Newington USA. GKN Aerospace engine systems manufacture components to commercial aerospace, military and space. The plant in Trollhättan has specialised on manufacturing large components to both cold and hot structures to jet engines, mainly used in commercial airplanes. Besides the large component manufacturing, GKN Aerospace also has a service plant where different solutions to the aftermarket are provided, in forms of maintenance, provide spare parts, sales and leasing of jet engines. GKN Aerospace also provides aftermarkets services to the military engine RM12.

In 1930 the aircraft industry started in Trollhättan, Nohab Aircraft was founded. Volvo acquired the business in 1941 and was named Swedish Aircraft, later the name changed to Volvo Aircraft and in 1994 it changed again to Volvo Aero. In the fall of 2012 AB Volvo sold Volvo Aero to GKN. Historically the plant in Trollhättan produced aircraft engines to the Swedish Air Force. During the seventies the military production accounted for 90% of the total turnover and only 10 % for commercial industry. In 2005 less than 10 % of the total turnover was for military and 90% for commercial. Former Volvo Aero is now named GKN Aerospace Engine Systems (GAES) and the plant in Trollhättan is called GKN Aerospace Sweden AB (GAS).

GKN was established in England 1759 and the headquarter is located in Redditch UK. GKN operates four divisions: GKN Driveline, GKN Powder Metallurgy, GKN Aerospace and GKN Land Systems. Approximately 44,000 people work in GKN companies and joint ventures in more than 35 countries.

4.1.1 Operation

GKN Aerospace has 9000 employees and had a sale of £1.481m in 2011. GKN Aerospace operates in three main product areas, aero structures, engine components/sub-systems and special products. GAS in Trollhättan is engaged in the engine components market, and has specialized in four markets segments: components for aircraft engines and gas turbines, military aircraft engines, sub systems for rocket engines and engine services. GKN Aerospace Engine Systems develops and manufactures components for commercial and military aircraft engines and aero derivates gas turbines

4.1.2 Products

GEAS largest market segment is to produce components to large commercial aircrafts, components from GEAS could be found in more than 80% of all aircraft. They have
specialized in complex structures and rotating parts. Figure 8 shows the areas GEAS has in their product range. The technology is quite complex and the material used, especially hot section areas has high requirements.

Fan cases are the biggest component of an aircraft engine and it is located in the front of the engine, it works as protection against fan blade errors and also to directing the air stream. The fan case is a forging, also called ring forging. The fan cases are mainly manufactured at GANE. Fan and compressor structures are manufactured for several different engine programs and are manufactured in forgings of titanium or alloys of stainless steel.

Compressor rotors and shafts are mainly manufactured in forgings of titanium. Compressors are purchased in large forgings and are roughed machined in turning operations. Since there are rotating parts there are high requirements on the material, to secure the quality shafts and compressors non-destructive testing is performed during the manufacturing process.

Combustor structures are in the hot section area of the engine and the place for the combustion. The component parts are precision castings and GKN perform precision milling. The combustor structures have high standards to withstand high temperatures over the entire life cycle.

Low pressure turbine cases are also a ring forging, also located in the hot section area. The part portion shall enclose the turbine and is designed for optimal airflow to generate thrust. LPT cases are produced in high volumes and GKN has a high-tech production flow to meet customer requirements.

Turbine structures are placed directly after the turbine to distribute the air flow to the outlet. GKN has great development experience of turbine exhaust cases, the product is a complex composition of forgings, castings and sheet metal parts welded together.

Figur 8 GKN material
4.2 Procurement at GKN

The procurements for production material at GKN is divided into three separate departments depending on commodity, castings and forgings, commodity machining and fabrications, commodity special components and procurement logistics. The three departments are also supported by resources and competence from a quality and supplier development department. The three departments forgings & castings, machining and fabrication and commodity special components all have a supplier team that includes buyers, supplier quality assure (SQA) and material control. The supplier team has together the overall responsibility for a supplier’s performance. The supplier team takes full responsibility for material cost, deliveries and quality of purchased material in their commodity group. They are also responsible for developing the supply base to meet both present and future needs.

In the procurement organization there is also a department for indirect material, indirect purchasing & purchase improvement (IPS).

Figur 9 organization chart (local GKN material)

4.2.1 Buyers

The buyer owns the commercial questions during the process of either a new contract with a supplier or renegotiation of existing contracts. The buyer also acts as team leader for a supplier team which means that the buyer is also in the process even after a contract has been made. A set up like that could be positive since it is in the buyer’s interest to negotiate a contract that the supplier can deliver against. On the other hand the risk is that the negotiations will not be as tough as it could be since the buyer has to pursue the relationship to the supplier even after a contract is signed.

4.2.2 SQA

The SQA responsibility is to act against the set of requirements to be determined by either technique at GKN or customer. All requirements that affect GKN are stored in internal systems. The requirements is set in different specifications that also tells what the supplier is expected to live up to. Not just in terms of material requirements or process approval but also in what way GKN would like to have the process performed. During the contract negotiation the SQA supports the buyer with expertise. Together
with the team they evaluate the offer from the supplier to make sure the supplier understood the requirements e.g. The SQA has also the responsibility for nonconformance made by suppliers. Together with the department for audit the SQA performs audit at the supplier’s location.

4.2.3 Material control

When the first article is approved the material control responsibility is to assure the delivery to GKN. The material control is a part of the supplier team and has operational responsibility in the material handling process. The tasks are to create, control, update and follow the planned delivery. On a daily basis the role means to have contact with suppliers, follow up when shipments were sent, what transportation modes were chosen. They follow safety stock levels at suppliers and at GAS, if the levels is to low at the supplier’s special handling plans might be necessary. As a lead in the new owners strategy the safety stock has been reduced, the effect of that change has not been visualized yet since it was not so very long ago.

If the supplier is late in schedule the material control might need to order special shipment to secure the production at GKN. Another scenario which is not unusual is when production at GAS makes an order in past time, meaning they need the detail faster than the lead time. To minimize the effect and risk of stopped production the material controller can make an airfreight shipment. The role also means to follow up the tied up capital in raw material cycle. The material controller owns the material from when the supplier makes a delivery registration in the EDI until the production takes the material out of stock.

Each material controller is measured in their working capital and what level they carry. Even though there is focus on working capital the service level and delivery precision is superior to ensure the production.

The order size is controlled by the material control, the respondents argues that it is difficult to use formulas to calculate the optimal order size since there is great value on each detail. Instead the order size is a compromise between optimal size, transport lead time and the packing instruction. It is set to a size when the purchase order is sent to the supplier, in accordance with the predicted weekly demand. For example if the weekly demand is ten details and for some reason GAS needs some extra for a week, then an extra ten need to be ordered since that’s how the packing instruction is set. The packing instruction is approved by GAS since with a FCA agreement GAS owns the material during transport. According to quality respondents a packing instruction in forms of number if details don’t need to be approved by GAS if the supplier owns the material during transport.

4.3 GKN Supplier base

The supplier base of production material could be divided into four groups, casting, forging, fabrication components and special parts. All acquired material regardless group has high requirement in both aspects of quality and technology and needs to be approved by the final customer. Criteria like this make all changes in the supplier base quite difficult to make. Since every supplier needs to be approved the process is demanding in terms of time and cost. The ability to change supplier is due to the
complexity of the part. Castings and forgings have a complex manufacturing process which makes it hard to change supplier.

Forgings at GKN is purchased in forms of rings and disk, rings are large components as low pressure turbine (LPT) cases. A disc forging is rotating parts and have high requirements on quality but the process isn’t as complex as the castings. But since there still is strict requirements it’s difficult to find suppliers that can fulfill the quality requirements for disc forgings. Ring forgings are a static part on the engine which lowers the requirements, that’s gives a greater opportunity to widen the supplier base. Historically GKN has purchased the required forgings from a few big actors mainly in north America but the last years they have expanded the co-operation with other companies both in Europe, Asia and south America.

The casting market is affected of one large supplier that has close to a monopoly position on the market. Even though GKN is one of the five companies in the world in acquire of castings they meet a large actor that dictates the terms. This large actor has grown through acquisition of other companies, also companies working with forgings. Alliances between business in the casting and forging areas are two identified risks in the supplier base. When a supplier to GKN is purchased by another business the relationship changes. There is also a risk that a former supplier suddenly becomes a competitor. One can say that this has happened when Volvo Aero was acquired by GKN. So far no negative effects have been identified but as time goes maybe some relationships to suppliers change.

### 4.4 External logistics

GAS buys all production material from the suppliers loading dock. Today GAS uses the FCA incoterm for production material, GAS carries the risk during the transportation. The transporters are provided by GAS to the suppliers loading dock. To administrate this GAS has a contract with Volvo Logistics (VLC) to handle the transport. When GAS was a part of AB Volvo there was a policy that the logistic cost should be reduced through economies of scale and larger procurements of contracts. The contract with VLC was recently renegotiated and a contract was signed for another three years. VLC is acting as a third part and has the responsibility to cooperate the transports to GAS and the procurement of logistic services. The main reason for GAS to use FCA is the ability to control incoming transports to reduce the amount of incoming trucks to the goods receives at GAS.

The negative aspects of FCA are the tied up capital, transport cost and risk, since the ownership transfer to GAS at the suppliers loading dock. In fact the working capital starts to count when the supplier register the goods in EDI and that could be one to three days before the goods are collected by GAS transporter. FCA also means that GAS carries the cost for transportation and carries the risk during the transport.
The alternative to FCA would be DAP, then the suppliers take the complete responsibility and cost for the transport, working capital, and insurance. The customs clearance would be the same as used at GAS today. If DAP was used working capital would be reduced.

For example one can review the logistic set up from a typical supplier on the west coast in North America. The lead time for the transportation is 45 days and that’s the optimal time for sea transport, even though GAS often suffers of delays. For example a ship from America is reloaded outside of Amsterdam for further transport to Gothenburg, if the ship misses reloading time the delivery is delayed by a week when the next ship departs. The same issue can occur in inland carriage with train. Each delay lengthens the time of working capital for GAS.

The goods begin their journey with a two days long inland carriage, the goods receive at a hub consolidation and for a further six days long train transport to the east coast. There it’s reloaded to for 32 days long sea transportation. When the ship arrives at Gothenburg harbor there are four days of port handling and then one final day of inland carriage to GAS.

With a DAP solution GAS would lower the tied up capital with 45 days. DAP has some negative aspect as well, one is that the control of the shipment is lost. Suppliers will be able to hire its own carrier, which results in an increased flow of shipments to GAS.
4.4.1 Information

The information between GAS and the suppliers for the orders and material control communicates in a program called web-EDI. Depending on GAS material need GAS places orders in EDI, the information is shown immediately at the suppliers. To reduce the bullwhip effect there is different deadlines in the lead time of an order where changes can be done. There is a firm zone where the quantities and delivery dates are fixed, then there is a trade off zone where GAS can change the parameters the delivery date and size can be changed, this is to reduce the fluctuation in the supply chain.

GAS has suffered from fluctuations as a supplier when their customers have made late changes in the orders, especially since the aircraft industry has suffered from economic recession. To reduce this an agreement has been signed with the biggest customers that GAS has no obligation to fulfill changes that customers makes within GAS production lead time and the suppliers firm zone. This arrangement hopefully reduces both the bullwhip effect at GAS and in the supply chain. In the interviews several interviewers has expressed thoughts about this, the new setup is good but also there is suggested that the best way to get a smooth supply chain is to reduce disturbances in the GAS production. Every time something goes wrong internally at GAS and the schedules changes or deliveries gets late there is a disturbance in the relationship which leads to uncertainty about future deliveries.

4.4.2 Transport

VLC is the transport partner that GAS uses. The material control places an order at VLC when a shipment should be performed. The contract allows GAS to use other freight forwarders and also the suppliers to find a transporter if they want.
The past year GAS has suffered of great delays in the inbound material due to delays in the transport. Specially the shipment over sea has been and still is a problem. The transport lead time is set to 45 day even though the lead time could be one to three weeks longer.

According to the VLC contract GAS has the opportunity to claim the transport either with cost reductions or penalty fees. My research shows that GAS never claims any transport.

Most of the forgings are shipped by boat with long transport lead time, this tie up capital during a long time but instead the transport price is cheaper. Several respondents meant that there is a contradiction between transport way and tied up capital. Airfreight is expensive, but the time of tied up capital during transport is short.

**4.5 Goods receive and customs handling**

When the goods arrive at GAS by truck the goods receive department has three days to perform their tasks before the goods should be in the pre production stock. The activities that they should perform before the goods are approved. The suppliers invoice is checked against the shipment and when it´s approved the invoice is approved to be paid. The goods and documentation are also checked from a quality aspect. Unfortunately poor quality on received goods is a problem.

GAS has a program that is called ASRA, it means that details are approved by GAS educated staff at suppliers location. If an ASRA represent has approved the product and documentation it has Full release status, meaning GAS could send direct to production. A detail that arrives to GAS with errors results in an escape that the supplier is responsible for. Each nonconformance is reported and all suppliers are measured with different kinds of quality indicators.

Approximately 15 percent of material from suppliers is shipped on drop ship. That means the supplier is approved to send material direct to GAS customers without passing GAS. There is still GAS that has the responsibility if there occurs a quality nonconformance on drop ship products.

**4.5.1 Custom handling process**

At GAS there is a process that approves them to take care of the custom clarification. This means that all goods that received duty unpaid.
As shown in the figure the goods arrive inside the EU border to a custom warehouse. That warehouse has to be approved by customs to issue something called T1, a declaration report. Then the goods are sent to GAS where staff check the shipment and before it is unloaded from the truck the transit should be ended and reported to the Swedish customs. Depending on the goods, final customer the tax and duty fee is paid immediately. If the goods are exported to a third country, no fees are paid.

4.6 Measurement performances

When Volvo was the owner, CCC days were one of the most important measurement performances. Each month the CCC days were calculated and communicated to the organization. The CCC days were also a part of the company bonus that all employees were a part of. A part in the goal to reduce the CCC days was to get as at least 90 days in payment terms, long accounts payable gives lower CCC. One of the respondents means that CCC was a good metric to get an overall view of the tied up capital and the activities that were made to reduce the CCC. If the production made a change that affected the stock before production is was immediately detected, the risk for sub optimization was low since it could easily be detected. Now there is no connection between the raw material cycle, work in progress and the finished goods.

When GKN acquired the business they have the same focus on the overall CCC. There is still focus but on each single part of the cycle and mainly the inventory. The tied up capital should be reduced. As one respondent said, there are “war on raw” and “inventory is evil”. As a lead in that there is not the same focus on payment days now. GKN nowadays doesn’t have the same requirement that there should be 90 days minimum of accounts payable. In the interviews respondents mean that this gives the opportunity to negotiate with the payment terms.
ROA is nowadays a higher standing performance measurement at GKN than CCC, GKN consider it to be a good measurement to visualize the assets in relevance to maximized profit that is the main goal.

4.7 Suppliers point of view
Changed incoterms gives affect not only to GAS but also the suppliers, it’s important to think about how it affect them. During the interviews some areas have been identified and I will present them further on.

4.7.1 Transport
Depending on supplier there is different knowledge in the shipping activity. Some suppliers have experiences sending goods domestic and have their own freight carriers to collaborate with. Others don’t have the knowledge of sending goods abroad and might be concerned about negotiating freight carriers. A small supplier that doesn’t send a big amount of goods doesn’t have the same opportunity to negotiate deals that gives low price which in the end affect GAS.

4.7.2 Business performances
Other areas identified during the interviews are the measurement performance at the suppliers. One of the identified vendors for DAP solution measures sales and cash flow for every quarter. In the end of a quarter there is typically that the suppliers contact GAS to secure that invoice gets paid in the right quarter.

Depending on the metrics used by the supplier, they may choose to have low tied up capital by transporting by air or have low transportation cost by ocean freight.
5 Analysis

This chapter analyses the empire and discusses the identified risks and possibilities with changed Incoterms. In the end I present the risks and opportunities.

5.1 Calculation

The current strategy at GAS is to keep a stock before production and the suppliers is set to keep a safety stock at their plant, even though it seems like the suppliers having trouble to keep the safety stock levels.

With a DAP incoterm solution the suppliers owns the material during the transportation until the goods receive at GAS dock. They also carry the risk during the transport. The win for GAS is reduced tied up capital during the lead time for transport. As a lead in the evaluation I have identified two potential suppliers where DAP could be interesting. The reasons are the products and the transport. The suppliers deliver forgings and the transport is made by ship. The inventory from these two suppliers is 38% of the total stock before production. The high value of the stock from these suppliers gives a good opportunity to evaluate the effects of changed ownership.

In my research question I state that I would like to investigate if there is a bottom line effect with changed incoterms. To be able to determine the bottom line effect I have made a calculation. The calculation is based on a cash flow diagram where I calculate the NPV that gives a number that tells if the change is profitable or not. To calculate the NPV I use the discount rate 12% given by GKN. The amount of years the calculation is based on could be discussed since there is a huge effect in year two the NPV gets higher if it’s calculated in few years. The variables I have taken into consideration in the calculation are cost of renegotiation, cost of reduced payment terms, increased prices, transport costs, tide up capital at sea and safety stock.

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Table 1

As shown in table 1 I get a negative NPV, the calculation is made whit the ideal lead time of transport 45 days. As stated earlier in the report 45 days of transport is not often fulfilled why I also will present another calculation further down. In table 1 I have calculated with a renegotiation cost of 200 000 sek and reduced payment terms of 10 days. The prices increase is an estimate in what level could be acceptable and still find a positive NPV. In this example I have calculated with 5.0% and the first year it is the half in increased cost. The positive cash flows come from reduced tied up capital and the loss of transport costs. I have also calculated with an increasing safety stock for the first two years, since the production has to be secured I suggest that increase before the
change is working smoothly. If 45 days in transport lead time could be fulfilled the safety stock could be lowered. In table 1 there is a negative NPV with only 5.0% of price increase.

What happens then if there is a time period of 60 days instead, in fact that transport lead time is not unusual.

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Table 2

The change gives a positive NPV.

I also tested the effect of giving the supplier ability that GAS still pays for transport and lower the payment terms as much as the days they have to own the capital. That is to avoid increase in price. If GAS still pays for transport the price increase acceptable before a negative NPV is received is only 1.8%.

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Table 3

5.2 Measurement performance

ROA denominator is the average total assets, in the balance sheet there will be a lower number to calculate with since the average assets will decrease if the ownership will be delayed. When ROA is used as a key measurement it gives a percentage number that is preferable to get as high as possible.

According to the finance department at GAS the CCC key measurement is no longer the priority measurement. That gives the opportunity to use the payment days to negotiate with suppliers. Suppose a supplier has 90 days end of month, that means that the average payment days is 105. If a supplier should take greater responsibility for transport and ownership of the goods it is likely they will demand to get paid faster. If the payment days decrease the CCC days will increase. The best effect from a CCC point of view is when the ownership is delayed but the payment days remain according
to Özbayrak and Akgün (2005). During the interviews it was suggested that the payment days could be reduced with the same amount as the suppliers own the material longer with DAP, the effect on CCC would then be completely absent. The effect on ROA would still remain though.

5.3 Logistic efficiency

Lumsden (2006) presented the logistic target mix earlier that I earlier described were components as delivery service, tied up capital and logistic cost were discussed.

5.3.1 Delivery service

At GAS the superior metrics for material control is service level and delivery precision, as I can see a change to DAP mainly affects the tied up capital in a positive matters. Lumsden (2005) argue that changing on factor also affects the others. Since the delivery criteria is higher at GAS I would say that before changing anything in the logistic set up it’s important to secure that the suppliers still can fulfill the delivery criteria. During the interviews concerns were raised about changing one factor before securing the others. In several of my interviews the respondents were concerned about the delivery service with a DAP solution.

If GAS makes an error in their own production there is a possibility to make a new order or to secure production or special treat a shipment and send it by air instead to reduce the delivery lead time. If the supplier is in charge over the shipment and GAS don’t have the same knowledge as today this opportunity to reduce production stop might risk carrying greater costs.

5.3.2 Logistic cost

With a full DAP solution the logistic cost would set to a significant lower level. The suppliers would use their own transporter etc. but on the other hand that cost would be set to the product price instead. My assessment is that the cost will not only be at the same level but also with a price increase for profit. With a new set up there is also necessary to make a new judgment about the safety stock since the lead time might change.

The cost for warehousing will stay the same or might increase with the higher safety stock. Although if a evaluation show that no safety stock in necessary the warehousing cost will remain the same. The number of orders placed to suppliers won’t change with DAP and thereby the ordering cost will stay the same. But the handling cost for each delivery risk to increase. Every inbound transport has a cost with handling of the goods. The delivery should be unload, make the custom clarification and goods receive control. With a higher number of inbound transports the cost will increase.

5.3.3 Tied up capital

Evaluation of a DAP solution compared to FCA clearly shows that the tied up capital would be reduced. This is because of that the average stock would decrease and thereby the tied up capital. Also the goods in transit would be eliminated from the suppliers with DAP since the suppliers owns the goods. Since the calculation of tied up capital in days in transit has days in transit as a factor and those will be eliminated.
5.4 Suppliers

During the interviews question how the suppliers would react on a DAP solution. As one respondent says sales performance at suppliers could be an issue. Since they measure sales performance there might be a problem in month and quarter when the change between FCA and DAP is made. For example if the forecast for sale is set to amount for a quarter and the sales get delayed because of the new setup. This occurs since the time of changed ownership of the goods changes from supplier to GAS. If the payment days reduce it will help but still there will be a delay.

Also the suppliers knowledge in exporting material and their contact with transporters. The ability to send material is important to secure at a supplier. If DAP is used it is the suppliers responsibility to secure delivery at a give time at GAS loading dock. But if the delivery is late either in goods in transit or custom GAS have to rely on the supplier to solve the problem. There by its also important to change the place where delivery precision is measured, from the suppliers loading dock to GAS. As I stated earlier GAS still will handle the material control. Questions have been raised during the interviews whether the suppliers will agree to own the material but not have control over the logistic flow and planning.

Since GAS has a special custom handling process the transporter chosen by the supplier has to be able to issue a T1.

5.5 Opportunities and risks

Opportunities

The opportunity with DAP is the possibility to reduce the tied up capital in goods in transit.

Suppliers could find a fright carrier that transport to a lower price than VLC.

Limitations

The by suppliers chosen fright carrier has to be able to issue a T1 when the goods arrive inside EU. Not all suppliers have the knowledge and capability to send goods domestic. The delivery precision has to be changed from suppliers dock to GAS dock instead.

Since the shipments over sea has varied in lead time the negotiation will be very complicated, if GAS can’t say how long time the transport takes it will be difficult to negotiate the payment terms. If the suppliers don’t know when the goods will arrive at GAS, they will have trouble making sales forecasts because the invoice is cleared at GAS and the payment days starts to count.

The suppliers ability to export material.

Potential positive effects

GAS reduces their tied up capital which means that they can participate in RRSP or grow both organic and thru acquisition of other companies. No goods in transit.

The suppliers can produce by them controlled batch sizes. The reason is that they can plan to optimize their production, if they also had control over the material control they had full potential to control their production and supply flow.
Potential negative effects

The shipments to GAS loading dock will increase if the suppliers use their own freight carrier.

At GAS there is concern about losing control over the material control. That also raising questions how to visualize the cost of transport.

The inbound transportations will increase since the supplier’s won’t collect the transport as VLC.

The suppliers get delayed sales on the quarter when the implementation is made.

Material control doesn’t have the same ability to order in past time.

The ownership changes at GAS loading dock. The suppliers will have trouble knowing how long their transports lead time will be, it is also hard knowing when they will get the invoice paid.
7 Conclusion

This chapter presents the report's conclusions by answering the initial research questions. I discuss around the conclusions and give some recommendations and suggest further research.

In what way do changed incoterms from suppliers affects GKN on a bottom line effect compared with FCA agreements that is used today?

When AB Volvo was the owner of Volvo Aero the key factors was to have low CCC, and the payment terms was one of the most important factors. GKN has a completely different point of view in how to run the company. If there is a saving that gives a positive effect in the balance sheet and on the result then it should be executed. In my research I have compared the NPV in the calculation to see if the DAP incoterm gives a positive bottom line effect. The calculation shows that just a few percentages in price increase give a negative NPV. I can’t find any bottom line effect in changed incoterm. In fact since it is just savings in the first year I find no reason from that aspect.

If the ROA indicator is superior there could be an idea to change to DAP, but it is important to take the risk identified into consideration before making that decision.

What risks could be identified when the incoterms changes?

The ownership of the goods is interesting, especially since the goods at GAS carry a great value. Generally the actor that has the lowest IRR should own the capital. If the suppliers owns the goods they will claim compensation for their increase in capital cost, probably price increase and fewer days in payment terms.

GKN will have an increasing flow of inbound transports. There is a risk of sub optimization with DAP, the cost of goods receive risks to increase when the transports have to be unloaded.

To secure the stock availability to production it might be necessary to extend the safety stock during an implementation period which is increasing costs as well.

There has to be an agreement of lead time in case of changes in production, especially since there is problem in the shipment lead time today. There has to be a signed agreement regulating who carries the cost if a delivery out of schedule.

Recommendation

The objective for GKN is to reduce the tied up capital, according to Lumsden (2006) one way is to reduce lead time. The last year has GAS suffered from late shipment due to the transporter. I recommend that before GAS takes any action towards their suppliers secure the lead time towards VLC. The contract makes it possible to claim late transports. If all late transports would be delivered in time it would help GAS to have a secure production. The material control could spend their time on other important tasks. It’s also necessary to have control on all part of the delivery process, nothing in my study shows that the transport problem would be better with changed incoterm.

To overcome the obstacle with a increasing number of inbound transport I suggest to investigate if the delivery address could be set to a terminal that collects the goods and later on send it to GAS.
I give the recommendation to evaluate if DAP could be combined with consignation warehouse. The potential risks identified might be reduced with a supplier managed warehouse. There might be a better “Win-Win” situation with a consignment stock, GAS reduces the tied up capital and the suppliers lower their warehousing cost. The consignment warehouse also avoids the problem with insecure transport lead time. The supplier is then responsible to keep a minimum level in stock. According Bragilia, Gabbrielli & Zammori (2013) suppliers with market power could find this solution attractive since they can reduce their stock holding cost. The authors argue that the set up cost also could be minimized for the supplier.

The calculation gives an indication on how big increase in prices GAS can approve. I suggest that GAS contact the suppliers and discuss the situation and compare their suggested prices increase. The decision is a management question and the possibility to free capital has to be compared with the prices increase and the identified risk. The main question is whether reduced tied up capital is worth more than shorter payment days and higher ROA.
Glossary

This part aims to be a help for the reader to simply find the meaning of abbreviation.

ARD – Accounts Receivable Cycle
APD – Accounts Payable Cycle
CCC – Cash Conversion Cycle
DAP – Delivered At Place
EDI- Electronic Data Interchange
FCA – Free Carrier Agreement
FGS – Finished Goods Stock
GAES – GKN Aerospace Engine Systems
GAN- GKN Aerospace Norway
GANE- GKN Aerospace Newington
GAS – GKN Aerospace Sweden AB
ICD – Inventory Conversion Cycle
JIT – Just In Time
NPV- Net Present Value
OEM – Original Equipment Manufacturer
OMS – Operational Management System
PV- Present Value
RMS – Raw Material Stock
SQA – Supplier Quality Assurance
TPL – Third Party Logistics
VLC – Volvo Logistics
VMI – Vendor Managed Inventory
VMR – Vendor Managed Replenishment
WACC- Weighted Average Cost of Capital
WIP – Work In Progress
Bibliography


Merriam, S. B. (1998) Qualitative Research and Case Study Applications in Education - Revised and Expanded from Case Study Research. Jossey-Bass Publisher: San Francisco, USA


**Oral references**

Agneta Aglund, Director Purchasing Logistics and Commodity Special Components
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Sean Tobin, Material Control 2013-05-03
Staffan Svensson, Senior Vice President, Procurement 2013-05-08
Appendix

*Interview guide material control*

Could you please describe the supply chain between supplier X and Y?
How long is the transport lead time?
How long is the overall lead time?
When does the tied up capital start to effect GKN?
Is fluctuations in SC a problem against your suppliers?
For how long does the goods stay at the goods receive?
When gets the goods released to the production?
Dose the transport lead time counts as safety stock?
What measurement performances do you report to?
Which factors is the most important to receive material in time?
In which area do you see the greatest improvements possibilities?
Why do GKN purchase the goods from the suppliers loading dock?
Could a changed incoterm give a positive effect in the material flow?
What is the greatest advantage with DAP incoterm?
What is the biggest risk with a DAP solution?

*Further questions to respondent with knowledge with contract*

Could you please describe the setup with VLC?
Is there a strategy to reduce the collaboration with them?
Do you have the ability to claim their service?
Do you charge back anything to VLC?
Could you please describe the suppliers responsibility in the packing process.
Interview guide finance

What discount rate do GKN use?
How do you calculate it?
How do you calculate the inventory rate?
How do you measure the tied up capital?
Do you calculate with the purchase price or cost of sold goods to calculate RMC?
Could you please describe the CCC?
Which factors in CCC is most important to work on to lower the CCC?
Could you identify any sub optimizing risk with CCC?
Is there a point to lower the payment days with the same amount of days that GKN don’t need to own the material?
What is your opinion on ROA?
Interview guide purchasing

Could you describe your responsibilities?
Could you describe the trends in the business and the effect on GKN?
How do you see the future?
Could you please describe the long term purchasing strategy?
Is there a special strategy for forgings?
There are quite few suppliers on forgings, how does that effect GKN?
What is the advantages with DAP?
What is most negative with FCA?
What is your experience of consignment stock?
What is the risk with changed incoterms?
Which area is most important for you to perform your work?
Interview guide quality

Could you describe the quality department responsibility against the suppliers?

What quality segments is the most critical today?

Do full release work satisfying?

According to you what is the main areas that the suppliers needs to get knowledge about if they would be responsible for the transport?

From a quality point of view, what is the greatest advantage with FCA?

From a quality point of view, what is the greatest advantage with DAP?

Is there any other quality aspects that has to be taken into consideration with a DAP solution?
Interview guide goods receive

Could you describe the customs process?
Which could issue T1?
What incoterms do GKN use today?
What is the advantages with DAP?
What is most negative with FCA?
Is DAP possible to interact with DAP?

Interview guide contracts

Is there possible to renegotiate existing contracts with FCA agreement to DAP?
What is the risk with changing existing contracts?
What cost could you identify with a renegotiation?
What advantage in the contracts negotiation could you identify with DAP incoterm?
What risk in the contracts negotiation could you identify with DAP incoterm?