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MANUFACTURING STRATEGY

a Case Study for

AvestaPolarit

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If we knew what we are doing, it would not be called research, would it? (Albert Einstein)

Alas, to express our gratitude towards all people involved in the completion of this thesis is infeasible. Nevertheless, we start with the recognition of the people at the AvestaPolarit Hot Rolled Plate Business Unit in Sweden that made this study possible. In this, we would particularly like to mention the invaluable initiative of Robert van der Woude.

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Finally, words could not express our deepest gratitude to our family, especially to our girlfriends Karoline and Marie, for their love, patience, support, favours and all the other things that make it so worthwhile to know them.

Göteborg in January 2004

Fredrik Axelsson & Guido Jeifetz

ABSTRACT

AvestaPolarit's Hot Rolled Plate produces stainless steel plates. The business unit does not compete by having the lowest prices. Instead, it does so by offering high reliability concerning quality and delivery lead-times. The company's supply chain has changed vastly over the past year, ever since the company took over TKN and the production of slabs (raw material) moved to England. This in turn emphasized the importance of having the right level and structure of stock for offering the high level of service. In the light of these new challenges, AvestaPolarit entrusted the authors with a project aiming to construct a framework for gaining an understanding of the *postponement/speculation strategy* decision.

The purpose of this master thesis was to evaluate and determine HRP's preferable postponement/speculation strategy. This was performed in view of HRP's new supply chain, increased customer requirements and competitive focus. Moreover, the effect that customer demand information (forecast and orders) and internal linkage between the departments pose on the P/S strategy decision and thus in the determination of the location of the CODP, was also researched.

A case study research, at the Hot Rolled Plate, was performed to fulfil the purpose. The aim was to collect relevant information for the purpose at hand. Unstructured interviews with managers from different departments were the main source of information. These were supported by in field observations, and documentation to some extent.

Sufficient evidence was found for recommending a manufacturing to stock / manufacturing to order strategy. Furthermore, indication was found to assert that internal linkage is a prerequisite for a successful implementation of this strategy.

CONTENTS

1
INTRODUCTION

The introduction presents the background of the research field for this thesis. Further, the researched company's historical background and today's challenges are portrayed. This serves as an opening for the problem description and the purpose, which, are next formulated. Finally, the selected structure and outline is presented.

1.1 BACKGROUND

The objective, most commonly ascribed to firms in economic analyses is profit maximisation (i.e. Milgrom and Roberts, 1992, pp. 40-41). Production economics is central when it comes to accomplishing this (Rudberg, 2002, p. 11). Production is looked at as the entire set of operations, manufacturing included, needed to support the creation of a product. In contrast, economics in manufacturing focuses on various allocation problems, in particular on the optimal use of productive resources within production. In this fashion, *manufacturing strategy* is a crucial component of the company's strategies, including a set of well-coordinated and structured approaches to establish objectives and actions programs aimed at ensuring a lasting advantage over competitors (Fine and Hax, 1985). In like manner, it should be in harmony with the company's overall strategies, as well with other functional strategies (Fine and Hax, 1985) so that the economics of production make the manufacturing company competitive (Rudberg, 2002, p. 11). Via the discovery of a company's environment (market, customers, etc.) it is possible to settle a fusion of priorities that should be focused upon when generating products (Rudberg, 2002, p. 11). Nevertheless, to be competitive a company must also understand which decisions have to be made along with the effects of those so that the production is executed

economically (Rudberg, 2002). Furthermore, this picture would be incomplete without understanding the financial consequences of these decisions and the restriction that will impose on the company's ability to make money. Rudberg (2002) defines the aim of manufacturing strategy research as the "*…establishment of a structured framework so that the right decisions are made to fulfil the manufacturing task and thereby deliver competitive products, which in turn offers possibilities for the manufacturing company to make money*" (p. 11).

The foundation for the research problem is a project entrusted by AvestaPolarit's Hot Rolled Plate Business Unit located in Degerfors, Sweden (Appendix 1). This project will be investigated by means of manufacturing strategy.

Next, a short presentation of AvestaPolarit's history and current situation is given.

1.2 AVESTAPOLARIT

The history of the metal industry in Degerfors dates back some 340 years (Jansson, 2002, pp. 15-22). George Camitz, a German nobleman, came to Sweden in the company of Swedish soldiers who had participated in the Thirty Year War. An officer in the Swedish army was impressed by Camitz's skills in metalwork and asked him to come to Sweden to practice his profession, an invitation that the German nobleman could not refuse. George Camitz started to serve under Queen Kristina, and during the winter of 1649, discovered the powerful stream of the river *Letälven*, in the region of *Värmland*. He promptly understood the potential of it as a power source, and in 1660, the first iron hammer was built, driven by waterpower from the 17-meter high *Sveafallen* waterfall in Letälven. The village of *Degerfors* started to develop around this iron hammer, as the demand for labour increased. Over the time, the iron hammer turned into two hammers, which turned into an iron mill. George Camitz died in

1687, but the mill stayed in his family's possession until 1843. Since that date, the mill was owned many proprietors. The iron industry had its vicissitudes and during some phases, the employees worked without salary in order to save the mill. The most famous owner during this period is Hans von Kantzow, who started the legendary football club *Degerfors IF* in 1907. During World War II Uddeholm purchased the ironworks in Degerfors and following several harsh years the ironworks was bought by Nyby-Uddeholm, which merged with Avesta in 1984. Later in 1992, Avesta merged with British Steel Stainless, the company that discovered the original composition of stainless steel. This fusion gave birth to Avesta-Sheffield (Jansson, 2002, pp. 15-22).

Today AvestaPolarit is the owner of the ironworks in Degerfors. AvestaPolarit is the result of the merger between the Swedish-British company Avesta-Sheffield and the Finnish Outokumpu's stainless steel division. This merger took place in January 2001. The most relevant motive for this merger was the strategic complementariness in terms of Outokumpu's cost efficiency and Avesta-Sheffield's broad product line and distribution network (AvestaPolarit, 2001a, p. 3). Currently AvestaPolarit employs around 9 200 people and reported net sales of approximately EUR 3 billion in 2002 (http://www.avestapolarit.com).

AvestaPolarit's exclusively operates on the business-to-business (Dwyer and Tanner, 2002, p. 6) stainless steel market. This material is durable, virtually free of maintenance, hygienic, lightweight, elastic, and fully recyclable. Additionally, this market is the fastest growing metal market in the world (http://www.avestapolarit.com).

In the remainder of this thesis, Hot Rolled Plate in Degerfors and AvestaPolarit will be treated as synonyms.

1.3 DESCRIPTION OF THE RESEARCH PROBLEM

AvestaPolarit Hot Rolled Plate, HRP for short, is a business unit of AvestaPolarit AB that produces, markets and sells stainless steel plates. The Logistic Department at HRP is responsible for the whole supply chain, from the purchasing of raw materials to the product distribution.

Effective management of a supply chain includes thinking creatively about how to integrate and perform logistics, manufacturing and marketing activities. In other words, it implies linking the business resources and the customer requirements through the logistics function to ensure goal achievement. Postponement and speculation strategies offer opportunities to achieve the delivery of products in a timely and cost-effective manner without forgoing customer requirements. This is done by, rearranging the conventional logistics, manufacturing and marketing dependence, which are often designed and managed autonomously.

The logic behind postponement is that risk and uncertainty costs are tied to the differentiation (form and time) of goods that occurs during the logistics and manufacturing operations. The risk of those operations can be reduced or fully eliminated by postponing the manufacturing and logistics operations until a final customer commitment has been obtained. Furthermore, a postponement strategy supports a high degree of customisation and enables the maintenance of low levels of inventories. Conversely, the disadvantages of this strategy are long lead-times, low reliability and highly complex production optimisation.

The converse concept of postponement is speculation, which means that the differentiation of goods should be made as early as possible and then be stored until a final customer commitment has been obtained. Speculation strategy makes it possible to reduce the lead-time to customers and also increases the manufacturing efficiency. However, it increases the level of production uncertainty, reduces the possibility of product customisation and increases the level of inventory.

HRP's interest in studying the postponement/speculation (P/S) problem in depth arose from the realisation that a simple rule of the thumb to decide the P/S strategy would not necessarily solve their problem. Currently, the customers' orders are "pushed" through the system, which resembles a postponement strategy, and there is a lack of reliability in the determination of the time when the products will be ready for delivery. This turned out to be an important issue since HRP's main competitive advantage is short and reliable delivery lead-time. Moreover, no system is in place for making the P/S decision, in the words of the Logistic Department Manager "it just happens".

HRP anticipated that a theoretical study of what is essentially a practical problem, would help them to understand the problem and enable them to evaluate which P/S strategy would solve their production strategy problem. By having a more reliable instrument for deciding which P\S strategy to use, they could for example reduce their delivery time, increase their capacity utilisation and better assess their production planning policy. Moreover, it could enable them to determine a stock structure, which permits HRP to offer an improved level of customer service, while aiding the production process optimisation.
Furthermore, they were interested in studying how the customers demand information (forecasts and orders) and how the internal linkage between the departments might affect the level of uncertainty of the P/S decision and thus the location of the Customer Order Decoupling Point (CODP). The CODP is the point in the manufacturing supply chain, which separates the activities that are performed under a postponement strategy from those that are performed under a speculation strategy.

The relevance of HRP's problem grew over the past year since HRP took over the German Quarto Plate ironworks TKN and the production of slabs (raw material) moved from Sweden to England. These events, together with an increased customer requirement, resulted in a more complex supply chain with a consequently increased production lead-

time, decreased capacity optimisation, decreased delivery reliability and increased complexity regarding raw material handling.

The conclusions and recommendations presented in chapters five and six, respectively, are based on solution concepts from manufacturing strategy theory investigated in chapter three. Such concepts were chosen in order to implicitly reflect the influence on P/S strategy decisions of customer demand information and departmental linkage.

Among other things, the application of manufacturing strategy theory, allows evaluating the linkage between HRP's departments by benchmarking it with the one described by this theory. Moreover, the CODP, which is an issue within manufacturing strategy, deals with the factors that should be considered for choosing the correct P/S strategy. Those are the market, customer, product, and production related factors. These factors need to be considered for solving HRP's problem of choosing the most preferable P/S strategy and at the same time locate the position of the CODP that better balances the production lead-time with the delivery lead-time. A further instrument is the uncertainty cube. This graphic tool allows one to depict a more complete picture regarding customer demand as well as helping to describe the importance of a well functioning internal linkage for making a P/S decision as the one that the HRP is confronting. Furthermore, these factors are used for understanding the strategic implications of a shift of P/S strategy.

The aim is to demonstrate the results that might be obtained by applying concepts from manufacturing strategy theory, to the problem of HRP, and to offer a method that could be used to analyse their problem.

The data collection for this study took place mainly during weeks 45, 46, and 47 of 2003. Therefore, the description on chapter 4 refers to the situation as it was at the time, and expressions such as now should be interpreted as in that time.

1.4 PURPOSE

The purpose of this master thesis is threefold:

- The first objective is to evaluate and determine HRP's preferable postponement/speculation strategy. This evaluation is performed in view of HRP's new supply chain, increased customer requirements and competitive focus. Moreover, the recommended P/S strategy should support HRP's competitive priorities.

- The second objective is to investigate the effect that customer demand information (forecast and orders) and internal linkage between the departments pose on the P/S strategy decision and thus in the determination of the location of the CODP.

- Third, the interaction between the first and second objective is going to be investigated as a way to proportionate a recommendation for HRP that would allow them to understand their problem.

1.5 OUTLINE

The structure and outline of this master thesis follows the formation of research papers in business and management studies, recommended in the book *Academic Writing: A University Writing Course* (Björk and Räisänen, 2003, pp. 335-360). Some modifications of this outline were made for improving the logic of the structure in this thesis.

The citation system also follows the system recommended by Björk and Räisänen (2003, pp. 343-344). The reference list is located at the end of the thesis and includes the sources of information that have been considered and evaluated when writing (Eriksson and Wiedersheim-Paul, 1997, pp. 141-142).

The master thesis contains six chapters, which are briefly presented next:

1 INTRODUCTION

The introduction presents the background of the research field for this thesis. Further, the researched company's historical background and today's challenges are portrayed. This serves as an opening for the problem description and the purpose, which, are next formulated. Finally, the selected structure and outline is presented.

2 RESEARCH METHOD

This chapter portrays the research method applied in the thesis. The starting point for this is the design of the study. Next, the method for collecting secondary data is presented followed by a section treating the collection of primary data. Last, the analysis of secondary and primary data is discussed.

3 MANUFACTURING STRATEGY

Chapter three presents the theoretical framework that has been investigated with the intent to cope with the purpose of this master thesis.

4 RESEARCH FINDINGS

Chapter four is a description of the present situation at AvestaPolarit in Degerfors, which is founded on the research findings attained from the case study made at the company. The findings are a summary and an interpretation of the interviews, supported by observations and documents to some extent. The study focused on four departments at the company.

5 DISCUSSION AND CONCLUSION

Chapter five synthesises the analytic findings made in chapter three and the research findings. It is in this chapter that the normative theory and the descriptive case study will be analysed and evaluated

simultaneously in the form of a discussion, which generates the conclusions made.

6 RECOMMENDATION

The last chapter presents the recommendation to the logistic manager, Robert van der Woude, at AvestaPolarit. This is a framework constructed from the conclusions drawn, which are founded on the investigated theory and the research findings.

2
RESEARCH METHOD

This chapter portrays the research method applied in the thesis. The starting point for this is the design of the study. Next, the method for collecting secondary data is presented followed by a section treating the collection of primary data. Last, the analysis of secondary and primary data is discussed.

2.1 RESEARCH DESIGN

Figure 2.1 illustrates the progress of the research and accomplishment of this master thesis. The model was constructed by the authors and was used as a plan on how to proceed when writing. The elements included in the model are assumed essential and they follow a logical process.

Next, the content of each element and the relationship between them are described in detail. Information concerning the position of the stages in the thesis is also presented.

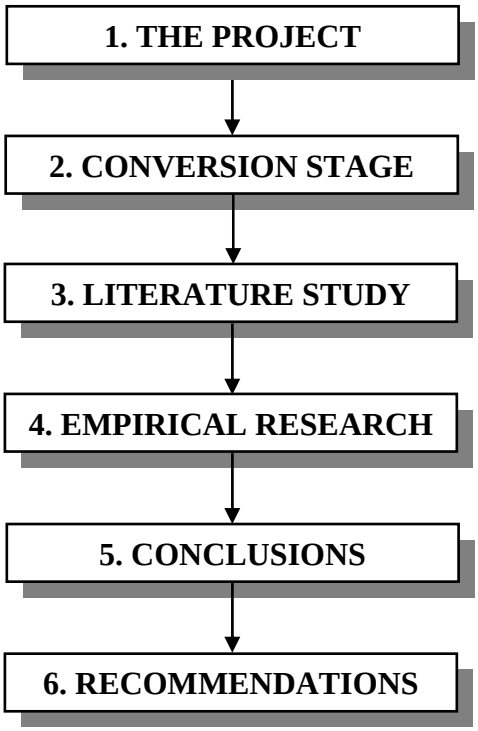


Figure 2.1. Research Design

1. THE PROJECT

When performing a task for an external associate, like this thesis project, it is important to collect and examine an adequate amount of background information concerning the assignment and the assigner (Brown, 2002, p.189). This investigation should be performed in an early stage of the working process. This investigation is included in the project stage of the research design, as illustrated in figure 2.1. The three first sections in the introduction chapter aimed to fulfil these information requirements and to give a background concerning the initiator of the project, and the content and objectives of the project.

In the project stage, it was furthermore important to understand the problem. Questions like why and for whom is it a problem, were clarified. This was done, since, if the problem is not defined and clarified to a full extent, then there is a risk of receiving a divergence between the thesis purpose and the real problem at hand.

2. CONVERSION STAGE

In this stage, the project is converted into a thesis problem, without changing the essence of it. This process concludes with the formulation of the study purpose, which is treated in section 1.4. This is constructed with respect to two variables. These are the problem description presented in section 1.3, and the academic requirements outlined by The Graduate Business School, at The School of Economics and Commercial Law in Gothenburg.

3. LITERATURE STUDY

The major part of the literature study was performed when writing the theoretical framework presented in chapter three. However, researching the literature has played an important role from the start. The purpose has progressed and matured as a result of the knowledge gained from the literature study. Simultaneously, the direction of the literature research changed becoming more specified, as the purpose

developed. Literature was also investigated for constructing the research method presented later in this chapter.

4. EMPIRICAL RESEARCH

The empirical research is founded on the literature study, concerning manufacturing strategy and the research method. The purpose is as well an important input. The research findings are presented in chapter four.

5. CONCLUSIONS

The analysis performed in chapter three and the research findings are confronted as an approach to compare the normative and descriptive findings. From this, discussion and conclusions are made. This is presented in chapter six.

6. RECOMMENDATIONS

The recommendation is dedicated to the logistic manager, Robert van der Woude at AvestaPolarit in Degerfors. The goal of the authors is to perform a contribution to the company as requested in the initiated project.

2.2 SECONDARY DATA

Data already collected in another context are defined as *secondary data* (Lekvall and Wahlbin, 1993, p. 141, & Eriksson and Wiedersheim-Paul, 1997, p.65). In other words, when the researcher is not directly observing the data, then secondary data has been used (Patel and Davidson, 1991, p. 56). In this thesis, secondary data was used for accomplishing the *normative research*. Normative statements are declarations about how it should be (Parkin, M., et al., 1997, p. 11). The manufacturing strategy chapter in this master thesis takes the form of normative research.

2.2.1 Collecting and Selecting the Secondary Data

The process of collecting secondary data started with an analysis of the *project* initiated by AvestaPolarit. The goal of this was to detect and define the academic angle of the project. This was done by performing a broad literature study, which covered *several academic fields*, concerning economics and business administration. Cost management, management accounting, production & operation management, industrial organisation, strategy and production economics are example of academic areas examined in the process of *converting* the project into a thesis research. After the purpose was defined, the literature study shifted into a specific view. The result of this study is presented in chapter three.

When *collecting* secondary data the electronic search engines systems from the Economic Library at the Göteborg University were used. Gunda, the library catalogue, was employed for locating relevant books, and Business Source Premier was mainly used when tracing significant articles in the business press and academic journals. Nevertheless, the Electronic Journals and Newspapers search system has also been used. Finally, new sources of information were also situated by examining the reference lists of already collected secondary sources.

The *selection* of secondary data has been performed through the following procedure: First, the title of the source was evaluated. If the title of the source seemed to be in the field of the project matter, the abstract of the source was examined. Secondary sources of data were analysed more thoroughly when the abstract was defined as relevant for the purpose at hand. Finally, sources that were considered as essential for the investigation and research have been employed in the accomplishment of this thesis, and are presented in the references.

2.3 PRIMARY DATA

Data directly collected by a researcher is defined as *primary data* (Lekvall and Wahlbin, 1993, p. 141, & Eriksson and Wiedersheim-Paul, 1997, p. 65). Observations, interviews, surveys and other sources of first-hand information are examples of it (Patel and Davidson, 1991, p. 56). In other words, if the researcher has directly identified the data used then primary data have been used. In this thesis, primary data is used when executing the *descriptive* or *positive research*. Positive statements are verifications of how it really is (Parkin, M., et al., 1997, p. 11). In the context of this master thesis, the presentation based on the investigation of the present manufacturing system at Hot Rolled Plate in Degerfors is positive research. In chapter four, the result of the descriptive investigation is presented.

2.3.1 Collecting and Selecting the Primary Data

As indicated, this thesis focuses on AvestaPolarit's Hot Rolled Plate Business Unit in Degerfors. When performing this type of organizational study, the case study is a common research method (Yin, 1994, p. 1), which also has been selected for this research. The case study has a distinctive advantage when a "*how?*" *or* "*why?*" *question is being asked about a contemporary set of events over which the investigator has little or no control*" (Yin 1994, p. 9). The research performed in this thesis is a descriptive study of the present situation at the Hot Rolled Plate in Degerfors, with respect to the purpose. "*How?*" and "*Why?*" questions have been raised with the aim to generate a complete description of *procedures outside the control of the authors*. These circumstances make it logical to have a case study approach.

The executed case study is in the field of qualitative research. Bryman (1997, pp. 75-85) identified the following differential characteristics of qualitative studies:

- *to see something through somebody else eyes*. The fundamental character of qualitative research is the pronounced wish to observe and express events, actions, norms and values from the perspective of the person examined.

- *descriptive research*. According to a qualitative researcher, it is of importance to provide detailed descriptions of the explored issues. This is reached by a full understanding of the inspected person's view of the issues at hand.

- *contextual research*. This characteristic expresses the qualitative research aspiration to study events, persons and actions in the light of the existing context.

- *process perspective*. A time perspective is common in qualitative research, which means that the researcher sees modifications in the investigated subject, and it is not static over time.

- *flexibility and lack of structure*. Qualitative researchers recommend an open, flexible and unstructured research strategy, as a method to avoid an incorrect frame of research. This approach also makes it possible to discover unexpected questions and issues during the research process.

- *the view of theory and concepts*. In general, qualitative researchers have an aversion to formulation of the theories and concepts before the actual research process has been instigated. Qualitative researchers encourage a research approach where theory formulation and testing are taking place during the collection of empirical data.

These characteristics prove to be true when undertaking the research. For example, the reality was seen from the interviewees' perspective. Furthermore, the used interview guides (Appendix 2-3) indicate an

unstructured and flexible research method. Finally, the collection and selection of theory was not completed until the case study ended.

The purpose of qualitative research is to achieve a deeper and more complete knowledge, compared to the fragmented understanding that usually is achieved from quantitative research (Patel and Davidson, 1991, p. 99). The ambition is to understand and analyse the whole. This ambition has also been an objective throughout the performed research.

The case study research was performed during weeks 43, 44 and 45 of 2003 at AvestaPolarit's rolling mill in Degerfors.

According to Yin (1994), it is preferable to use many different sources of information when performing case study research (pp. 90-94). There are six sources available for collecting evidence in a case study (Yin, 1994, p. 80). In this master thesis, the following three sources have been used for *collecting* the data:

- *Interviews* have been the greatest source of data of the research. The strengths of this source of evidence lie in that it focuses on the case study topic and on that it is insightful. The weaknesses are the possibilities for biases, inaccuracies, and reflexivity (Yin, 1994, p. 80). The goal of making interviews in qualitative research is to gather information concerning the respondents' knowledge and thoughts concerning a particular topic (Merriam, 1994, pp. 86-87). The purpose of the collected information was to perform a description of the current situation at the Hot Rolled Plate. This supports the use of a non-standardised and unstructured interview technique (Patel and Davidson, 1991, p. 62). Interview guides (Appendix 2-3) have been used for performing the interviews. When constructing these guides the strength and weaknesses of this interview technique was taken into consideration. The goal with the interview guide was to cover a large research spectrum, with respect to the purpose and characteristics of the study. This is the

reason why the guides do not have any straightforward questions, and instead contain broad research themes (Svensson and Starrin (Ed), 1996, pp. 62-63). This is a form of *open-ended interview*, which is the most common form of case study interviews (Yin, 1994, p. 84). The issues that form the guides have the character of being the type of research question that focus on the respondents' subjective experience. The goal with the performed interview is to get the interviewees to speak freely and openly (Robson, 1997, p. 232). To achieve this, effort was focused on:

- making the interviewees speak the most during the interviews.
- having the issues in the interview guides in a straightforward, clear and non-threatening way.
- avoiding cues, which lead the respondents to answer in a particular way.

The interviewees were selected to cover a wide spectrum of departments for which the manufacturing strategies are of importance (Winroth, 2001, p. 7). Moreover, this selection was founded on the problem description, the literature study and the project leader, Robert van der Woude's, experience. All performed interviews have been recorded and notes have been taken during the meetings. This is an example of active listening (Svensson and Starrin (Ed), 1996 pp. 67-68). The purpose with this procedure was to increase the amount of gathered information from the interviews. Robson (1997) writes that this documentation process is essential for the quality of the research (p. 232). One to one and a half hours was the approximated time for each interview. All interviews have taken place at the ironworks in Degerfors. The exact time and place for these interviews was completely decided by the interviewees. The taped interviews were transcripted, followed by an analysis and interpretation.

- *Documentation* has the strengths of being stable, unobtrusive, exact, and usually has a broad coverage. The weaknesses of documentation might be its low retrievability, selection and reporting biases, and lack of access to documents (Yin, 1994, p. 80). The most important document used in this master thesis is the project description, which is the starting point. Documents including company information and documents showed during the interviews have also been used during the research process.

- *Direct Observations* have taken place during the research process. This is a minor part of the research, and occurred during the weeks the authors were researching at the rolling mill in Degerfors. The strength of this source of evidence is that it covers the context of the events in real time. The weaknesses are a high consumption of resources, and the possible presence of selectivity and reflexivity (Yin, 1994, p. 80). Observations can be divided into structured and unstructured (Patel and Tebelius (Ed), 1987, p. 96). The purpose of the observations was to gather information about the different departments' working procedures, without using any observation scheme (Patel and Tebelius (Ed), 1987, p. 98). This implies an unstructured observation technique. The fact of having an office at AvestaPolarit made it possible for the authors to get an understanding of some of the daily activities and problems. During the interviews, the respondents were also asked to demonstrate some of the work done at the department.

After the primary data had been collected, it was systemised, compressed and analysed. The summaries and interpretations of the performed research are presented in chapter four. This is a *selection* procedure where the authors have selected data from the performed case study research and transformed into research findings information.

2.3.2 Validity and Reliability

All good research struggles to achieve valid and reliable results through an ethical acceptable method, and qualitative research is not an exception to this (Merriam, 1994, p. 174). These issues may even be of greater importance in qualitative research, compared to experimental research. The reason for this is that in qualitative research, it is not possible to decide the level of validity and reliability before the research is carried out. This is often possible when doing experimental research.

In the following three sections the essence of the concepts of validity and reliability are discussed. In the light of this discussion, the performed qualitative research is evaluated.

Construct Validity

Yin (1994) writes that construct validity is difficult to achieve in case study research (p. 34). Critics against this research approach often point out the fact that case study investigators fail to develop operational set of measures and that subjective judgment is used to collect the data. Robson (1997) clarifies the concept as, if the research really measures what the researcher thinks it measures, the level of construct validity is high in the research. There is no easy, single way of determining constructive validity (p. 68).

In this research, no particular concern about this issue has been made and it is difficult to state the level of constructive validity. The broad approach applied when performing the case study, and the unspecific aim of achieving a description of the present situation at HRP in Degerfors, are circumstances that make it possible to claim that some degree of constructive validity is present in the study.

Internal Validity

Internal validity takes care of how well the achieved results reflect the reality (Merriam, 1994, pp. 177-178). It is the researcher's obligation

to present an honest description of the respondents' subjective view of the issues at hand. When studying the reality from this perspective the internal validity is of great strength in qualitative research.

According to Merriam (1994), there are six fundamental strategies to secure the internal validity in a case study (pp. 179-180). Two of those fundamental strategies have been applied in this qualitative research. First, the participating respondents have read and made comments on the trustworthiness of the presented result in chapter four. Merriam call this strategy *control of the participants*. Secondly, by letting the thesis tutor and student colleagues state their point of view and make comments concerning the research findings, the strategy of *horizontal perusal and criticism* have also been applied to secure the internal validity.

External Validity

Yin (1994) sustained that external validity is present in research if the findings from the study are generalizable beyond the immediate case study (pp. 35-36). Low external validity is a common weakness in case studies. Critics typically point out that single cases provide a poor fundament for generalizing. These statements should be read in the light of Stake (1995), who wrote that the real purpose of a case study is particularization, not generalization (p. 8). When a particular case is examined, it is not of primary significance how it is dissimilar from others, but what it is without these comparisons. The case study might offer knowledge about others. However, the main objective is to understand the case itself. Yin (1994) on the other hand, considers that the external validity in case studies should be understood in another context (pp. 36-37). Survey research relies on *statistical generalization*, whereas case studies rely on *analytical generalization*. The struggle in analytical generalization is to generalize a particular set of results to some broader theory. In this context, external validity is achieved when the researcher generalizes study results to theory.

Further, the scientist does not try to select a representative case for the research.

In chapter five, the findings from the case study are analysed and discussed in the light of the theoretical framework. This is partly an attempt to investigate how well it is possible to generalize the research findings at HRP in Degerfors to the issues of manufacturing strategy investigated in this paper.

Reliability

The goal of reliability is to minimise the errors and biases in a study (Yin, 1994, p. 36). Merriam (1994) defined reliability as to what extent achieved results can be repeated (p. 180). The foundation for this statement is that there is only one reality, which will lead to the same result every time this reality is explored, but this is not the groundwork in qualitative research. In qualitative studies the effort is to explain the "world", which is born and dies every instant, from the view of the humans who are living in it (Merriam, 1994, p. 181). Moreover, since different humans have different interpretations, several realities are present at the same time. This makes it impossible to create a reliably study from a traditional perspective.

Reliability has therefore to be achieved through other techniques in qualitative research. One method could be to focus on the validity. It is a fact that internal validity cannot be present without reliability (Merriam, 1994, p.181 & Robson, 1997, p. 67). A technique to increase the reliability in a qualitative study is to increase the internal validity.

As described in the section concerning internal validity, two of the six fundamental strategies of securing the internal validity have been applied in this case study. The use of those strategies has indirectly improved the reliability of the study, in the manner previously described.

2.4 ANALYSIS OF PRIMARY AND SECONDARY DATA

To analyse something is to examine the elements that compose the whole (Abate (Ed) et al., 1996, p. 48). In the light of this definition, analysis was performed through the entire master thesis. According to Merriam (1994), this is a normal approach for qualitative research, since the gathering of information and analysis are often executed simultaneously (p. 136). This does not imply that the analysis is completed when the collection of data is fulfilled. On the contrary, after the assembling of information, the analysis goes into a more intensive phase. In this thesis, chapter five is the result of this intensive analysis.

Yin (1994) presents three different dominant modes of analysis for case study research (pp. 106-115). The analysis performed in this thesis is an example of an "*explanation-building*" analysis. This mode has its primary focus on explanatory case studies, with the aim to provide an explanation of what is happening (Robson, 1997, p. 379). Initially, in this approach is to construct a theoretical framework and then to compare the findings from the case study with this theory. In this thesis the comparisons made are between the theoretical framework presented in chapter three and the research findings summarized and interpreted in chapter four.

3
MANUFACTURING STRATEGY

Chapter three presents the theoretical framework that has been investigated with the intent to cope with the purpose of this master thesis.

The word strategy comes from the Greek word strategos, and means "Warfare" or "Art of the General" (Bengtsson and Skärvad, 2001, p.11). As this translation indicates, strategy is from the beginning a military term, but today the concept is of wide use. In business administration, the strategy has a short history. According to Bengtsson and Skärvad (2001), business strategy can be identified as the art of using the resources of the corporation with the aim of achieving the goal of the company (p. 11).

Within a company, it is possible to define different levels of strategies, with dissimilar aims. Comstock (2001) writes that on the corporate level of strategy issues concerning the business environment, investments and resources allocation from a broad perspective are analysed. (p. 20). Large corporations will often have several business units in the organization, which have the objective to satisfy different segments in the market sector. Therefore, every business unit need to develop its own strategy in terms of market segment, this is the business level of strategy (Hill, 2000, p. 26). The lowest level of strategy is the functional level of strategy (Hill, 2000, p. 27). Priorities for this level of strategy are the developments and investments in line with the market segments that the corporate is competing for, or will be competing for in the future. The necessary capacity and competence for competition and surviving are also investigated and improved on this level (Comstock, 2001 p. 20).

Figure 3.1 illustrates the integration of functional strategies within the corporate strategy. If the company at hand is constituted of business units,

each unit will have its own functional strategies. Figure 3.1 exemplifies different functional strategies in a manufacturing organisation (Comstock, 2001 p. 20).

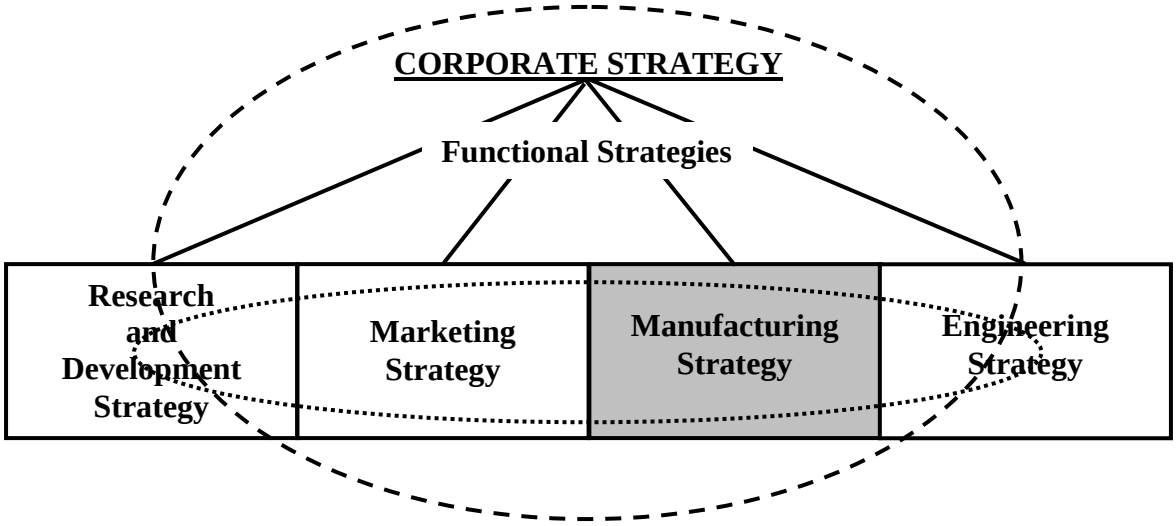


Figure 3.1. Integration of Functional Strategies in Manufacturing Organisations
Source: based on Hill, 2000, p. 28, & Comstock, 2001, p. 20

An organisation uses different functions in order to fulfil its mission and tasks (Hill, 2000, p. 27). In figure 3.1 four different functional strategies are placed as relevant elements of the corporation strategy in a manufacturing company. However, it is important to understand that companies are not different parts or functions, but wholes (Hill, 2000, p.27). Therefore, an essential and very complex problem is to remodel the different functional strategies into a completely uniformed corporate strategy, with harmonized objectives. This condition is illustrated in figure 3.1 by the two ovals, which cover all strategic parts. The competitive and changing environment of today's markets amplifies the importance of mutual development and integration of the functional strategies inside the corporation (Comstock, 2001, p. 20). Hill (2000) claimed that the reality is far from this (p. 28). In several companies, the functional strategies are developed independently and separated from the other functional strategies.

> "*Lacking essential integration, the result is a complication of distinct, functional strategies which sit side by side, layer by layer in the same corporate binder*" (Hill, 2000, p. 28).

The remainder of this chapter will investigate in depth the functional strategy that has a manufacturing view and perspective. This strategic perspective is called manufacturing strategy.

The strategic view of manufacturing as a competitive weapon dates back almost 50 years, to Miller and Roger (Miller & Roth, 1994). They did not differentiate between a marketing strategy and a manufacturing strategy. Rather, they saw manufacturing policies as a necessary ingredient of a marketing strategy (Miller & Roth, 1994). The notion of manufacturing strategy as a separate but related functional component of a marketing strategy is more recent, and it is normally accredited to Skinners 1969 seminal paper.

> *"A manufacturing strategy describes the competitive leverage required, and made possible by, the production function. It analyses the entire manufacturing function relative to its ability to provide such leverage, on which task it then focuses each element of manufacturing structure. It also allows the structure to be managed, not just the short-term, operational details of cost, quality and delivery. And it spells out an internally consistent set of structural decisions designed to forgo manufacturing into a strategic weapon"* (Skinner 1986)

> *"The notion is simple enough namely, that a company's competitive strategy at a given time places particular demands on its manufacturing function, and conversely, that the company's manufacturing posture and operations should be specially designed to fulfil the task demanded by strategic plans"* (Skinner, 1969, pp. 138-139).

Manufacturing strategy implies looking at manufacturing from the perspective "How can we compete", instead of solely focusing on productivity (Skinner, 1969). The mistake of considering as top objectives of the manufacturing function the cost and efficiency dimension is typical of the over simplified concept of "good manufacturing operations" (Skinner, 1969).

Leong et al. (1990) initiate the debate about research in the field of manufacturing strategy by noting that business strategy research has long ago recognised the distinction between research on the content of strategy and on the process of strategy. Conversely, this distinction has not been applied explicitly in manufacturing strategy research. This situation is identified by the authors as a threat for the swift advance of the entire field. Moreover, they sustained that failing to treat each dimension in a separate way and therefore mixing them is likely to lead to inappropriate treatment of either process or content.

Fahey and Christensen (1986, p. 168) defined this dichotomy between content and process.

> *"Content focuses on the specifics of what was decided, whereas process addresses how such decisions are reached in an organisational setting. That distinction is useful, in spite of the obvious interaction between the two in organisational life"*

Karlsson (2001, pp. 16-17) also notes this difference between content and process. Defining a strategy as being the result of a web of decisions that take place inside an organisation and its environment, and that are intended to achieve its long-term goals. Karlsson defines the term operations strategy as being "*the pattern of strategic decisions and actions, which set the role, objectives, and activities of the operation*" (Karlsson, 2001, p. 16). As with any type of strategy, one can consider its content and process separately. The content of an operations strategy are

the specific decisions and actions, which set the operations role, objectives and activities. The process of operations strategy being the method that it used to make the specific content decisions (Karlsson, 2001, p. 16).

There is proof in the literature that consensus have reached a more advanced status in respect to content than for a process model (Leong et al., 1990). More importantly, the manufacturing strategy content has withstood the test of empirical evaluation by researchers (Leong et al., 1990). This agreement supports this master thesis, since it addresses manufacturing strategy content. Still, before presenting the content model a description of the manufacturing strategy process will be presented.

3.1 MANUFACTURING STRATEGY PROCESS

Manufacturing strategy process refers to the development of the manufacturing strategy. This process could take two approaches:

- Top-down, *market-based* (outside-in) approach. The process is hierarchical, in which the corporate strategy forms the context for the business unit strategy. The business unit strategy in turn forms the context for the functional strategies (Bröte, 2002, p. 49). Skinner (1969) first suggested this approach.
- Hays (1985) argues against the market-based model by suggesting a down-top *resource-based* (inside-out) where functional capabilities drive corporate strategy (Leong et al., 1990). The resources-based approach suggests that it is more profitable to focus on developing, protecting and leveraging a company's unique operational resources and advantages in order to change the rules of competition (Gagnon, 1999). This is antithesis to the market-based approach, which sees the operations as perfectly adjustable system focused on following the rules dictated by markets.

3.2 MANUFACTURING STRATEGY CONTENT

The content model of manufacturing strategy can be divided into three broad elements (Leong et al., 1990; Dangayach and Deshmukh, 2001): (1) competitive priorities based on corporate and /or business units goals (2) decision categories that have long term importance in the manufacturing function; and (3) Strategic linkage. These groups constitute the manufacturing strategy content and by no means should be understood as a hierarchy. Figure 3.2 is a synthesis of these descriptions.

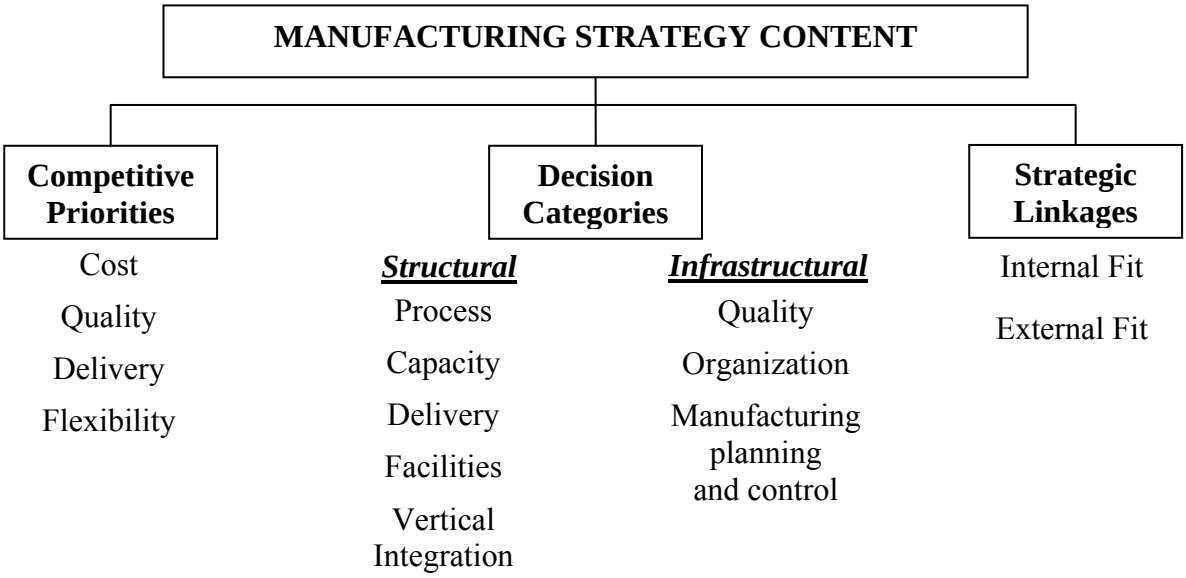


Figure 3.2 The Typical content model
Source: based on Rudberg, 2002, pp. 19-27 & Olhager and Rudberg 2002

The competitive priorities and decision categories traditionally compose the manufacturing strategy content (Olhager and Rudberg, 2002). This is illustrated and linked by Miller and Roth (1994) when they write:

> *"Two core elements are central to the definition of a manufacturing strategy as a functional sub-strategy. The first element is what the manufacturing function must accomplish (manufacturing task). This is defined in terms of the capabilities the manufacturing unit must have. […] typically includes, quality, cost/efficiency strategy ability. […]. The second element of a manufacturing strategy is defined by the pattern of manufacturing*

> *choices a company makes (structural and infrastructural). […] The central theme that links the two elements of a manufacturing strategy is the notion that the pattern of choices followed by the manufacturing must be congruent with the manufacturing task"* (Miller and Roth, 1994, pp. 285-286).

There is a common agreement that the effectiveness of a firms operation strategy can be measured by assessing the linkage between competitive priorities and the corresponding decisions regarding structure and infrastructure of operations (Boyer and McDermott, 1999). The degree of fit between an organization's competitive priorities and the decisions regarding structural and infrastructural investments provides an important aspect to develop the full potential of the manufacturing task as a strategic weapon (Boyer and McDermott, 1999).

In the following, competitive priorities, decision categories and strategic linkage will be addressed in detail.

3.2.1 Competitive Priorities

Hayes and Wheelwright in 1984 introduced the term "competitive priorities" and defined it as strategic preferences, or the dimensions along which a company chooses to compete in the targeted market. They defined four competitive priorities: (1) cost; (2) quality; (3) delivery; and (4) flexibility (Krause et al., 2001). Today after all these years the conclusion is much the same as Hayes and Wheelwright original formulation, which comprise the content of a corporation's operations strategy (Krause et al., 2001; Boyer and McDermott, 1999).

Hill (2000, pp. 38-40) introduced the concept of order winner and order qualifiers in order to differentiate the importance among competitive priorities. An order winner makes a product win in the market place,

whereas qualifiers are criteria that must be provided by a firm to enter or stay in the market.

Early conceptual work on competitive priorities indicated the nuisance of trying to focus in more than one competitive priority (e.g. Skinner, 1969 & Wheelwright, 1984). Thus trade-offs must be made. Wheelwright (1984) declares that it is difficult for a company to try to compete along all the dimensions simultaneously. Many scholars have challenged this view (Leong et al. 1990). Cobert and Van Wassenhove (1993) suggested that the competences are not mutually exclusive as implied by the traditional trade-off model. They sustain that the competences are cumulative. According to their view, attempts to improve the performance should be organized in such a way as to reinforce rather than replace one another. Moreover, De Mayer and Bonheure (1990) encountered significant empirical evidence to support the cumulative model.

Irrespective of whether trade-offs exist or not, the manufacturing competitive priorities are used to link the manufacturing strategy to market requirements (Rudberg, 2002, pp. 22-23). This is analysed after the decision categories, under the title strategic linkage

3.2.2 Decision Categories

Manufacturing has been characterised by Skinner in 1969, and Hayes and Wheelwright in 1984 as consisting of a pattern of individual decisions that affects the ability of the firm to meet long-term objectives (Leong et al. 1990).

Fine and Hax (1985) indicated the importance of a comprehensive manufacturing strategy; nevertheless, they recognized that the complex web of decisions must be broken into bits that are more able to be analysed. Leong et al. (1990) found out that even if the decision

categories differ from author to author there is still an essential agreement on those areas that affect the manufacturing strategy. Figure 3.3 lists the strategic decisions, which are categorised into structure and infrastructure. This approach was first suggested by Hayes and Wheelwright in 1964 (Leong et al. 1990). Whereas structural decision categories deal with decisions of capital spending, infrastructure decisions affect the people and systems that make the manufacturing system work. This distinction of operation strategy has been compared to that between 'hardware' and 'software' in a computer system (Slack et al. 2001, p. 78). The hardware set limits of what can be done. Within the hardware limits, the software governs how effectively the computer actually is in practice. The same principle applies to operations. The best and most costly facilities and technologies will be effective only if the operations also have the proper infrastructure, which governs how the everyday work will be performed (Slack et al. 2001, p. 79).

Decision Categories	Sample of policy areas
Structural	
Capacity	Amount, timing and increment size
Facilities	Size, location, specialization and focus
Process Technology	Process choice, technology and integration
Vertical Integration	Direction, extent and balance
Infrastructural	
Quality	Definition, roles and tools
Organization	Design, human resources and competence development
Manufacturing Planning and Control	System design & integration, decision support and **CODP**

Figure 3.3. Decision Categories and Associated Policy Areas
Source: Rudberg, 2002, p.24

3.2.3 Strategic Linkage

"Suppose ten persons decide to cooperate in building a boat. If each has his own plan, and they do not communicate their plans,

> *the chances are that the resulting craft will not be very seaworthy: they would probably meet with better success if they adopted even a very mediocre design, and if then all followed this same design"* (Simon, 1965, p. 9-10).

Interrelations are intrinsic to companies under the assumption that people work together in order to achieve the organisation's goals. Simon's (1965) message is that when people decided to work together towards a common objective they became dependent on each other's actions. To put it in other words, because of this joint effort, these people are dependent upon each other to carry out their activities in their organisation. Consequently, if people do not share the information, meaning that they do not communicate, the outcome would probably be inferior than if they do interact (Lakemond, 2001, pp. 61-62). This sharing of information is central for achieving a strategic linkage.

A company's competitiveness in a particular market can be described in terms of its ability to achieve external and internal fit. External and internal fit describes the strategic linkages within manufacturing strategy content, see figure 3.2. Traditionally this concerns the linkage between

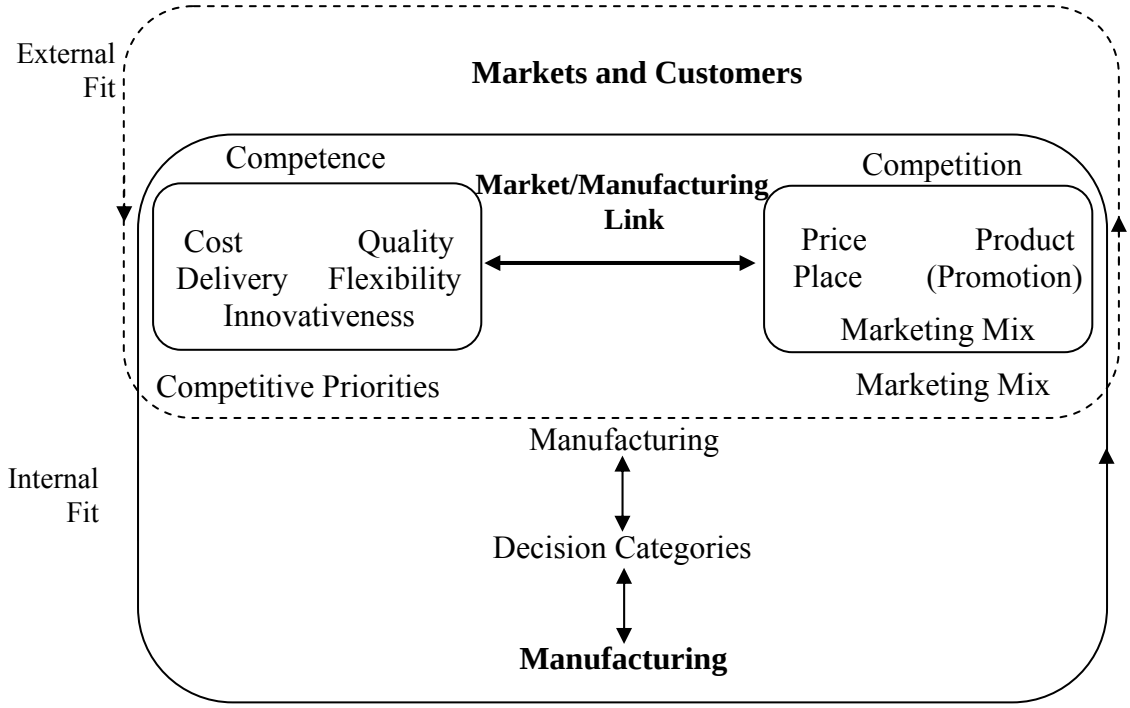


Figure 3.4. The Internal and External Strategic Linkage
Source: based on Corbett and van Wassenhove (1993); Bozarth and McDermott (1998).

the manufacturing, marketing and the market, which figure 3.4 illustrates. The concept of *internal fit* focuses on developing internal complementarities (Miller, 1992). First, internal linkage addresses the subject of linking the competitive priorities, with respect to the manufacturing objectives, with the decision categories. Second, it ensures that the elements of the decisions categories complement each other in accomplishing the manufacturing goals. Finally, it addresses the market/manufacturing link with respect to the competitive priorities and the marketing mix (price, product, place and promotion) (Kotler, 1999, pp. 109-111), with a harmonising aim. This multifaceted linkage requires taking into consideration the interaction among interdependent variables and decisions as described (Rudberg, 2002, pp. 25-26).

The concept of *external fit,* requires that organisations must match their structures and process to their external setting (Miller, 1992). From the manufacturing perspective, the linkage of the competitive priorities to the customers' needs is achieved through the marketing mix. This is the task of the external fit, making sure that the competitive priorities are in accordance with customer demands (Rudberg, 2002, pp. 25).

The competitive priorities are sometimes used to describe competitiveness (external fit) and sometimes competences (internal fit), in spite of being two very different sides of the same problem (Corbett and Van Wassenhove, 1993). With this in mind we can state that measuring internal competence is not enough, a measure of external competitiveness is essential. Therefore, it is natural to turn to the marketing field for achieving the external fit (Corbett and Van Wassenhove, 1993). It is evident that competitive priorities are strongly related to the marketing mix. In fact, they are the manufacturing and marketing sides of the same problem (Corbett and Van Wassenhove, 1993). Corbett and Van Wassenhove summarised this issue:

> "*[…] manufacturing competence is not a sufficient condition for competitiveness. In the short run, it is not even a necessary*

> *condition, as it may be beneficial to sell a product below its unit cost for a period of time. In the long run, however, this is not sustainable; building competences is then a necessary condition for maintaining competitiveness. The distinction between competences and competitiveness is critical when discussing manufacturing strategy since it immediately highlights the fact that the core competences in manufacturing are of little value if they are not properly aligned with competitive positioning*" (Corbett and Van Wassenhove, 1993, p. 110).

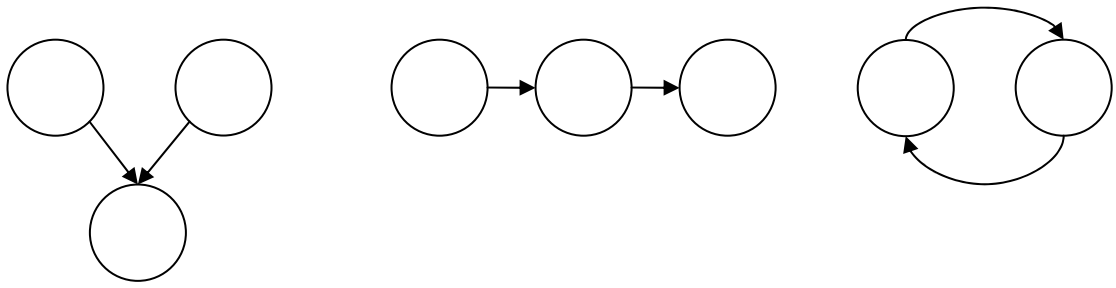
Figure 3.5 lists the different, often opposing views held by manufacturing and marketing on a range of topics. In this fashion the marketing mix deal with a company's competitiveness, while the manufacturing competitive priorities deals with the competences that the manufacturing function has developed or need to developed (Rudberg, 2002, pp. 24-25). In other words, the marketing is the outward whereas the manufacturing is the inward perspective, of the same idea, how to win in the market place. The aim of the linkage is the combining of these two perspectives, since they are interdependent. Through the linkage, a better fit is achieved and therefore the company will perform better.

Dependence in organisations could be defined as the degree to which an actor or department is dependent upon another to perform its tasks. When this occurs, it is said that dependency occurs. When two specific persons or work units are dependent upon each other, we can speak of interdependencies. This connotes the existence of a shared interest about something between two parties, for example resources, work or information. Hence, interdependencies refer to a reciprocal interdependence, this situation come to an existence in situations in which the output of each person's work unit becomes input for the others (Lakemond, 2001, pp. 61-62). Besides the interdependence, also known as reciprocal dependence, two other types of dependences could be differentiated.

Issues		Perspectives and Goals: Manufacturing	Marketing
PRODUCT	Range	Restricting range enhances volumes, helps reduce cost and simplifies control	Customers typically seek variety. Restricting range reduces segment
	Standardisation Vs Customisation	Lack of change reduces uncertainty and room for error. Limiting server discretion maintains cost and throughput profiles	Customisation often is important particularly in mature markets. Server discretion personalizes services often at little cost-enhances the customer
Cost and Profit		Measured on meeting cost budgets. Resist order that increase cost. Has no control over pricing.	Sales revenues is the key performance measure. Profit implications are not part of the decision or evaluation. Higher costs are not parts of its budget consideration.
Productivity Improvements		Reduce cost unit	May cause a decline in quality conformance provision
Facilities Location		Considerations concern cost and the convenience for suppliers and staff	Customers may find it unattractive, undesirable and, for a service business, inaccessible
Standardisation Vs. Customisation		High utilisation of capacity has an effect on cost and on assets. Pressure to manage capacity and thereby keep investment as low as possible	Product/service may be unavailable when needed. Quality compromised in high demand periods.
Job design		Oriented to minimising errors and waste. Simplify tasks and the use of technology where possible	Employee oriented to operations task and not customer need. Restricts the ability to meet changing requirements as they occur
Queues		Optimise use of available capacity by planning for average throughput	Increases lead times. Customer facing long lead times or queues may go elsewhere

Figure 3.5. Usual Manufacturing and Marketing Perspectives in Key Issues
Source: Hill (2000, p.34)

The pooled and the sequential dependence, see figure 3.6. The former comes to life when different department of persons work for the overall organisational goal, yet they do not interact with each other to fulfil it. In the latter, each part is directly dependent on upon the previous for doing their activities. The reciprocal interdependence is the most difficult dependence to coordinate, of the presented, since each unit or person is directly affected and dependent on each other's actions. Nonetheless, in this situation the coordination plays a greater role. On the other hand, pooled dependence arises in situations where no direct interaction occurs between the parties, thus it is less difficult to coordinate, furthermore the significance of this coordination is somehow diluted (Lakemond, 2001, pp. 62-63).



Polled **Sequential** **Reciprocal**

Figure 3.6. Dependencies Situations
Source: Lakemond, 2001, p.62

It should be clear by now that cooperation is a consequence of dependencies that take place in an organization. Moreover, the level and type of dependency dictates the importance and the way to coordinate the activities. A further feature to take into consideration is if the dependencies are stable and fixed or unstable and variable, in view of the fact that when the dependencies are more uncertain and unpredictable a coordination activity is largely required to provide information and secure agreement as the bases of coordinated action. Generally, satisfactory coordination does not arise naturally. Employees working at different departments often have different attitudes, backgrounds, day-to-day business, and are sometimes separated geographically. This creates a necessity for *explicit coordination process***.** This process could be

achieved from organisational rules and norms, that is, "the generalised description of the behaviour and the relationships of the members of the organisation". Moreover, the organisation structure can assist the coordination action in an organisation by determining the functions, interactions and responsibilities. The way the overall organisation is structured provides coordination through grouping the members of the organisation in different sub-groups or departments and defining the interaction pattern in the organisation. In addition, an appropriate content of the work tasks can alleviate the coordination need (Lakemond, 2001, pp. 64).

Rehme (2001, pp. 18-21) suggests a distinct style of coordination processes required by different dependence situations (i.e. reciprocal, pooled and sequential):

> Pooled: *"The coordination mode standardisation involves the formulation of rules and routines for use throughout the firm. It requires instances that are invariable, few and repetitive, where activities in different units are not reliant on each other for task competition".*
>
> Sequential: *"Coordination made by plan involves schedules by which the interdependent units can be managed. The schedules outline the various starting points for the activities and are appropriate in a more dynamic situation than rules and routines".*
>
> Reciprocal: *"Mutual adjustment relies on the transmission of new information during the action process. The more unreliable and variable the situation, the greater the reliance on mutual adjustment".*

In short, dependencies are inherent to organisations and dependencies could and should be managed by coordination. Moreover, the coordination strategy varies with the type of dependence (e.g. reciprocal,

pooled and sequential) plus the variability and stability of the dependence.

3.3 CUSTOMER ORDER DECOUPLING POINT

The customer order decoupling point (CODP) is an important issue inside the manufacturing strategy content. In particular, the concept concerns an infrastructural decision. However, as described earlier the elements of the manufacturing strategy content are closely related, and the CODP is not an exception.

The understanding of customer requirements and their implication for the manufacturing companies is an essential issue. Nowadays, cost and resource focus has shifted to put more significance on how the customer perceives the output (Winker and Rudberg, 2001b). This shift places demand on the manufacturing companies; requirements are put on *reduced lead-times* and simultaneously on that *unique customer specifications* concerning product properties are realised (Winker and Rudberg, 2001b).

By using the customer order, which captures customer specifications, as a control point, production activities are based on either certain or uncertain information concerning customer specifications (Winker and Rudberg, 2001b). Later in this section, the binary description of the degree of uncertainty will be treated in more detail. Namely, the degree of uncertainty will be unfolded, in the sense that some properties of a customer order may be known whereas others are not. Production systems are considerably influenced by this, the level to which a customer establishes product specification. Moreover, this structure is influenced by the point in the goods flow where forecast-driven production and customer order-driven production are separated (Giesberts and van der Tang, 1992). This point is called customer order decoupling point (CODP). An alternative to this definition is provided in Olhager:

> *"The CODP is traditionally defined as the point in the manufacturing value chain for a product, where the product is linked to a specific customer order"* (Olhager, 2003, p.320).

In congruence with the latter definition, the CODP is sometimes referred as order penetration point (OPP).

The CODP is important for a number of reasons which were identified by van Donk (2001, p. 298):

- "*It separates the order-driven activities from the forecast-driven activities. This is not only important for the distinction of different types of activities, but also for the related information flows and the way the goods flow is planned and controlled.*"
- "*The upstream activities can be optimised in some way, as they are based on forecast and more or less independent from irregular demands in the market.*"

The traditional CODP typology contains four cases: engineer-to-order (ETO), make-to-order (MTO), assemble-to-order (ATO), and make-to-stock (MTS) (Giesberts and van der Tang, 1992). This typology is somehow limited and does not depict all the situations companies face when dealing with customer orders (Rudberg, 2001a). Moreover, most companies live with more than one of these four situations at a time. This is most likely to occur, with companies with more than one product or market segment. Therefore, it is indispensable to understand the elements of the decision-making process, with respect to customer orders and how these properties decouple parts of both the decision-making activities and materials flows (Rudberg, 2001a).

The concept of MTO strategy has similarities with the just-in-time (JIT) approach. The basic ideas behind JIT are: (1) Work-in-process inventory is reduced to a minimum. (2) Production is only initiated by an actual demand. (3) A close relationship with suppliers will secure the delivery

needs. (4) The JIT approach goes beyond the savings of inventory costs. (5) A successful use of the JIT concept requires serious commitment from top management and from workers (Nahmias, 2001, PP. 358-359). These concept fundamentals are also relevant basics in the MTO strategy. The advantages and disadvantages of the just-in-time philosophy are also relevant to the concept of MTO. Examples of advantages with a successful implemented JIT-system are: lower inventory costs, improved production efficiency, quick location of quality problems, and improved coordination with internal and external actors in the production chain. Disadvantages could be: amplified work in idle time, decreased production level, reduced possibility to benefit from aggregate demand and supply, and larger dependency on the performance of the suppliers (Nahmias, 2001, PP. 390-393).

The presentation of the CODP is organized in the following way. First P:D ratio is used as a way to illustrate the CODP. The factors affecting the position of the CODP are treated subsequently. Next, decision-uncertainty and the CODP is investigated followed by a discussion of the factors affecting the shift of the CODP. Finally, the decisions arising from the MTS/MTO combination is analysed by means of the CODP, furthermore the decision hierarchy is remarked throughout the discussion.

3.3.1 P:D Ratio and the CODP

The P:D. ratio is a useful tool to explain in simple terms the basic concept of the CODP. In the P: D ratio P and D are independent variables. P measures the production lead-time and is under full control of the company and D measures the delivery lead-time, which is the time from order to delivery. This is determined by the wants and needs of the customer or market (Wikner and Rudberg, 2001a). If the delivery time (D) is shorter than the production lead-time (P), production should be performed on speculation if the company is willing to accomplish time-to-market. A company must produce before the actual order has been

made by the customer. The situation when all manufacturing activities have to be performed on *speculation* is called MTS, and could be seen as one extreme of the CODP. ETO is the opposite extreme of the CODP continuum where all the manufacturing activities are *postponed*. The product is not fully technically specified the moment a customer order is to be accepted (Giesberts and van der Tang, 1992). In this situation, not only production and assembly but also all activities, including engineering and procurement, are done only after a customer order is received (Wikner and Rudberg, 2001a). Between these two extremes, two other situations could be revealed ATO and MTO. In the ATO situation, it is only a portion of P that takes place on speculation, whereas the final assembly, transformation or configuration takes place once an order has been made. Consequently, MTO is order focused. All production is based on actual orders where only in some cases procurement is done on speculation (Wikner and Rudberg, 2001a).

Summarising, the further downstream (to the right) the CODP is located the more manufacturing activities must be carried out under uncertainty, and the further upstream (to the left) the CODP is located the more manufacturing activities can be based on actual customer orders. The different positions of the CODP can be visualized in figure 3.7.

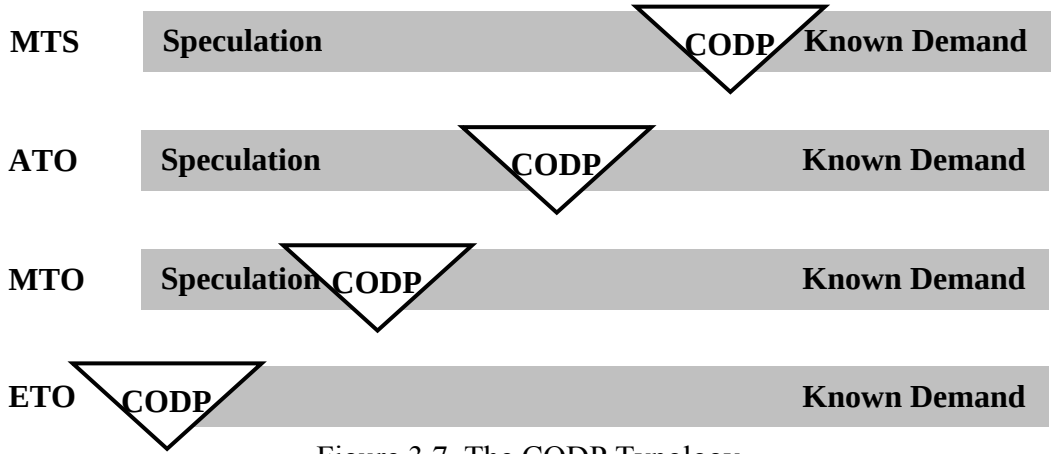


Figure 3.7. The CODP Typology
Source: Wikner and Rudberg, 2001a

In the next section P and D, together with other factors influencing the location of the customer order decoupling point are to be discussed.

3.3.2 Factors affecting the positioning of the CODP

The choice of the position or the positions of the CODP is important since there is a fundamental difference between pre-CODP and post-CODP. On the one hand, pre-CODP should be concerned with cost, in maintaining an optimal mix and inventory level at the CODP as well as optimisation of production activities. This is feasible since pre-CODP activities are isolated from the demand volatility. Thus, at this stage focus moves to price competition via cost efficiency with respect to capital tied up in capacity, inventories and process optimisation. Post-CODP is all about speed and flexibility, given that it is from this point that the delivery lead-time to customer starts running. Thus, at this stage the flexibility (e.g. product mix and volume) and delivery speed is the central focus. (Olhager, 2003).

In an attempt to aid the decision-maker in the selection of the position of the CODP the most relevant factors affecting the CODP are unfolded into four categories, related to Market, Customer, Product, and Production Characteristics in order to provide a holistic view of the relevance of choosing the right delivery strategy, by choosing the right CODP position. This classification follows the work of Huiskonen (2003), Olhager (2003), Pagh and Cooper (1998).

Market-related factors

The *Delivery lead-time requirement* (D) refers to the average delivery time to customers (Pagh and Cooper, 1998). This is determined by the market, and constrains how far backwards the CODP can be positioned (Olhager, 2003). If the customer requires a shorter delivery time it is likely to be appropriate to use some degree of manufacturing speculation (Pagh and Cooper, 1998), meaning that manufacturing activities should be done without an assured customer order.

Product demand volatility measures the uncertainty of the customer's orders. Low volatility means that the item can be forecast-driven;

hence some kind of speculation would be possible, i.e. MTS. In contrast, with high volatility, the risk of speculation would be high since high volatility makes forecasting difficult hence it will be appropriate to postpone the manufacturing, i.e. MTO (Olhager, 2003, Pagh and Cooper, 1998, Huiskonen, 2003)

Products with large sales volumes are more likely candidates to use some kind of speculation, i.e. MTS, than the products with small sales volumes since with large sales volumes high inventory turnover rates are relatively easy to obtain (Huiskonen, 2003).

Product range and product customisation requirements have similar effects with respect to the CODP. A wide product and customisation range would support a postponement strategy i.e. MTO since the investment in finished stock would be too big to bear. Conversely, a narrow product and customisation would back up a speculation strategy (Olhager, 2003).

Customer-specific factors

The most relevant factors to determine the customer importance are the *customer's profit contribution* (today) and its *growth potential* (tomorrow). This depends at least on the customer's total purchases, the dispersion of the purchases over the supplier's range of product and the frequency as well as order lot size. Bigger orders of fewer products are usually more profitable to supply than a large amount of small orders of many different products. Moreover, larger orders make it easier to attain higher logistical efficiency (Huiskonen et al., 2003). Furthermore, high frequency of order leads to the simplification of the forecast making (Olhager, 2003).

The *grouping of the customers into clusters* sharing a particular need or want are of great interest as it is to the customer to whom we are going to deliver. A common way suggested in the literature for segmenting the customers is by defining the order-winners and order-qualifiers from a customer perspective (Olhager and Wikner, 2000).

This proved to be an important aspect to determining the position of the CODP since it identifies the importance of the delivery lead-time for different groups of customers.

Product-related factors

When the *customisation opportunities* that are offered are wide and enter the product at early stages, incentives for a MTO policy are clear. Given that, the multiplicity of different configuration enters early on in the manufacturing process where the identification of which products are going to be demanded is complex. Whereas if customisation enters in a very late production stage ATO may be more appropriate since standard products could be produced and later be customised by the customer special requirements. Furthermore, it is worth noting that if the product is standard the risk of speculation is minimal, which provides an incentive for MTS. Conversely, if the product is highly customized the risk of speculation is high (Olhager, 2003 & Pagh and Cooper, 1998).

Production-related factors

Production lead-time (P) is a major factor contributing to the total lead-time to the market. The relation between production lead-time and time to the market represent a key limit on the position of the CODP. The position of the CODP could help to improve the time to market, but the decisions have their trade-offs, so a conscious analysis of the repercussions of the positioning of the CODP should be analysed (Olhager, 2003).

The *number of planning points* in a manufacturing process limits the number of possible CODP positions. The planning point from a planning and control perspective is a manufacturing resource, a set of manufacturing resources such as work centres, or a work cell that can be regarded as one entity. This means that this entity cannot be broken down into smaller items. An operation or the operations are made or not. In a job shop where individual resources are planned, the

variety for positioning the CODP is large. Conversely, dedicated line or continuous process can be treated as a single production unit and therefore offer only two possibilities: before or after the process (Olhager, 2003).

The *flexibility* of a production process, through short lead-times is an incentive towards some kind of postponement i.e. MTO since the system is easier to optimise. A non-flexible system would need a more stable demand for jobs, thus some sort of speculation i.e. MTS would be needed to optimise the operation (Olhager, 2003).

The position of the *bottleneck* of the production process gives an incentive to position the CODP downstream relative to the bottleneck. The reason behind this is to try to protect the bottleneck from the volatile demand and variety of different products (Olhager, 2003). Having the bottleneck scheduled by forecast permits its best utilisation.

Resources with *sequence-dependent set-up times* are best positioned upstream from the CODP. According to Olhager (2003), the reason behind this is similar as to the bottleneck, since sequence-dependent set-up time resources easily turn into bottlenecks without proper sequencing, only possible by forecast driven demand.

The *capacity utilisation* is positively related with the level of speculation. The reason behind this is that when using a speculation strategy the production system is protected from the demand volatility and therefore the production planning can be made to make the most of the installed capacity. Conversely, if the production has to service incoming orders the priority changes from utilising the capacity to order fulfilling.

As Olhager (2003) pointed out, many factors potentially can affect the positioning of the CODP. These factors are interrelated to some extent, as

illustrated in figure 3.8. The addition of the customer characteristics forms the market characteristics, which in turn affects product

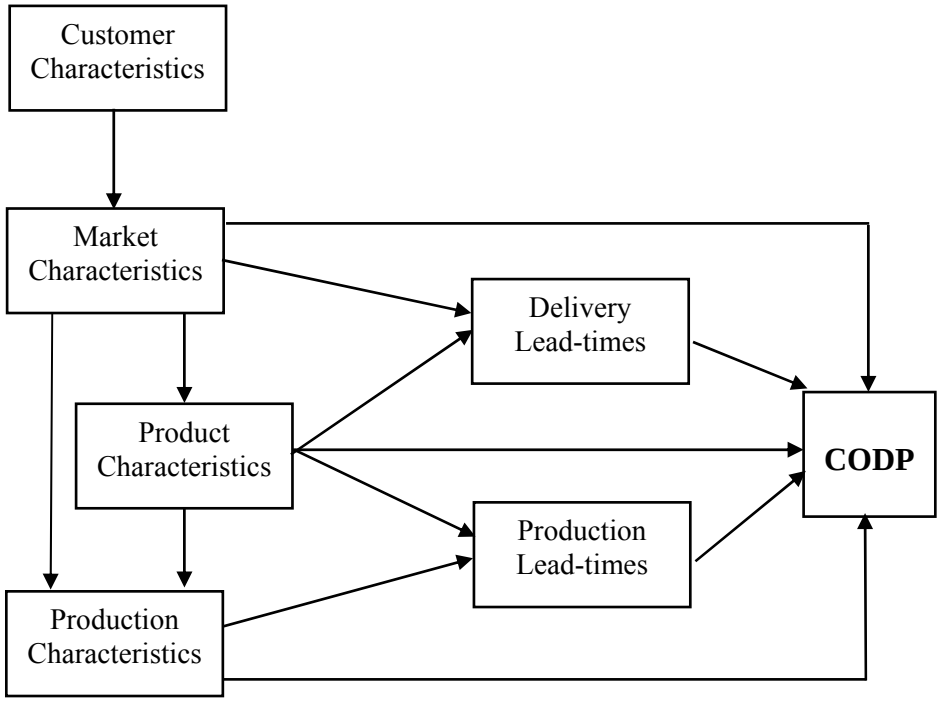


Figure 3.8. Factors Affecting the CODP
Source: based on Olhager (2003)

characteristics. The relation of the market characteristics and the production characteristics yield the delivery time required by the market. This serves as an important input for the manufacturing function that must decide the positioning of the CODP, by matching its production lead-time with delivery lead-time.

As mentioned, the approach applied in this thesis, concerning factors affecting the CODP, is holistic. Contrary to this is the process-oriented approach, which could be found for example in Huiskonen et al. (2003). The authors divide the process of selection of the CODP into 4 stages: (1) Determination of the product-specific factors. In this stage, the products are divided into four categories: periodical, make to order, make to stock, discarded and make to order. The categorisation is effectuated by means of the demand pattern and annual sales volume; (2) Determination of the customer-specific factors. It is in this stage that the customers are divided into new opportunities, utilisers, chance customers and partners by

analysing each customer purchasing potential and purchasing volume; (3) Customer grouping. In these, the four stages in Huiskonen framework, customer grouping is refined by analysing the service effects that the changes in inventory policy could have on the customer. This is done by management judgement; (4) linking the basic solution and the customer groups. In the last stage the customer grouping is linked with the product-based inventory location policies in order to assure that, the service affects the importance of the customer.

3.3.3 Uncertainty and the CODP

Until now, our discussion on the CODP assumed a binary approach concerning customer order information. The order was made or not by the customer. This implies that the decision-making i.e. for determining how much to produce and procure, was made under certainty or uncertainty. This is far from what happens in reality where the picture is more multifaceted. In this section, efforts are made to obtain a better description of the quality of information concerning demand that the decision-maker has at the time of electing. This proves to be important for electing the positioning of the CODP.

Providing the customer with the right "product" is said to create value for the customer and by doing this, the organisation has the possibility to make money (Wikner and Rudberg, 2001a). By taking this view, the definition of three demand attributes from the customer's point of view is made possible; a product must provide some form of shape, time and quantity utility. These demand requirements can be transformed into a set of important issues concerning the supply of products (Wikner and Rudberg, 2001a):

- What? What product does the customer want?
- How much? How much of the product does the customer want?
- When? When does the customer want to have the product delivered?

From the discussion above it can be seen that when the demand requirements are translated to supply issues, customer demand is in itself not one single input to the decision-making, but rather three different inputs (Wikner and Rudberg, 2001a). It is only after these three imputes are defined that the customer order is completely characterised and the decision could be made under certainty from a supply perspective. Conversely, if one of these factors is not completely defined the decision is said to be made under some degree of uncertainty.

As Wikner and Rudberg (2001a) noted, to provide the maximum possible value to the customer, the supplying party must identify the customers' demand requirements in terms of operational supply issues. They sustained that the value of information plays a major role when $P > D$, this creates a situation where the three supply issues must be resolved at a point in time when the information concerning demand requirements is not completely certain. The former case present a case of speculation strategy, given that the time to market is shorter than the production lead-time, production activities should start before the order arrives. Even when this situation does not arise, production under uncertainty is likely to occur when i.e. the firm is willing to increase customers service level, production is done driven by forecast and so forth.

It is worth noticing that, the supply issues are mutually independent. This means that, if one supply issue is certain it does not provide information about the degree of certainty of another supply issue (Wikner and Rudberg, 2001a). A useful way to exhibit the certainty/uncertainty that a firm faces concerning its customer demand is the uncertainty cube, see figure 3.9. This cube displays the degree of uncertainty facing the company using the three dimensions *what?*, *when?*, and how *much?*.

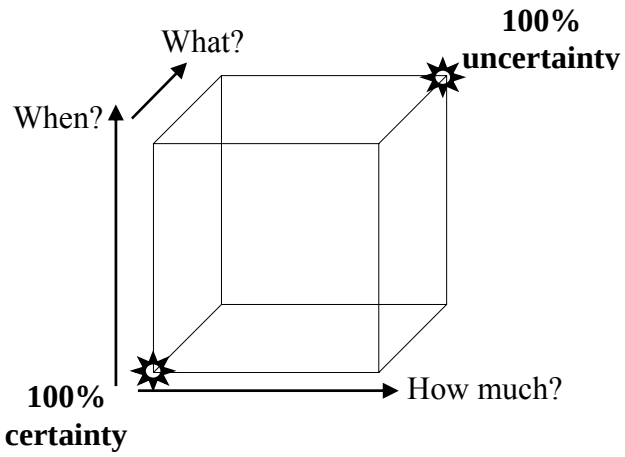


Figure 3.9. The Uncertainty Cube
Source: Wikner and Rudberg (2001a, p.15)

As depicted in figure 3.9. the two extreme points in the continuous of the degree of uncertainty are 100% certainty and 100% uncertainty. The former occurs when the decision-maker has no information concerning the three parameters, but nevertheless has to make the decision. On the other hand, if the decision-maker could define all three parameters, the decision is said to be made with 100% certainty. The remaining situations are a combination of these two extreme cases (Wikner and Rudberg, 2001a).

At this stage, the uncertainty cube will be used as a functional way to further explain the CODP. Consider the next example described below (see figure 3.10.):

1. At this stage, no information concerning the specification of the customer orders are known. Nevertheless, some kind of forecast i.e. based on historical data might be available. The uncertainty cube is set at 100% uncertainty, moreover *some* production activities could have started. This is showed by the dotted P-line in figure 3.10.
2. If the information of the customer wants is known, the uncertainty is reduced in the *what?*-dimension. Still since they are mutually independent, the other two dimensions remain unchanged. At this

time, the production function has certain information on what to produce. Still, a lack of information concerning quantity and delivery time is present.

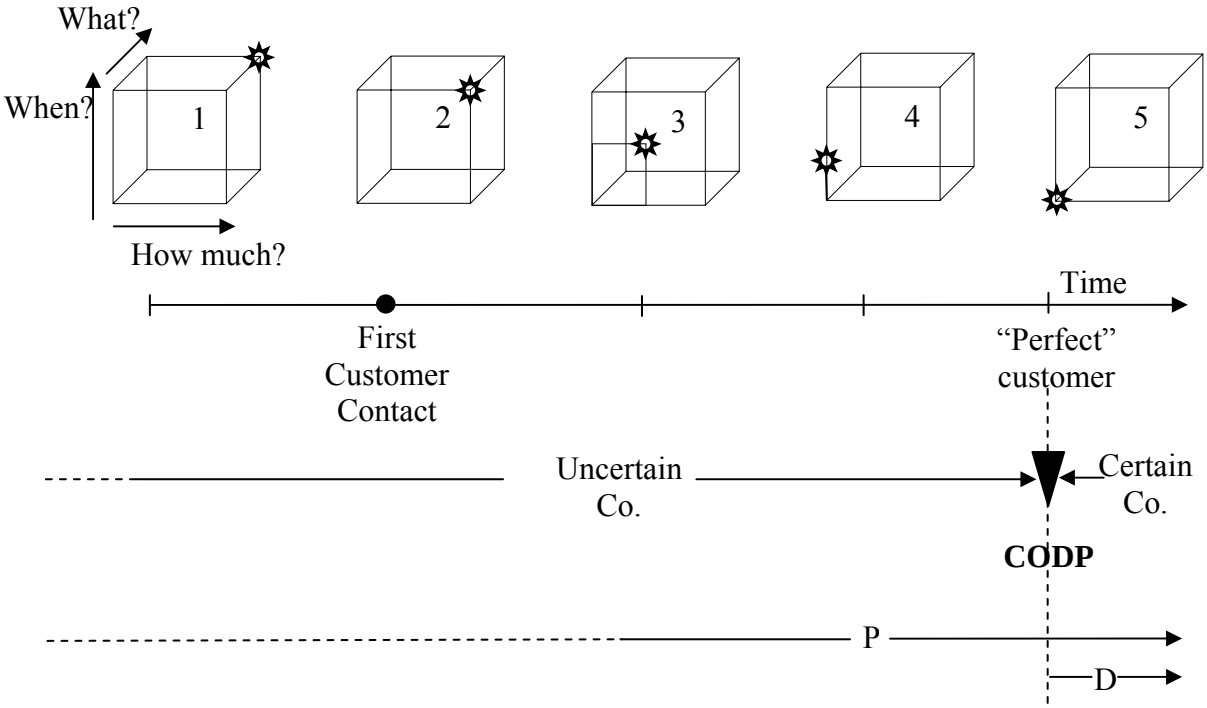
3. Later on, the customer may provide an estimation of the quantity and delivery time. Thus, as seen from the cube number 3, the uncertainty is reduced in the *when?*-dimension and *how much?*-dimension, and by this the total uncertainty is reduced further. Moreover, production activities might have increased which is illustrated by the full P-line in figure 3.10.

4. The information concerning the customer order is more accurate. Even now, a lack of information in the *when?*-dimension is still present.

5. Finally, the produced customer order is received i.e. a "perfect" order and the entire dimensions are certain. Therefore, the uncertainty cube is set at 100% certainty.

In this example, the producer is able to make a decision with full certainty only after the customer order has been received. If a decision has to be made before this point in time the decision will -by definition- involve some degree of uncertainty.

The previous discussion regarding customer demand certainty/uncertainty was based on a crucial tacit assumption; the information concerning customer demand is *symmetric* throughout a company. This means that all the participants in the organisation receive the information concerning customer requirements in the same instant.



Figures 3.10. The Uncertainty Cube and the CODP
Source: Wikner and Rudberg (2001a, p.17)

3.3.4 Upstream and Downstream shifting of the CODP

Any positioning change of the CODP has to be strategically appropriate, i.e. it should strengthen a competitive priority. By shifting the CODP upstream, the competitive priority will be strengthened, through a shorter lead-time. Another option for achieving this is by reducing the production lead-time and maintaining the CODP in its initial position. This has the advantage of reducing some in-process inventories, on the other hand, this is probably more complicated to realise. If delivery time is essential for winning in the market place the CODP should shift accordingly to the new requirements set by the market (Olhager, 2003).

A move to the right in figure 3.7 signified a down stream shifting; conversely, a move to the left is an upstream shift. Next, the pro and cons of shifting the CODP downstream and upstream are analysed.

Downstream shifting

Reduce the delivery lead-time to customers, and increase the manufacturing efficiency, i.e. by minimising the bottlenecks, are the two most important reasons for downstream shifting of the CODP. For example, in the case of sequence dependent set-up times on a bottleneck, it would be beneficial from an optimisation perspective to run this resource based on a forecast, rather than having to be exposed to the fluctuating customer order items and quantities. From a customer point of view a downstream shift may improve delivery speed, reliability, and price. The upstream shifting disadvantages are i.e. the increased level of uncertainty, reduced level of customisation and increased level of inventory (Olhager, 2003).

Upstream shifting

Increasing the knowledge of the dimensions of customer orders at the time of production, i.e. allowing a higher degree of customisation and reducing the amount of inventory are the main advantages for upstream shifting. Furthermore, the risk for obsolete materials in inventories and the dependence on forecast in the production will be reduced. The disadvantages for an upstream shifting are the longer lead-times and the reduced reliability. Moreover, the efficiency in the production is most likely to be reduced since the production activities will be exposed to demand variability (Olhager, 2003).

3.3.5 The MTS/MTO combination by means of the CODP

Finally, yet important to mention is that the MTO and MTS strategies in practice can operate in a hybrid MTO-MTS. Given the different strategic context in which this situation appears it is important to understand the different managerial actions compared to a pure MTS or MTO setting. The differences that these strategies (MTO and MTS) represent on the production planning, performance measurement competitive priorities and operational issues are illustrated in figure 3.11 Questions arising from

this combination are i.e., which product should be produced to stock and which to order, and how to share the capacity between those. A possible scenario is that MTS products could be manufactured to fill-up over-capacity in periods of low demand (Soman et al., 2002).

Issues	MTO	MTS
Production Planning	-Order execution	-Anticipating demand (forecast) -Planning to meet demand
Performance measurement	-Order focus: avg. response time avg. order delay	-Product focus: fill in rate avg. inventory level
Competitive Priorities	-Flexibility -Shorter delivery lead-times	-Higher capacity maximization -Cost reduction
Operational Issue	-Capacity planning -Order acceptance/rejection -Attain high due dates adherence	-Inventory planning -Lot size determination -Demand forecasting

Figure 3.11. Different Approach of MTS and MTO on Central Issues
Source: based on Soman et al. (2002)

The dichotomy MTO/MTS are affected by multifaceted factors. Issues concerning MTS/MTO strategy are complex and analytically intractable. Therefore, they must be unfolded in smaller tractable problems to make it possible to scrutinise and make the *right decision*. Soman et al. (2002) divided this issue into three decision levels:

MTS/MTO decisions

This level concern issues with planning horizons that range from a couple of months to a year. The decisions are taken periodically with a strategic view and a low degree of operational details. MTS and MTO decision is taken at this level. The factors in figure 3.11 occur simultaneously. Therefore, the trade-offs between them must be taken into consideration. The main interest is to balance the required service level and the costs. This is done by concurrently analysing the market demand and the product-process characteristics. Inputs for the choices

made, are the strategy formulation made by business unit level of strategy, see section 3.1.2, aggregate demand forecast and information from the lower levels of decision (Soman et al., 2002).

Production and inventory decisions

This level treats issues with planning horizons that range from a couple of weeks to a month. The main issue is to balance the level of producing to stock, with an increasing amount of uncertainty. The goal is to allocate the production capacity between MTS/MTO products for *maximising the expected profit* while maintaining the required service levels measure by due-date performance for MTO products, and capacity utilisation rate for MTS products. Concrete examples of decisions made on this level are capacity allocation between MTS and MTO, order acceptance, lot size and inventory policy. The framework for the choices made at this level moves down from the MTS/MTO level, customer demand forecast. Other important pieces of information come from the feedback generated by the lower level (Soman et al., 2002).

Scheduling and control decisions

This level treats issues with planning horizons that range from a day to a week, and it entail a great level of detail. The main concern is on scheduling and control decisions. The goal is to minimise the set-up times and maximising capacity utilisation, while meeting order requirements and inventory policy decided in the upper-levels. The direction for the decision in this level is determined by the previous level and the actual customer demand. Moreover, the feedback from the actual production i.e. machine failure and product queue is an input to this level (Soman et al., 2002).

The described hierarchy is depicted in figure 3.12. The figure shows how the CODP decision is broken into the decision levels. As mentioned Earlier, the CODP is an infrastructural decision within manufacturing strategy content. More specifically, it is a manufacturing and control

issue, see figure 3.3. It is worth keeping in mind the relationship among content elements, which are not illustrated in the figure.

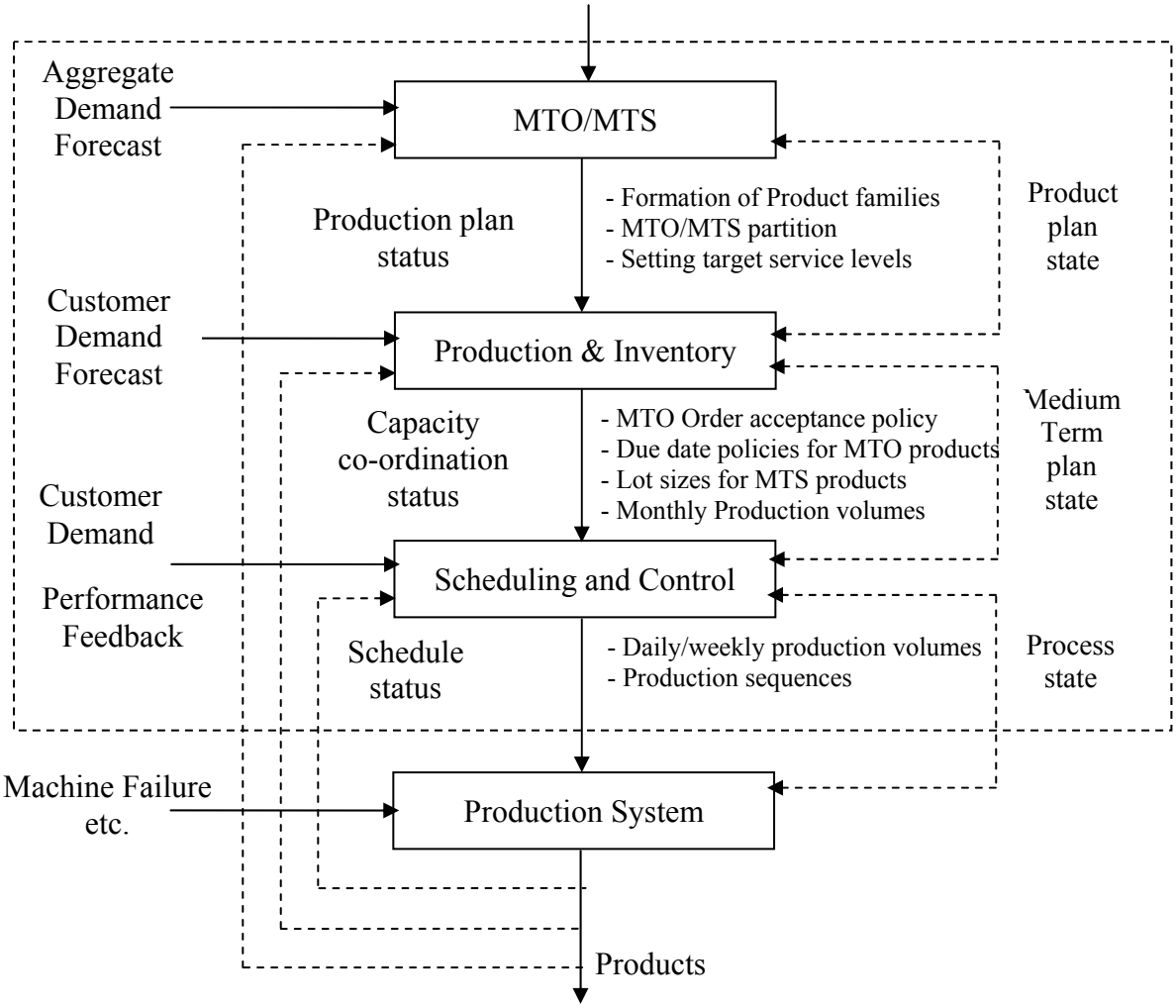


Figure 3.12. Hierarchal Approach to MTS/MTO Problems
Source: based on Soman et al., 2002

Hill (2000) uses a similar hierarchical approach when he treated the interface of *operation planning and control* (pp. 248-250). Hill's hierarchy is composed by demand management and planning, scheduling and execution. Anthony and Govindarajan (2001) place the operational planning and control in context (p. 6). This is illustrated in figure 3.13, where strategy formulation could be seen as the corporate (business unit) strategy that gives the framework regarding goals, strategies and policies. The management control box includes figure 3.12. This is illustrated by

the dotted rectangle appearing in both figures 3.12 and 3.13. Task control is the production system in figure 3.12.

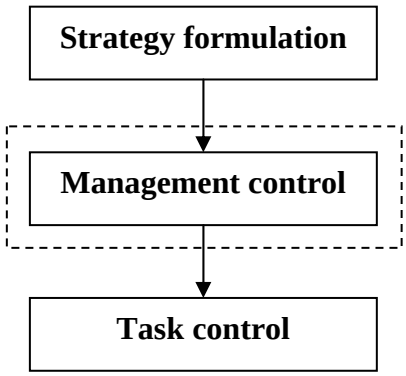


Figure 3.13. General Relationship of Planning and Control
Source: based on Anthony and Govindarajan, 2001, p. 6

4
RESEARCH FINDINGS

Chapter four is a description of the present situation at AvestaPolarit in Degerfors, which is founded on the research findings attained from the case study made at the company. The findings are a summary and an interpretation of the interviews, supported by observations and documents to some extent. The study focused on four departments at the company.

The interviews made at AvestaPolarit focus on the four relevant departments for coping with the purpose. The relevance is born from the problem description and the manufacturing strategy literature. The departments are the Financial Department, the Manufacturing Department, the Logistic Department and the Marketing Department. Interview guides were used when performing the interviews. These are presented in Appendix 4. The chapter is a summary and an interpretation of the recorded one to one and a half hour long interviews with representatives from the departments, supported by observations and documents.

4.1. THE FINANCIAL DEPARTMENT

The Financial Department includes five employees and the financial representative is one of them, and works as a production controller. This controller job is closely related to the production, with a main interest in the management of the capacity of the production process "*in yield, utilisation and so on*". The production controller generates budgets, cost estimates and data to the ABC-system. The system was implemented in 2002, with help from an external consulting firm. This system is only used for monitoring the past performance and not as a management tool.

The goal is that the employees at the Marketing Department will learn how to use the ABC-system, as an information tool when writing new orders. According to the representative at the Financial Department, a dialogue has been initiated between the departments of Finance and Marketing. This discussion is striving to increase the Marketing Department understanding of the elements and application of the ABC-system.

The production costs are monitored on a monthly basis through rough cost estimations, where only the large picture of the different costs is presented in a one-page table. The different process steps and the administration are divided into different cost units. It is worth noting that the completing process steps (cutting, pickling, inspection and packaging) are more costly than the production steps (heating and hot rolling). The costs are separated into fixed and variable costs, where only one cost driver drives variable costs, the amount of tonnage. All costs are finally divided by the produced amount of kilos or number of plates during the current period. This yields the production cost per kilo or cost per plate. This rough estimation of costs is a tool to monitoring if the production is following the budget plan. The ABC-system is more detailed when estimating the different costs. The material is excluded from the rough cost estimation, but according to the financial representative, represents 70% of the total cost. An important parameter regarding material costs, is the difference between input and output (yield loss). According to the representative, the yield for “easier” to produce products is 85%, but for a more “difficult” to produce, the yield is approximately 65%. A low yield means that the amount of scrap from the process is high, and the usage of the purchased material is low, resulting in higher finished plate cost.

AvestaPolarit is using the principle of lowest value when valuing the stock. The company does not charge a specific stock cost on each product. Instead, each plate is given an average stock cost.

The present cost system at AvestaPolarit does not have any active role in the decision making process. The system is only used for monitoring and benchmarking. A thesis concerning pre-calculations has been made at the company, but the findings from this paper have not yet been put into action.

The tonnage dimension of an order is one of the most important parameters that determines the product cost. From a cost perspective, there is a huge difference between producing one plate and producing several plates, with the same characteristics. It is also often difficult to co-ordinate different orders to optimise the production, even if the Logistic Department is trying to achieve this, the representative said. To co-ordinate the production it is necessary that the order arrives during a three-day period and is of the same thickness and steel grade. If the plates were produced for stock, then it would be easier to improve the production by co-ordinating orders. The financial representative thinks that it is better to produce for stock, from a manufacturing perspective. The problem with this is that the products must be common and easy to sell, in other words standard products. AvestaPolarit already has a small stock of finished products. Because the company have customised products as a marketing strategy, it is difficult to have too many products in stock. The representative questions if this is the correct marketing strategy. The representative supports this assertion by manifesting that in the short run HRP does not earn any money on small and uncommon steel grade orders. It could have an impact in the long run by securing future cash-flows, but this is uncertain. At the same time the plant in Degerfors is dependent on tonnage, with an aim of 110 000 tonnes in 2004, "*maybe it will be necessary to accept all orders*", the representative responded. Even if some orders do not generate a profit, they may give a contribution to the company and from this perspective are of interest to the HRP the representative affirmed. A contributing order is one that generates enough money to cover the material cost and the variable costs, but does not completely cover the fixed costs. In general, at least an order size of 15-20 tonnes is necessary to generate a profit.

According to the present five-year plan the costs are expected to decrease. The main reason for this is that the delivered amount of tonnage will increase causing a cost reduction. The financial representative also believes that the administrative costs are too large, and have to decrease during the coming years.

During the summer of 2003 the heating process was rebuilt at HRP in Degerfors, this augments the heating capacity. From a cost perspective it has now become important to load this process step in a way that minimises the energy losses. The financial representative said that after the reconstruction of the heating process the bottleneck almost disappeared. Currently, the bottleneck is usually in the completing steps and it is moving dependent on the product mix.

The information produced by the Financial Department is communicated through reports sent to the mother company Outokumpu Group in Finland. However, reports are also produced for HRP in Degerfors i.e. to the departments.

The financial representative thinks that level of centralisation is increasing in the whole Outokumpu Group. This will lower the level of independent decision making for each business unit, and instead the important decision will be taken on a central level in Finland. For example, HRP must change the present internal report system into a system that is unified for the whole group.

The financial representative argues that experience, their own and from others, is the most important parameter in order to take the right decision concerning orders.

With reference to the departmental linkage, the representative said, "*the departments of Finance, Manufacturing, Logistics and Marketing are often living in different worlds and have different views on the same issues*". The representative explained that the information flow and

linkage between the Financial Department and the departments of Marketing, Logistics and Manufacturing is not sufficient. The representative argues that the main reason resides in the physical distance between the departments. This distance governs the likelihood of spontaneous and informal meetings between co-workers belonging to different departments. These relations have increased the information flow between the departments on a daily basis.

4.2. THE MANUFACTURING DEPARTMENT

Quarto Plates are made of steel slabs. A slab is a rectangular piece of solid steel weighing several tonnes. The HRP imports 85% of these slabs from SMACC in Sheffield, England, and 15% from Avesta, Sweden.

The production is run on five shifts, 24 hours a day. The first step in the process is the *Grinding Hole*. At this stage, the slabs are ground and cut to suitable sizes for plate manufacturing. In the *Walking Beam Furnace,* the slabs are heated up to 1230° Celsius. During the summer 2003, the heating system was upgraded, by increasing the numbers of burners and by increasing the level of oxygen in the burning gas mix. These modifications have increased the capacity by approximately 30%, "*hopefully*" 40% explained the manufacturing representative. The next step is the *Hot Rolling*, where the slabs are rolled under pressure of 4500 tonnes in a *4 high reversing mill*. The rolling mill is from 1962, "*but still running quite well*". The thickness of the plates produced range from 5 mm to 105 mm. To give the plate optimal mechanical properties and corrosion resistance the plates are reheated in the *Roller Hearth Furnace*. In the *Straightening* stage, the plate consistent properties and plate straightening are achieved through carefully controlled rolling. This stage is followed by the *Cutting Line* where the plates are cut to high dimensional tolerances. Depending on the thickness and shape automatic plasma, cutting, manual plasma cutting or laser cutting is used for cutting the plates. If special edge specification is required by, the customer the

plate goes through *Edge Preparation* if not the plate goes directly to the *Pickling Line*. In this stage, the plate is shot blasted and sprayed with acids. This is done to remove scale from the heating and rolling process, but also to maximise the surface finish and corrosion resistance. Finally, the plates are inspected, marked and packed. It follows from this description of the production process that a high degree of dependent lead-times is present, see figure 4.1.

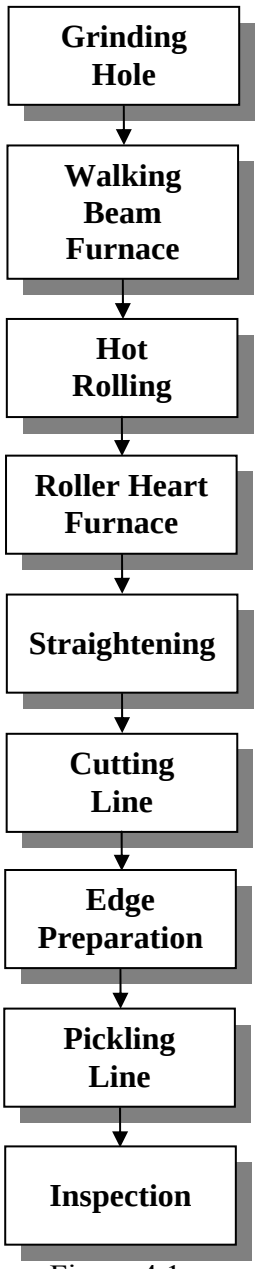


Figure 4.1.
Production Process
Source:
based on
AvestaPolarit, 2001b

When observing the production it became clear that the natural number of planning points is four. The first goes from the grinding hole to the straightening. The second planning point is the cutting line and the third is the edge preparation. Finally, the pickling inspection, marking and packaging conform the last planning point.

It is possible to produce a large amount of different QP products by combining grades, sizes and edges.

There are several set up costs associated with changing the production line from one product to another product. The set-up times could be as long as 4 hours.

It is not easy to locate the present bottleneck in the production process. The reason behind this is that it moves in response to the product mix. Still, the manufacturing representative believes that the present bottleneck is mainly located in the *Pickling Line*. This is due to that investments to upgrade the operation are delayed at least two to three months.

"*Hopefully*" this investment will be fulfilled in the near future, the representative responded.

Six months ago, the *Walking Beam Furnace* was the most frequent bottleneck in the production process. The *Pickle Line* was also a bottleneck. This knowledge comes from several investigations that took place with the purpose of locating the real bottleneck at HRP in Degerfors. The findings also indicated that the bottleneck was moving between the production steps, and was dependent on the present production mix of QP. For example, after the investments in the *Walking Beam Furnace* were completed, the bottleneck became more frequent in the process of manual plasma cutting. Therefore, the company invested in a new manual plasma cutting machine to become more productive.

According to the manufacturing representative, investments in the production process have been successfully implemented. The capacity was increased from approximately 65 000 tonnes/year 1998, to 75 000 tonnes/year in 2000. This year the capacity is forecast to rise to 90 000 tonnes/year and the aim for to 2004 is 110 000 tonnes/year.

The representative of the Manufacturing Department expects that in the near future stainless steel for chemical tankers will represent a large part of the total demand. Standard products are a large part of the production today and the representative believes that this production will remain similar in the future.

The production planning and scheduling has been a big problem for several years, the manufacturing representative replied. "*I would not like to say a disaster* (meaning it is)". The representative explained that the main reason for this has been the split between the Manufacturing Department and the Logistics Department, which is responsible for the planning and scheduling. Earlier the detail planners belonged to the Logistics Department. The communication was poor and "*I can not say how much they worked together* (logistic department and the detail

planners), *I do not know. The only thing I know is what I got, and how they loaded the production. It was bad, it was real bad"*, said the manufacturing representative. One month ago (September 2003) the structure was reorganised and the detail planners were placed under the sphere of the Manufacturing Department. The manufacturing representatives hope that this will improve the operative planning and scheduling of the production. Furthermore, to improve the performance of the manufacturing, the representative is planning to implement a MPS-system (Material Planning System), which could verify the present capacity in all process steps of the production. This will allow the Logistics Department to load the mill with respect to these capacity limits.

Today the Logistic Department is over-loading the production line from time to time. The downside of this is the resulting late deliveries to customers and inefficient production. "*The problem is that the Logistic Department only plan the rolling*" this is the main reason for this problem arising. The Manufacturing Department cannot take the responsibility for the production if the Logistics Department load more than the practical capacity. The different lines do also have different capabilities, which also must be considered, when planning and scheduling the production. At present, "*they do not follow any rules to load the machines*" affirmed the representative.

Problems also arise regarding the supply of slabs. During the majority of the production weeks a lack of materials occurs. This has a negative impact since it is a waste production time, "*when production capacity is not used, it is lost for ever*", the representative alleged.

Today the only responsibility for the Manufacturing Department, in relation to the planning and control, is to "*put in numbers concerning consumption of time and capacity*", and the representative expects that the Logistics Department will load the mill with respect to these restrictions.

For the moment, the Manufacturing Department cannot influence the planning and scheduling largely. Nevertheless, the representative expects that the organisational changes and a new logistics manager, Robert van der Woude, will contribute to diluting this. "*I hope and think he can do a lot more than we have done before*". "We *need to start communicating more with the Logistics Department and the Marketing Department*", the representative concluded.

An important concern for the manufacturing representative is the closing of the stainless steel mill in Degerfors. The last melt was done the 26th of September 2003. The slab production was transferred to SMACC, England. This had had negative effects for the HRP. For example, the communication is more complex, the minimum delivery sizes are larger, the delivery time is longer and the scrap handling is more complicated than before. Moreover, new problems arise when small orders are produced in a special grade and given the required delivery size. "*We order one melt for one plate and then we have 75 to 80 tonnes in stock for a long time*" the representative illustrated.

From an Outokumpu Group perspective, the transfer of the production had generated scale effects with cost reduction.

The manufacturing representatives think that it is a good idea to produce plates for stock if it is standard QP and the company knows that it will be possible to sell these plates during a reasonable time horizon. The representative underlined that "*we have not worked in that way, ever*". Producing to stock makes it possible to run the production more efficiently. The production series could be made longer with the result of a lower unit cost. This is accentuated by the dependent lead-times in the production process, the manufacturing representative explained.

The representative thinks that the Manufacturing Department could provide a lot of information to the Marketing Department and Logistic Department. This will result in a more successful operation from those

departments. Beside technical advice, information concerning productivity, lead-times, cost per-operation and bottlenecks could be provided.

The Manufacturing Department has a better linkage to the Logistic Department compared with the Marketing. According to the representative, this is expected since the Logistic Department is situated between the two other departments. In general, the information flow could and should be developed between the departments. It is important to note that this does not necessary imply more formal meetings, the representative summarized.

The manufacturing representative believes that the newly developed active based cost (ABC) system is a step forward. It could be a helpful tool for all the departments to gain an integral understanding of the profitability structure of different products.

4.3. THE LOGISTICS DEPARTMENT

The Logistics Department is the link between the departments of Marketing and Manufacturing, according to the interviewed representative. The main task for the logistic department is to manage the whole supply chain. This ranges from the ordering of the melts to the distribution of the final plates.

The starting point for *"everything"* is the customer order. Commencing with the booking of the slab melts, through the scheduling and planning of the production, to the distribution of the final product. Usually, each customer is treated independently and differently. Some of the customers have long-term contracts, and therefore they have the possibility to make reservations in the production schedule, for the likelihood of needing stainless steel plates. The representatives call these customers "*Key*

Customers". Most reservations are made for standard products (general sales, see figure 4.3) and products for chemical tankers.

The customers' requirements always come in first place when planning the production. It is therefore important to have good communication between the departments, to secure that the requirements are possible from a technical and a profitable perspective. The logistic representative also said: "*I do not know the customers and I do not care"*. Meaning, the order conditions are set through the interaction between the Marketing Department and the customer. The order requirements are then the primary input for the planning of the production. *"I just work to fulfil those requirements"*, the spokesperson of the Logistics Department said.

Since the last decade, customers started demanding shorter delivery lead times and increased reliability. This follows the just-in-time trend, where the customer places the order as late as possible. The result from this is a reduced period from order to delivery.

Usually orders are not produced early. This is only done when there is unutilized capacity in the production line. It is important to keep in mind that that the early production comes from a perfect order and it is not produced for an unknown demand.

Slabs are the basic raw material for the production of QP. 85% of the slabs are produced at the group mill (SMACC) in Sheffield, and 15% from Avesta in Sweden. The transportation of the slabs from SMACC is a complex process and many actors are involved. The expected delivery time for slabs from SMACC is two weeks, and *"hopefully"* the slabs will be delivered on time. From an Outokumpu Group perspective, even if the transportation is expensive it is cheaper to buy from SMACC, compared to the production remaining in Degerfors.

It is possible to buy 18 melts per week. Each melt contain 145 tonnes and it is not possible to buy a part of a melt. For example, sometimes a melt is

purchased to satisfy an order of just five tonnes of the special grade. In this case, 140 tonnes of raw material will be stocked. This material may stay stored for over a year. This restriction makes order size an important aspect when setting the delivery time. A way to cope with this is to split a melt with another company in the Outokumpu Group, nevertheless this is not a typical operation.

The production lead-time is very dependent on the current level and mix of the present plant loading. Now the load is 80 000 tonnes a year, therefore the approximate time to fulfil an order is eight weeks. Under other periods, the loaded quantity has been much less, and the theoretical production time has been as low as two weeks. Further reasons for variability of the lead-times are machine break down, complexity on the slab supply, reservation made etc. Based on observations the logistic department have problems in fulfilling the promised delivery-time to the customer.

During periods of short loads in the production, the communication between the departments of Logistics and Marketing is more frequent, sometimes occurring on an hourly basis. The main intention is to maximise the capacity utilisation. The informal communication is aided by the fact that the two departments share the same floor in the office building.

The aim of the scheduling and planning is to fill up the rolling process subject to satisfying the customers' delivery requirements and production constrains. The reason behind the fill up priority is that the production manager desires the rolling process to be filled up, as a method to pull slabs from the grinding and to push rolled plates further in the production line. A crucial parameter is the mixing of orders. This is done by taking into consideration the character of the material and the thickness of the produced plates (5mm - 120mm). It is worth noting that no profitability considerations are taken into contemplation when planning and scheduling the production. A computer program aids the production

scheduling and planning. For example, the system keeps track of the level of raw material needed, material on stock, and opened melt orders. The computer system also provides information concerning the booked production capacity structure. This information is classified in reserved, confirmed and planned orders and confirmed but not planned orders. Information regarding real production times is collected and used for future production planning.

The representative said that the main competitive priority for the company is short lead-time to the customer so HRP is prepared to produce some orders in a shorter time. This is accomplished by reserving capacity in the system and making it possible for these orders to bypass the existing production queue. The logistic representative calls this short lead-time route "*Gräddfil*" (VIP-line), which is a Swedish expression when someone does not need to wait in the established line. Best-case scenario, if an order is made before Thursday, the delivery could take place during the coming week. The Marketing Department should treat this production possibility with care, for two main reasons. First, these opportunities are costly and are very limited. Secondly, rapidly produced orders should generate extra value to the company, in monetary terms or in something else i.e. future selling opportunities. "*I hope they* (Marketing Department) *know this"*.

According to the logistic representative, the Marketing Department are using the relationship between delivery lead-times and prices when negotiating with customers. The problem is that the department only discusses minor changes in time and price with the customers. This is illustrated as the

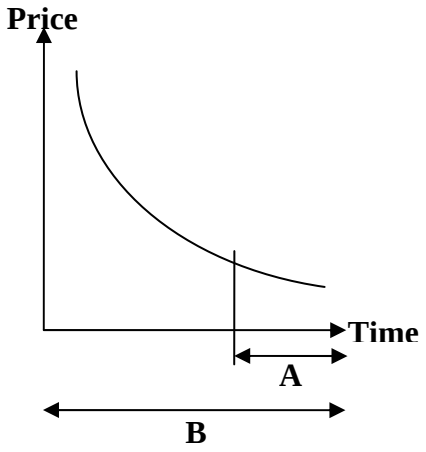


Figure 4.2. The Relationship between the Delivery Time and the Price of the Product
Source: Logistic Department, AvestaPolarit

double arrow "A" in figure 4.2. The spokesperson from the Logistic Department thinks it would be possible to increase this to larger changes in time and price, which is illustrated by the double arrow "B" in figure 4.2. It would be possible to develop this further by increasing the stock production, which will imply very short delivery lead-times and therefore increase the bargain position of the Marketing Department when negotiating new orders.

Regarding the bottlenecks the representative expressed that these are *"jumping"*, meaning that they are moving from one operation to another. The production mix is a significant factor affecting the location of the production bottleneck. The logistic representative thinks that the department has a good understanding of the different mixes impact on the location of the bottleneck.

In the year 2002 the production level was 75 000 tonnes a year, and this year (2003) the production level will be about 100 000 or 110 000 tonnes a year. According to the logistics representative, it is possible for the rolling mill to produce this quantity, but maybe not for the grinding hole or the pickling line. Nevertheless, the Logistic Department load the rolling mill full up, and have promised the Manufacturing Department to load the mill with 3 600 tonnes per week and *"we shouldn't go over this"*.

Overbooking can happen from time to time. However, this does not have to be a problem. Since, it is possible to outsource some production operations to external parties. It is important to note that this is only possible for some operations after the straightening stage.

AvestaPolarit have some products in stock. This stock is a result of the take over of TKN. Furthermore, to supply internal customers (service centres). Usually the rule governing the decision on what and how much has to be stocked is "*the finger in the wind guess*" but also past

experience. The representative thinks that the way this decision is taken is likely to change in the near future.

In relation to the link between the departments, the logistic representative said: "*Hopefully*" the employees at the Marketing Department have sufficient information about the present load at the plant. In view of the fact that this information is crucial for promising something to the customer that the Manufacturing Department is able to accomplish.

In the past, we had logistic personnel in the production. Nonetheless, nowadays these employees belong to the Manufacturing Department. Therefore, currently the Logistics Department verify the production flow through contact persons in the grinding hole, the rolling mill and the pickling line.

Every Wednesday representatives from the department of Logistics, Manufacturing and Marketing meet. During those gatherings, information is exchanged concerning selling, planning and production issues

In performing the logistic task, the department could have great use of demand forecasts and offers made from the Marketing Department. Currently, the Logistic Department receives short-term demand forecasts, however they are not so accurate all the time, said the spokesperson. On the other hand, the offers made are not shared and therefore, the Logistic Department do not consider them when planning and scheduling.

The representative evaluates that no more short-term information is needed from the Manufacturing Department. However, the representative asserted that that there is a lack of information concerning the long-term manufacturing activities.

The representative contradicts this when explaining the lack of understanding regarding the effects of operation requirements for different products at the department. This understanding is important,

since it makes it possible to fully utilise the resources used in the production.

The newly created ABC-system could be useful for shifting the focus from capacity utilisation to profit maximisation. The representative at the Logistic Department thinks that the ABC-system is trustworthy. However, in practice this system might be difficult to implement as a planning tool.

4.4. THE MARKETING DEPARTMENT

Figure 4.3 illustrates the sales organisation at the Hot Rolled Plate in Degerfors. The marketing manager has the overall responsibility for the marketing function, which is divided into four sale segments.

Figure 4.3. Sales Organisation at HRP
Source: Market Representatives at HRP

New application is the smallest sales segment, focusing on QP applications. Pulp & Paper and Chemical Tankers generate a sale of above 50% of the total, depending on the number of active construction projects on the market. These two segments share the characteristics of generating a smaller number of orders, containing a large quantity of stainless steel. General Sales is the largest segment, counted in number of customers and employed personnel. The number of QP products in this segment is very large, but the demanded quantities in each order can be rather small.

The market price on metal (nickel and chromium), production cost, and world market price of QPs are three important parameters for pricing of

the plates. The material cost constitutes about 70% of the finished plate price. The metals prices used in the production are very volatile, and therefore these prices are monitored carefully when setting the price of finished plates. This means that the price of identical QPs may change from one batch to another. AvestaPolarit stabilises the prices on QP by stocking some quantity of the needed nickel. The outcome of this strategy is that the nickel price on smaller orders equals the average price of the nearest two previous months nickel price. Larger orders will have a nickel price that follows the spot price. AvestaPolarit also hedge the nickel price of large and long duration orders. In this case, the customer receives a fixed plate price.

The plate prices are calculated from a base price system and a price variable based on average price of nickel, chromium and molybdenum for a two-month period, which started three months before the pricing date. There is a trend of increasing plate prices, since the amount of scrap steel in the world market is diminishing, because of ever-increasing demand from new actors. This results in a larger amount of premium raw material being used in the products.

Another factor affecting the prices is the negative relation between delivery lead-time and price. The prices increase if the delivery time is shortened. These prices are based "*on a feeling, what you do think you can get*". "*We try to get something extra from the customer when using this*". "S*horter delivery times by two to three weeks*" is the usual time span when discussing this possibility. There is an automatic weekly reservation of 50 tonnes of special and standard, made in the scheduling plan. This makes it possible to place orders with a shorter delivery time.

According to the sales representative, AvetstaPolarit's marketing strategy is not to offer the cheapest QPs to the market. Instead, the policy is to be reliable concerning delivery times, producing high product quality and offering an excellent full service program. These reliability concerns are

tracked and evaluated on a regular basis as a way to assess how well the competitive priorities are supported.

The demand in the stainless steel business is rather stable; nevertheless, it follows the cycles in the world market. For example, the demand in the coil industry is more volatile compared to the stainless steel industry. QP is used primarily in heavy industries and construction programmes. Projects in this segment area are continuous and are not that dependent on the world economy trend in the short run, however in the long run this correlation is significant.

Cover building with stainless steel has been a growing market. The initial cost is large, but in the long run this will be a good investment because the stainless steel is free of maintenance and has a very long duration. Another growing area is LNG-projects (Liquid Natural Gas). AvestaPolarit will have a bright future as a supplier of stainless steel in this type of project.

Orders are mostly based on offers, and therefore the sale force has accurate information about the requirements of the order before it actually turns into a definitive customer order. This information previous to the order is not shared with other departments. It is only shared in the case that technical advice is needed. The objective then is to get access to technical knowledge required to write the offer.

AvestaPolarit primarily competes on the requirements stated by the customer; still price is an important aspect. The normal time for producing an order and making it ready for delivery is eight weeks, said the sales representative during the interview. "*More or less, it is always the same time*".

The level of communication between the Marketing Department and the Logistics Department is strongly correlated to orders. If the order only includes standard products with a normal delivery time, the order is

booked without any additional sharing of information. Special products or orders with a short delivery date can require more contact between the departments.

Marketing has declined small quantity special grade orders, when remaining slabs from the melt are not foreseen to be sold in the near future. This order type might take place only if the customer is willing to pay the price of whole melt.

Profit is more important than the set selling goal of 110 000 tonnes/year. The special grades have a slow turnover and this is kept in mind. These kinds of orders are worth accepting if the company can make "*nice money*" on the customers' inquiries.

"*We do not keep any stock at all.*" is the response of the marketing representative when asked about the stock issue. Questioned about the possibility to produce to stock, the representative evaluated that it is possible to perform it for standard plates since it would be able to forecast with a high degree of reliability. This is explained by the fact that 60-70% of the sale of standard plates result from the demand of AvestaPolarit's Service Centres.

Every week all the departments at AvestaPolarit are represented at a meeting where information concerning activities, issues and problems at the different departments are presented and discussed. The department also has daily contact with the Logistics Department concerning issues on the operational level.

According to the representative, the Marketing Department take manufacturing concerns into evaluation when pricing stainless steel products i.e. products that are special or require a short delivery time will be charged a higher price.

The Marketing Department have no information with respect to slabs in stock. "*I do not care. It is up to the logistic department to fix that.* The expressed reason behind this is that it would be very difficult to push the QP into the market. Therefore, this information cannot be used in the selling function. Production is on demand. We have a product program (grades and sizes) that is agreed between the departments and we work from that, the representative added.

The Marketing Department representative thinks that the production capacity status is an important input from the Logistic Department, when performing the sale tasks. Moreover, the representative argues that this information is received.

Demand forecast is the most important information that this department can provide to the departments of Manufacturing and Logistic. This information is shared during the Monday meeting where the three departments participate. This is short term forecast from one to two weeks.

The marketing representative think that a system that includes all given offers could be valuable information for the Logistics Department when planning and scheduling the production.

With respect to the ABC-System, the representative argues that it would be very useful for the Marketing Department, if the information from it were reliable. In their opinion, the existing ABC is not reliable. The figures are not correct. The representative argues that the reason behind this is that the system is "*including losses for different things that we cannot affect really*" i.e. currency hedging. These "*things*" should not be included in the calculations. It must be based only on production cost.

5
DISCUSSION AND CONCLUSION

Chapter five synthesise the analytic findings made in chapter three and the research findings. It is in this chapter that the normative theory and the descriptive case study will be analysed and evaluated simultaneously in the form of a discussion, which generates the conclusion made.

Several conclusions can be stated by comparing the theory presented in chapter three with the research findings identified through the case study.

The essence of manufacturing strategy includes looking at the manufacturing from the perspective of "how we can compete". Meaning, how to make the best decisions to provide the transformation that produces a product, without forgoing the customer requirements. Thus, an effective manufacturing operation is not necessarily one that offers maximum efficiency, or engineering perfection, but rather one that fits the needs of the business, that is, one that strives for the consistency between its competences and the business competition to ensure goal achievements. A critical issue for realising this is the strategic linkage in the organisation.

5.1 STRATEGIC LINKAGE

Strategic linkage is one of three elements that form the content view of manufacturing strategy. The importance of this interrelation was explained in terms of reaching an internal and external fit. The internal fit was defined as the linkage necessary to develop internal

complementarities. Thus, this links search the harmonisation of the manufacturing competitive priorities and decision categories. Furthermore, it concerns the achievement of consensus between the infrastructural and structural manufacturing strategy content decision categories. Ultimately, it proposes closing the gap between the manufacturing and marketing perspectives. This is done by consenting the manufacturing competitive priorities and the market through the marketing mix. The external fit deals with how the resulting product of the interrelation between the competences and competition should match their environmental setting, mainly the market.

The focus of this master thesis regarding strategic linkage has been the internal fit. Since, one important objective of the case study was to evaluate the internal fit between the departments of Manufacturing, Logistics, and Marketing.

From performed interviews, indications were found that both the representatives of the Marketing and Logistic departments were pleased with the present linkage between the three departments. The marketing representative expressed no need for additional information from the other two departments when performing the sales task. Moreover, it is clear from the spokesperson's sayings that the department focus only on the market losing sight of the manufacturing issues. This is exemplified from the representative's view of the company's slab stock. Manifesting, "*I do not care, it is up to the logistic department to fix that*", even though the resulting stock is a direct consequence of the performed sales. According to Hill this situation is common in manufacturing organisations, see section 3.1.3. When it comes to the Logistic department, its spokesperson said that the starting point for "*everything*" is the customer's order. Implying that the focus for planning and scheduling is in fulfilling the customer orders written by the Marketing Department. This could be seen as a market-based approach on how to compete in the market place. It can be read from the research findings that the spokesperson from the Logistic Department understands the

importance of the information concerning the present load in the production line, when setting the order requirements with the customers. Nevertheless, it is not clear that the logistic department secure this. This could be seen by the disagreement between the departments of Logistics and Marketing, regarding delivering lead-time. On the one hand the representative from the Logistic Department, stresses the variability on the delivery time, because of factors as machine break down, complexity on the slab supply, current load in the production line, reservation made, product mix at the time and so forth. On the other hand, the marketing spokesperson affirmed that the delivery is "*more or less always the same time which, could only be modified by using the reserve capacity*"

With respect to the linkage the representative from the Financial Department sustained "*the departments of Finance, Manufacturing, Logistics and Marketing often live in different worlds and have different views on the same issues*" this could be interpreted as a dysfunctional internal fit, that is symbolised by a poor consensus between the departments. The representative mainly owes this to the physical distance separating the departments, which in turn dictates the likelihood of spontaneous and informal meetings.

The lack of internal fit became evident during the interview with the manufacturing representative. This was corroborated by how the planning and scheduling is performed. "*I would not like to say a disaster*", affirmed the representative. Far from what was expressed by the other departments, the manufacturing spokesperson identified four important reasons for problems in this area. First, the production is only scheduled for the rolling production step even if this is no longer the bottleneck. This become worse since the Logistic Department representative believes this is the preferable way to schedule the production. Second, no rule is followed for loading the machines. Third, the manufacturing department cannot influence the scheduling and planning of the production. Finally, the departments of Marketing and Logistic need to communicate more

with the Manufacturing Department. This could be difficult since these two departments evaluated that there is no need for this.

The conclusion made is that HRP has a market-base view of competition. As mentioned earlier this implies that the manufacturing is a perfect adjustable system that follows the rules dictated by the market, in the eyes of the Marketing Department. This is clear from the low influence that the Manufacturing Department can have on the business unit strategy in comparison to the influence that the Marketing Department has. Thus, the strategy seems to have been constructed as a top-down market-base approach, where there is no clear interaction between the different functional areas. This in turn jeopardizes the achievement of an accurate internal fit.

From the research findings the interrelation between the departments is illustrated as sequential dependencies, see figure 5.1. This flow is supported by the market-based view, where the Marketing Department drives the flow. This is best demonstrated regarding customer order treatment since the Marketing Department focuses on the external fit.

Figure 5.1. Sequential Dependence

5.2 CUSTOMER ORDER DECOUPLING POINT

As mentioned the CODP is an infrastructural decision belonging to the manufacturing strategy content, see figure 3.3.

The CODP is a useful way to depict the interrelation between customer orders and manufacturing issues. The CODP separates the activities into order-driven and forecast-driven. This is accomplished by separating the

value chain into two separate parts with respect to the manufacturing strategy. Implying that two manufacturing strategies must be developed one pre-CODP and one post-CODP, since its production planning, performance measurement, competitive priorities, and operational issues differ.

The uncertainty of the customer demand is a key issue regarding the positioning of the CODP. The theory stated that knowledge of the customer requirement is essential for achieving profit. This requirement was unfolded into three elements and are illustrated by the uncertainty cube, see figure 3.9. The discussion on how this uncertainty diminishes, when acquiring further information from the customer, was based on the assumption that the information is symmetric throughout a company. From the research findings, it was established that this is not a reasonable assumption. This is because the Marketing Department keep information private, implying the existence of asymmetric information. The marketing representative asserted that the customer orders are mainly based on offers made by that department. This offers content information, which is likely to be present on the forthcoming orders. This information is not forwarded to the Logistic Department, even if the responsibility of this department is to take the decision concerning time and mix of the production. It is important to note that the marketing representative thinks that forwarding this information to the Logistic Department could be valuable for planning and scheduling the production.

The example in section 3.3.3 will be replicated, but in this case, total asymmetric information between the departments will be assumed. This indicates an information mutual independency between the departments. As before the example is consists of 5 stages (see Figure 5.2):

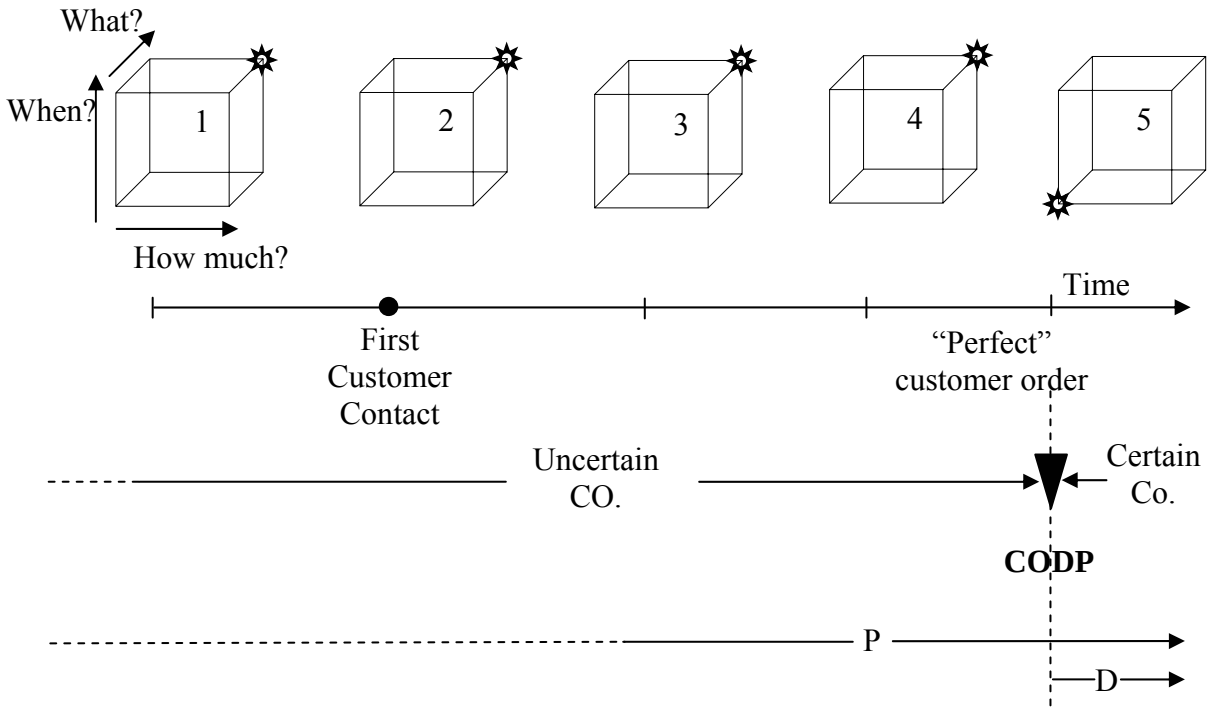


Figure 5.2. The Uncertainty Cube and the CODP-Asymmetric Information
Source: based on Wikner and Rudberg, 2001a, p. 17

1. At this stage, no information concerning the specification of the customer orders are known. Nevertheless, some kind of forecast i.e. based on historical data might be available. The uncertainty cube is set at 100% uncertainty, moreover *some* production activities could have started. This is shown by the dotted P-line in the figure 5.2.

2. If the information regarding the customer wants is known by the Marketing Department, the uncertainty is not reduced in the *what?*-dimension, since the decision-maker is the Logistic Department.

3. Later on, the customer may provide an estimation of the quantity and delivery time. Still the uncertainty for the decision-maker is 100%.

4. The Marketing Department is rather sure of the requirements of the forthcoming order, but the decision-maker does not possess this information.

5. Finally, the customer order is received, and the three dimensions are certain. It is at this stage that the Logistic department take acquaintance of a customer order and the customer order can be placed on the planning and scheduling.

As it is clear from the preceding example, the uncertainty has not diminished since a "total" independence of what is known by the Marketing department and the Logistic department is present. As long as the linkage between the two parties does not improve, the uncertainty to the Logistic Department will not diminish when the Marketing Department receives information concerning customer demand.

The effect of an improved linked between the two parties will affect the:

- *Time-to-market,* given that the production activities can be started before in time with a reduced uncertainty. Therefore, the production of the right product specification can be improved.
- As a result of the reduced time-to-market, *higher prices* could be charged since "time is money" and the customer might agree to pay a plus for this improvement, see figure 4.2.
- The *manufacturing optimisation* is more likely to be achieved given the better planning and scheduling that the improved information from the improved link might provide.
- *Efficiency of the stock management* may well be improved in view of the fact that the increased information quality, could aid in the determination of which customers (products) are more willing to pay the plus price for the shorter lead-time.
- *Capacity utilisation* will probably be higher due to the improved information. Since, even when no customer order exists, the knowledge of possible orders, i.e. offers, can initiate the production activities.
- Increase *stock turnover* is likely to be seen given the improved information link. The logistic department could better estimate which products are more likely to be sold in the future.

Apart from the flow of information between the departments concerning customer demand, other factors were identified as influencing the positioning of the CODP. These factors were classified as market, customer, product and production related. When performing the case study the relevance of these was explored.

The market-related factors can be unfolded into:

Delivery lead-time. The representative of the Logistic Department expressed that the lead-time had decreased, because the customers place their orders as late as possible. The representative also explained the importance of the relationship between price and time, see figure 4.2. Moreover, the marketing representative affirmed that an order-winning factor is to have a short and reliable lead-time. These circumstances imply that some degree of speculation is to be needed to shorten the delivery lead-time.

Product demand volatility. The representative at the Marketing Department described the demand as being rather stable and in the long run related to the development of the world economy. The representative explanation for this is that the relationship between the business segments has a stabilising effect. A stable demand supports a speculation approach. It is worth noticing that for very special products the demand is volatile, which supports a postponement approach. Nevertheless, this is a small part of the total sales.

Large sales volumes. The product structure can be divided into standard and special products. The former represents 85% and the later 15% of the total production confirmed by the logistic representative. 60-75% of the standard products are internal orders from the company's Service Centres. For standard products the sales volume is large, thus the inventory turnover is high, supporting a speculation approach. For special products, the sales volume is in most cases low, thus, the inventory turnover is low, supporting a

postponement approach. The marketing strategy of offering an excellent full service, encourages the production of special products.

Range and product customisation. The HRP offers a wide range of products by combining grades, sizes, and edges explained the manufacturing representative. This in line with the marketing strategy, see previous factor. This in turn supports the use of some degree of postponement.

The customer –specific factors have been divided into:

Customer's profit contribution. The activity based cost system, which could yield the profit by customer/order, has been developed, but still it is not used as a pro-active management tool. The logistic representative manifested that this system could be useful for shifting the focus from capacity utilisation to profit maximisation, in the planning process. The spokesperson from the manufacturing department also believes that the ABC system will serve to gain an integral understanding of the profitability structure of different products. These circumstances make it difficult to make a statement regarding speculation/postponement.

Grouping of the customers into clusters. At this time, it is not easy to cluster the customers, since orders are the drivers of the manufacturing. Intrinsic to an order driven production is the postponement approach. The question is if this is the accurate way to proceed for every order, product or customer. This is supported by the fact that it is difficult to coordinate the orders in a way to optimise the production, affirmed the representative from the Financial Department.

Third is the product-related factor discussed, which is:

Customisation opportunities. In the HRP production, the product can be customised as early as the procurement of materials. Given that, the grade specification of the final plate is determined by the composition of the slabs, which is the basic raw material. The customisation process of the product escalates through all the production line. This gives an incentive for a postponement approach. However, it is necessary to keep in mind the composition of the product structure, where 85% correspond to standard and 15% to special products.

The production-related factors were divided into:

Production lead-time. The transfer of the slab production to SMACC in England increased the production lead-time. This is because the delivery lead-time increased and reliability decreased concerning the supply of slabs compared to when the slabs were produced in Degerfors. This lack of reliability causes a waste of capacity and disturbs the planning and scheduling, which consequently make it more difficult to optimise the production. Moreover, some deficiencies were noticed regarding the accomplishing of the time to market. All these aspects support a speculation approach.

Number of planning points. From the research finding, it could be read that the number of planning points is four. This is intrinsic to the production process, where some stages must be treated as one entity. For example, some plates that are of the same thickness and grade could be produced until the straightening stage and then stocked. At this stage the dimension of the plate is not clear. Later on, driven by a customer order the plate can be cut to the requested size, and follow the production line. Having several planning points through the production simplified the application of a speculation approach.

Flexibility. From observation effectuated at the HRP production facilities, it is possible to state that the plate production has to follow a fixed route, thus it is not flexible. To optimise the process the demand should be stable. This could be aided by following a speculation approach, where the production is forecast-driven.

Positioning of the bottleneck. Positioning the CODP downstream relative to the bottleneck permits its best utilisation, since its filling is by forecast demand. In the case of the HRP the bottleneck moves dependent on the product mix, this was explained by the manufacturing, logistic and finance representatives. By using some degree of speculation, it could be possible to establish the preferable product mix, which minimises the probability of the bottleneck's appearance.

Sequence-dependent set-up times. For the same reasons discussed in the two previous aspects of the production-related factors, it is preferable to some degree of speculation as a method to aid the scheduling of the sequence-dependent set-up time operations at the HRP.

Capacity utilisation. Given the fact that the production planning is focused on incoming orders the planning cannot maximise the capacity utilisation. The manufacturing representative affirmed that this is a big problem and expressed "*when production capacity is not used, it is lost for ever*". At the same time, the aimed production level has increased in the last couple of years. This implies the necessity for better utilising the capacity and therefore gives a reason for using some kind of speculation strategy.

As seen from the above analysis it is not possible to establish a clear cut, whether the elected manufacturing strategy regarding the CODP should be founded on a speculative or postponement approach. As described this is a multifaceted decision, where the trade-offs should be carefully

analysed. In other words, more than one of the four CODP typologies (MTS, ATO, MTO and ETO) is relevant. According to the theory, this is a common situation for most companies that operate in more than one market or product like the HRP at Degerfors.

From the interview with marketing representative, it was discovered that the production is order-driven. This implies the usage of an MTO strategy. Further, the company have a fixed product program formed by dimension and steel grades. The conclusion from this is that the company do not use an ETO approach. The research findings and the factor analysis indicates strong incentives for a MTS strategy. The interview with the logistic representative pointed out that some stock was already in place. However, this is not to be confused with having a MTS strategy

Between the MTS and MTO the ATO strategy is located. As explained when analysing the number of planning points, an ATO strategy is possible at HRP. In summary, the three relevant CODP strategies for the HRP are MTS, ATO, and MTO.

Next, the combination of these strategies will be considered. However, the ATO strategy will be excluded for simplicity reasons. The assumption made is that since the ATO is located between the MTS and MTO strategies, it will be evaluated indirectly.

When operating in a hybrid MTO/MTS the conjunct implications concerning production planning, performance measurement, competitive priorities and operational issues must be considered. Given that, each strategy requires different managerial actions.

The research findings indicated that even though the HRP is on a MTS/MTO situation, it only focuses on customer orders. The orders drive the production. In other words, an MTO strategy is applied. The HRP situation can be further analysed by the means of figure 3.11. The production planning issue is set by a MTO strategy. The logistic

representative replied that the starting point for all the operations is the customer order. This was also emphasised by the marketing representative. No indication of planning to meet demand was encountered, the forecast made is for short time periods and based on secured orders. The performance measurement has an order focus, since average lead-time and order delay are considered as the principal indicators of accomplishment, explained the marketing representative. The competitive priorities are, Flexibility with the aim to have an excellent full service programme, and lead-times with an aim to offer shorter delivery lead-time. The logistic representative expressed that the latter was not considered to a full extent. Lead-times could be shorter and this should be followed by increased prices, see figure 4.2. Finally, operational issues have a very strict MTO focus, explained the logistic representative. Only to some extent were inventory planning and demand forecasting performed at the HRP.

The conclusion made is that that the HRP have incentives to apply an MTS/MTO strategy. However, the company only focuses on the customer orders (MTO). Even more, the production is scheduled simply by taking into consideration the current orders, with little concern for the long-term demand. All these imply that AvestaPolarit do not have a MTS strategy. From this, it is obvious that the company do not posses a hierarchical approach suggested in figure 3.12, to combine the MTO/MTS situation.

Through the application of the solution offered by manufacturing strategy, AvestaPolarit is likely to achieve short customer lead-time (competitive priority) and at the same time improve the allocation of resources through a manufacturing process optimisation.

6
RECOMMENDATION

The last chapter presents the recommendation to the logistic manager, Robert van der Woude, at AvestaPolarit. This is a framework constructed from the conclusions drawn, which are founded on the investigated theory and the research findings.

At present, a MTO strategy is used, and the primary recommendation is that AvestaPolarit should have a MTS/MTO production planning strategy. Several factors were identified for supporting this strategy. The most important ones are the increasing significance of the delivery lead-time together with the raised production lead-time due to the move of the mill to SMACC, England. Moreover, the low demand volatility for large sale volume products, and high demand volatility for low sale volume products also supports the MTS/MTO decision. The characteristics of the production process with moving bottlenecks, due to changes in the production mix, together with the intrinsic sequence-dependent lead times make it natural to apply some kind of speculation strategy i.e. MTS for optimisation reasons. Finally, the increased production level is a further reason for adding a MTS strategy to the present MTO to improve the capacity utilisation.

It is intrinsic to the MTS strategy making production-planning decisions under uncertainty. Since the production is initiated before, the customer makes an order. The research findings indicated that the information concerning customer orders is asymmetric. What is more, this information is located in the Marketing Department. As the example in chapter five, showed the uncertainty does not decrease for the Logistic Department until the order is made official. In the past, this situation was not crucial since MTO was the applied strategy. However, in

recommended MTS/MTO strategy, this turns out to be essential for minimising the level of uncertainty when producing to stock.

It is worth noting that the shift from a MTO strategy to a MTS/MTO strategy pose different requirements to the production planning, performance measurement, competitive priorities and operational issues. These should be treated with an MTS and an MTO approach simultaneously, depending on if the production is forecast-driven or order-driven, see figure 3.11.

The combination of these issues is complex and analytically intractable. Therefore a hierarchical approach is recommended, see figure 3.12. These levels should live inside the Logistic Department, since it is responsible for the whole supply chain. However this hierarchy is dependent on important inputs from the top-management regarding the corporate strategy, Marketing Department concerning demand forecast and order winners/qualifiers, Manufacturing Department for the production status and free capacity, finally the Financial Department should proportionate information with respect to the profitability structure i.e. cost drivers.

To succeed in applying the hierarchical approach to a MTS/MTO problem, the internal fit between the departments is a prerequisite. Since the dependences will turn out to be more complex. The sequential dependence, see figure 5.1, is appropriate for an order driven production. In an MTS/MTO situation, like the one recommended, there would be an increase in the interdependence between the departments and therefore the approach to be used for linking them must be adjusted as well; From a pure sequential to a hybrid between the pooled and reciprocal, as shown in figure 6.1. This is believed to achieve an improved strategic linkage and coordination, provided that the Logistic Department will serve as a consensus-maker of the market-based and the resource-based view in the hierarchical approach. In other words, the link between competences and competition will be improved, see figure 3.12. This consecutively is likely to provide a stronger voice to manufacturing issues.

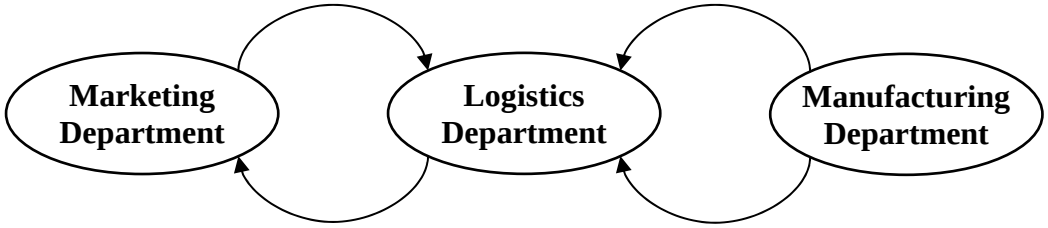


Figure 6.1. Pooled/Reciprocal Dependence

By combining the suggested hierarchical approach and the hybrid pooled-reciprocal dependence the following can be suggested. The product plan state should involve the Marketing Department. On the other hand the process state should comprise the Manufacturing Department. Finally, the medium term plan state should involve both departments.

In summary, a framework for gaining understanding of the implications that customer requirements and the new supply chain pose on the production planning was proportionate. This was analysed by the means of the CODP and the uncertainty cube. Furthermore, a hierarchical approach was suggested for aiding the linkage between the customer and production requirements, given that the context poses an MTS/MTO situation, which could be assisted by this approach. The internal linkage at the HRP was researched and evaluated. It was affirmed that a transformed linkage was necessary to support the recommended MTS/MTO strategy.

Additional research should focus on the definition of which products/orders/customers should follow a MTS or a MTO strategy. This should be done with respect to the competitive priorities, see figure 3.2. Moreover, the hierarchical levels of the MTO/MTS decision recommended are a general framework; further effort is needed on this. For example, on the design of policies for: the formation of product families, MTO acceptance, lot sizing for MTS products, production sequencing, setting target service levels, etc.. Moreover, the means for improving the internal link i.e. better information systems, re-structure of the departments, strategy meetings, etc should be studied.

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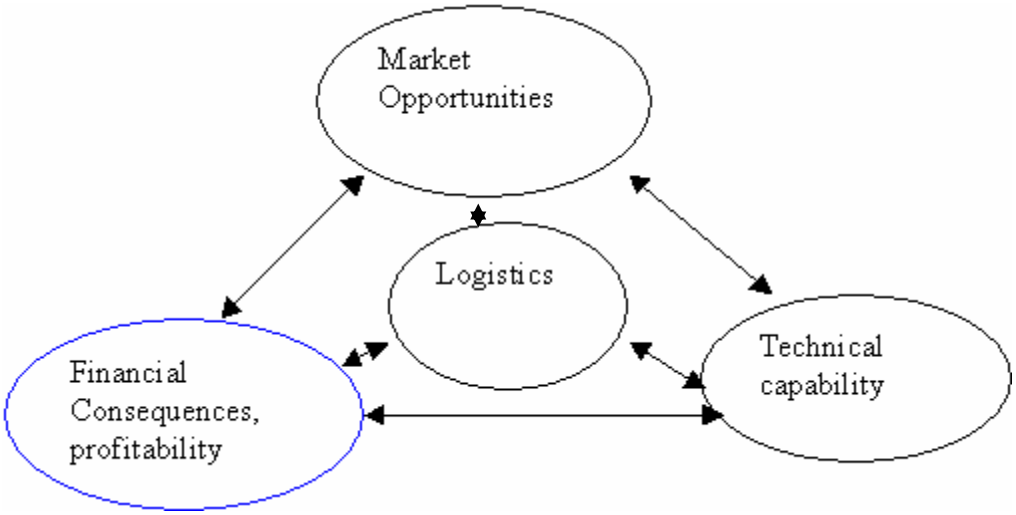
APPENDIX 1

-----Original Message-----
From: Robert.Van.Der.Woude@AvestaPolarit.com
[mailto:Robert.Van.Der.Woude@AvestaPolarit.com]
Sent: Fri 9/26/2003 8:04 AM
To: Guido Jeifetz
Cc:
Subject: Re: Thesis



Guido,

As comment to your description below:

An ABC system is existing in Degerfors, which can trace all cost for products produced in Degerfors, but:

- ABC is an after calculation system which makes it sometimes difficult to decide market actions pro-active
- The process routes has changed tremendously in the last year and the different routes have different cost parameters: Degerfors has variable and fixed cost as normal, which can me managed by the BU HRP management team, but VDM has another kind of fixed cost, which can not be managed and a variable cost which is different to the Degerfors one, SHRP route has a complete variable cost for the time being.

  We know the market opportunities, the technical capabilities, and logistical possibilities, but all three has parameters which has financial consequences. How do we take the right decision and

what is the detailed level we can use to take decisions?

I think it would be good when you can put all your ideas on paper what you should do, I think you are on the right way. After this we can plan a half day of discussion about this in Degerfors.

Can you give me a date when you officially started with the thesis? Can you also tell how much in percentage Fredrik will be involved?

Best Regards,/Med vänliga hälsningar

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APPENDIX 2

Interview Guide

Robert van der Wouder

Project Leader

- The motive for the Arabella-Project
- Arabella-Project's importance for Degerfors
- Duties as the Manager of Logistics
- Challenges as the Manager of Logistics
- Goals as the Manager of Logistics
- The information flow between the departments
- The planing process (goals and information requirements)
- Producing for stock
    - → (What? How much? When?)
    - → Policies and Departments
    - → Stock at the moment

- 125 000 tonnes a year (Optimal and Strategy changes)

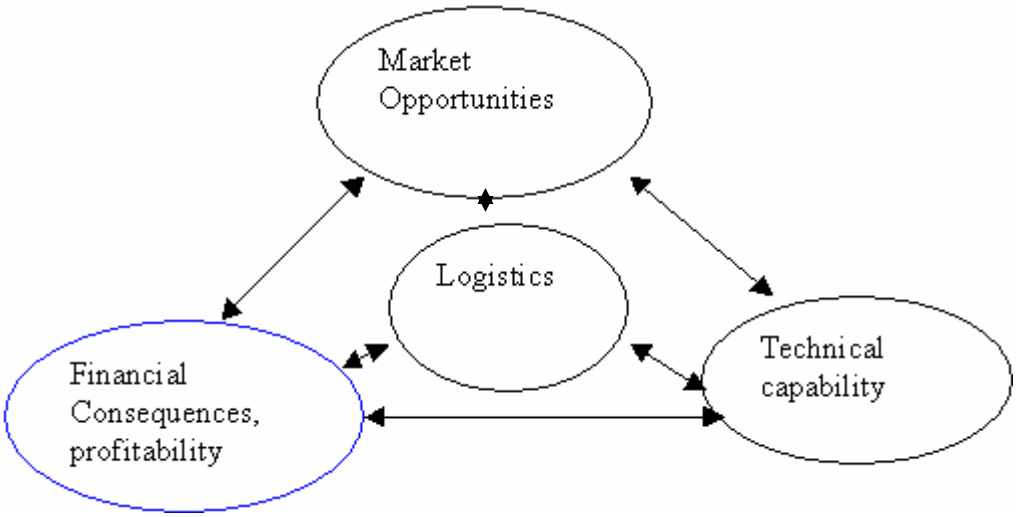

Figure related issues

- Relationship illustrated by the arrows in the figure
- Importance when handling orders
- Profit = Margin + Volume
- Decisions and information

APPENDIX 3

Interview Guide

Financial Representative

- Financial Department: Organisation and Tasks
- Cost System (Pros & Cons)
- Improvements of the Cost System
- How to Cost
- Excluded Costs
- Stock Costs
- Costs measuring for Reports
- Cost Measuring for Internal Information Sharing
- Information needed to make the best decisions from a Cost Perspective
- Understanding of Prices, Costs and Profits (The Departments understanding)
- Current Cost Trend
- How to lowering Costs for the future
- Additional Information

Interview Guide

Manufacturing Representative

- Manufacturing Department: Organisation and Tasks
- Products and Projects
- The Production Process
- Bottle Necks
- Production Plan: Pros and Cons
- Scheduling Plan: Pros and Cons
- Possibility to influence Production and Scheduling Plans
- Producing for Stock: Pros and Cons
- Set Up Costs
- Different Products – Different Costs
- Information of importance for the Manufacturing Department from the Departments of Logistic and Marketing
- Information assumed to be of importance for the Departments of Logistic and Marketing from the Manufacturing Department
- Information System
- ABC System as a management tool
- Additional information

Interview Guide

Logistics Representative

- Logistics Department: Organisation and Tasks
- Handling of orders:
  - → Customers & Key Customers
  - → Long Term & Short Term Contracts
  - → Special & Standard Products
  - → Dependent & Independent Orders
  - → Planning & Scheduling Process
  - → Bottle Neck
- Producing for Stock: Pros and Cons
- Measuring the delivery performance
- Trends in lead-times
- Information of importance for the Logistic Department from the Departments of Manufacturing and Marketing
- Information assumed to be of importance for the Departments of Manufacturing and Marketing from the Department of Logistic
- Information Systems
- ABC System as a management tool
- Additional information

Interview Guide

Marketing Representative

- Market Department: Organisation and Tasks
- Market Strategy
- Products
- Producing for Stock
- Customers
- Volatility of the Demand
- Service Centres Demand
- Product Pricing
- Orders
    - → Goals and considerations
    - → Incentives systems
    - → Information Linkage
- The Future Business
- Competitors

- Information of importance for the Marketing Department from the Departments of Manufacturing and Logistic

- Information assumed to be of importance for the Departments of Manufacturing and Logistic from the Department of Marketing

- Information System

- ABC System as a management tool

- Additional information

LIST OF ILLUSTRATIONS

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