Abstract

This thesis provides an understanding of how small companies change their strategies while growing. Small companies usually have lack of standard processes and there is a lot of focus towards the customers and the markets but as they start to grow there emerges a need to adopt standardization. As many small companies consider flexibility as their competitive advantage they don't want to compromise on their flexibility towards the customers while pursuing standardization, so the strategies of such companies have to be adjusted keeping this fact into consideration. In this study we used a small manufacturing company, Rancold AB as a case study to carry on our analysis. As the company was facing certain challenges while growing, an improvement project was initiated by the company and we were asked to provide improvement suggestions.

During our analysis we found out that as the companies start to grow there is a shift in focus from markets towards the resources and the owner-manager wants to better utilize the available resources to improve the efficiency. For many companies in the manufacturing industry, growth implies an increase in the number of orders; so to manage this increase in volume of work they have to make changes in their manufacturing process, as was observed in the case company. When growing, companies also start aiming to achieve competitive advantage by developing new order winners and qualifiers. In the case of Rancold AB, this was done by promoting shorter lead times and better quality. To support this they have to make changes in their manufacturing strategy and shift from Make-to-order towards Assemble-to-order strategy. To introduce new standards without compromising required flexibility, we concluded that external flexibility towards the customers should remain unchanged while integrating internal flexibility in the new standard ways of working.

Keywords

Growth, Small companies, Operation Strategies, Standardization, Flexibility, MTO

Definitions of terms used in this thesis are provided in the appendix.

Acknowledgement

We would like to express our gratitude towards Marcus Assarlind, our supervisor at Chalmers University of Technology, who has provided much valuable guidance and help along the way towards this thesis. Also our very sincere thanks goes out to Sorush Alikhani, our supervisor and project manager at Rancold AB, Gothenburg, who made this thesis possible and also supported us along the way in our improvement project. Finally we would also like to thank the management and staff at Rancold who have been welcoming and supportive of our work.

Table of Contents

1 Introduction 1

1.1 Background and Problem description 1

1.2 Purpose and Research Questions 2

1.3 Scope 2

2 Method and Data Collection 4

2.1 Research Methodology 4

2.2 The single case study 5

2.2.1 Induction 6

2.3 Data collection 6

2.3.1 Three types of data sources 7

2.3.2 Keeping bias in mind 9

3 Theoretical Framework 11

3.1 Small companies and Growth 11

3.2 Manufacturing Operation strategies 14

3.3 Make-to-Order Environment 17

3.4 Discussion of the Theoretical Framework 20

4 Empirical Data: A Case Study at Rancold 21

4.1 About the Company 21

4.2 Growth of the company 21

4.3 Business Process 22

4.4 Current Situation 23

4.4.1 Focus towards markets 23

4.4.2 Manufacturing Strategy: Make-to-Order 23

4.4.3 Manufacturing Process: Jobbing 24

4.4.4 Layout of the Work shop area 25

4.5 Challenges faced by the company 26

4.6 Improvement Project at Rancold 28

4.6.1 Restructuring the production department and establish a standard process 29

4.6.2 Redesign the workshop layout 29

4.6.3 Reducing Product's customisation level to reduce lead time 30

5 Analysis 34

5.1 Growth of the company 34

5.2 Change in Operation Strategies 35

5.2.1 Shift in focus: From Market to Resources 35
5.2.2 Change in Manufacturing Strategy: From Make-to-order to Assemble-to-order 36
5.2.3 Changes in Manufacturing Process 37
5.3 Standardization without compromising Flexibility 38
6 Conclusion and Discussion 40
6.1 Research Question 1 40
6.2 Research Question 2 41
6.3 Contribution 42
6.4 Prospect of future research 43
7 References 44
Appendix

List of Figures

Figure 1: Inductive Approach 6
Figure 2: Operation Strategy Decision Categories 15
Figure 3: Manufacturing Strategy Configurations and Competitive Priorities 16
Figure 4: Product-Process Matrix 19
Figure 5: Growth Statistics 22
Figure 6: Core Business Process 22
Figure 7: Ordering Process 23
Figure 8: Current Structure of Production Department 24
Figure 9: Product division among teams 25
Figure 10: Production Area Layout 26
Figure 11: Flow for the Product DISKBÄNK 28
Figure 12: Work Flow and Connection of teams 29
Figure 13: Proposed workshop Layout 30
Figure 14: Product Figures – Family 1 31
Figure 15: Product Figures – Family 2 31
Figure 16: Proposed structure for Family 1 Figure 17: Height Adjustment Screw 32
Figure 18: Proposed design – Family 2 32
Figure 19: Organization Structure and Employee Distribution 34

List of Tables

Table 1: Growth Statistics 21
Table 2: Proposed Team Structure 29

1 Introduction

1.1 Background and Problem description

Increased demand for specialized products has led to a large growth in the number of Make-to-Order (MTO) companies, which according to Stevenson et al (2005) are greatly represented by small companies. Authors like Cohn & Lindberg (1972) and Carter & Jones-Evans (2000) described the typical small company's processes as informal and unstructured and they also advocated that small companies should avoid rigid standardized processes in favor for flexibility, meaning that they need to be "loose" enough to be able to adapt to environmental uncertainties such as variations in customer demands. Porter (1985) wrote that small companies are also characterized by a generic strategy of focusing on a narrow market segment and differentiating on product uniqueness, which is also mentioned by Carter and Jones-Evans (2002) as one of the main reasons for the need of flexibility.

Carter and Jones-Evans (2000) explained that as a small company grows, the existing structure and strategies are likely to prove inadequate to facilitate pace of development. The term "growth" can imply an increase in the amount of output, export and sales (Penrose, 1959). Carter and Jones-Evans (2000) further wrote that a typical response by the owner-manager during growth might be to gradually formalize structure in terms of the allocation of formal responsibilities and the development of linking mechanisms. In a model for business development presented by Churchill and Lewis (1983), it is described how formal systems and processes often start to emerge and develop gradually as the company grows.

Mel Scott & Richard Bruce (1987) wrote that business growth can be seen as a transition between two stages which often is accompanied by a crisis. The crisis is a result of the changing environment which forces the company to make new strategic choices and develop its processes. The change in strategies and processes depend very much on the industry type and the operating environment of the company. For a small company within the manufacturing industry a typical growth parameter is the increase in the number of orders, so in this case strategy changes will focus on managing the increased order quantity. Researchers such as McMahon (2001) and Covin et al (1990) has proposed growth models suggesting strategic choices based on organizational characteristics and desired growth performance. Although, these models are to a high degree general and does not encompass detailed information about how companies generic operations strategies and processes develop during growth.

1.2 Purpose and Research Questions

The purpose of this thesis is to contribute to the understanding of how small companies change their operation strategies in response to the challenges faced when growing. This is done by presenting a single case study, from which the collected data is analysed using theory from literature on Operations Strategies and small business behaviour during growth.

The case study was performed at Rancold AB, which is a small company involved in the restaurant equipment manufacturing and located in Gothenburg, Sweden. The company is experiencing an increase in sale of in-house manufactured products. Rancold AB also expressed a wish to implement some degree of standardization in its processes in order to improve process control and efficiency but at the same time doesn't want to lose its flexibility towards customers as it is considered as the company's biggest competitive advantage. To overcome the challenges faced during growth and also to implement standardization, an improvement project was initiated at Rancold under our leadership. This project is a part of the case study and can be seen as a transition from the current strategies to the new strategies.

Under the scope of this thesis we investigated how this case company handled its particular situation and what changes it brought in its operation in response to the new environmental conditions and challenges that appeared because of the increased business activity. Using our findings from the case study and the literature review, we answered the following two research questions:

1. How are Operation Strategies of small manufacturing companies adjusted while growing?
2. In what way can business processes in small manufacturing companies be standardized without compromising the desired levels of flexibility?

1.3 Scope

The research in this thesis was performed according to the single case study methodology which makes some of the conclusions inappropriate for generalization. This thesis should instead be seen as an in-depth study of one case whose purpose is to contribute with understanding rather than building of theory.

The improvement project carried out at the case company aimed at identifying the problem areas that inhibits growth and providing feasible suggestions for improvement. However no actual implementation of the solutions was carried out under the scope of this thesis.

To fit the time frame, the focus areas included in the improvement project and data collection were chosen in accordance with the company's interest. The following areas of Rancold's Manufacturing Operations strategy were studied: Organization structure (production department specifically), workshop-area layout and product manufacturing.

Throughout the report, the term "flexibility" refers to manufacturing flexibility unless defined differently. The term "standardization" is also reoccurring, and may imply different meanings depending on the context. For this thesis, the term standardization refers to work processes and resources such as skills and knowledge which are linked with the tangible parameters responsible for the efficiency of the overall business process in a manufacturing firm.

2 Method and Data Collection

2.1 Research Methodology

According to Meredith (1998), the purpose of any field research is to gain knowledge, create understanding and help with creating explanatory theory. It can be used to discover previously unrecognized phenomena and provide new classifications and methods for measurement. Dubois and Gadde (2002) described it in a more general way and wrote that "the main objective of any research is to confront theory with the empirical world" (page 555).

Handfield et al (2002) mentioned a number of possible research objectives and ways of contributing to knowledge, listing the following: discovery, description, understanding, mapping, relationship building, theory validation, extension and refinement.

The purpose of this thesis was to study one particular company's adjustments and development of operations strategies during growth. Due to the informality of process and strategy execution and development within the chosen company, most of the strategic choices were and are taken in a reactive manner. Thus, little information about what would be observed during the project existed from the beginning.

For this reason, the study started out with an exploratory approach with the purpose of "discovering" changes in the environment which would affect the following focus of the study. Rancold AB's most prominent growth parameter was its increase in sales and thus an overall increase in business activity which had created a stressful environment with high load on its processes. Similar to what Carter and Jones-Evans (2000) described as common among growing firms, Rancold AB expressed that they experienced their current structure inadequate to cope with the increase in work load. Explicitly, the company expressed that their manufacturing process had started to fail with delivering finished products on time.

This led the project into the focus of studying the manufacturing with surrounding processes, with an approach of what could be described by Handfield et al as "understanding", "mapping" and to some extend "relationship building" between theory in the theoretical framework and Rancold AB's changing environmental conditions. The overall contribution of the knowledge extracted during this thesis was to contribute with understanding rather than validating, extending or refining existing theories.

The methods of collecting and analyzing data during this thesis work were chosen so that they would conform to scientific methods. This was done by practicing three central components of scientific and critical thinking: empiricism, rationalism and skepticism (Schafersman, 1997). Empiricism, one of several commonly accepted approaches in the study of human knowledge (known as epistemology), refers to the collection of empirical

data that was used as a foundation for the analysis in the thesis. Rationalism means practicing logical reasoning while analyzing the collected data using literature and previously acquired knowledge. Skepticism implies keeping a skeptical attitude towards presumed knowledge and questioning own beliefs (Schafersman, 1997).

The subsequent sections will further describe the research methodology and parts of the process responsible for yielding the empirical data. Rational and skeptical reasoning was applied when dealing with the collected data extracted from the empirical study, and played an important part in the Analysis and Discussion sections.

2.2 The single case study

The research and collection of empirical data for this thesis was characterised by the single case study methodology. McCutcheon and Meredith (1993) wrote that case research is "one of many empirical approaches that aim to develop our understanding of "real world" events". For this thesis, one company was chosen for in-depth studies in order to provide detailed data to help with understanding and describing the challenges that a small growing business faces.

The case study focused on changes in the operations strategy of the company. Handfield et al (2002) described Operations management as a complex subject, arguing that "each layer and component subsystem adds complexity that makes generalizations more difficult to see and substantiate" (page 421). Handfield et al referred to Meredith (1998) who wrote that the case study methodology is particularly good when the aim is to provide understanding of a phenomenon, which according to Handfield et al often is the case when the research subject is complex. Thus, the case study approach seems to be an appropriate method for studying the changes in the operation strategy in the context of a changing environment.

Dubois and Gadde (2002) wrote that the case study approach has not always been accepted as a scientific method. They refer to (Yin, 1994) who stated that the main argument against case studies is their inability to provide theories suitable for generalization. Similarly, Handfield et al (2002) concluded that critics commonly claim that case-based approaches lack rigor and that researchers "cannot generalize the results because of the small sample size" (page 429). McCutcheon and Meredith (1993) also wrote that research based on the case study methodology might lead to skepticism among some researches who view case study research as "lacking in objectivity, replicability and control, the supposed features of methodological rigor" (page 246).

However, Handfield et al (2002) further stated that this criticism stems from a misunderstanding saying that analytical generalization from small sample research is not possible, while statistical generalization from e.g. survey research is. Dubois and Gadde (2002) referred to the American organizational theorist Karle E. Weick as one of researchers that changed his mind about case study research. In his book 'The social psychology of organizing' (1969), Weick referred to case studies as too situation specific and not

appropriate for generalization. Ten years later (1979) a second edition of the book was released with a new view on case studies, saying that case studies are better tools than previously imagined. Weick (1979) wrote in his new book that researchers should draw benefit from the detailed information offered by case studies and try harder to make interpretations from these. Dubois and Gadde (2002) concluded that what had been seen as a problem was now recognized as an opportunity and stated that the case study approach had become a recognized research methodology within many scientific disciplines. They further explained that learning from one particular case should be seen as strength rather than a weakness, as "the interaction between a phenomenon and its context is best understood through in-depth case studies" (page 554).

2.2.1 Induction

In the context of the single case study, the approach to the actual data extraction and analysis during the research process can be seen as an inductive approach. An inductive way of working means going from performing observations into trying to generalize and create broader theories (Trochim, 2006). Although the overall approach was inductive, some of the instances can be seen as abduction. According to Peirce (1955) abduction implies drawing conclusions about facts under uncertainty, based on other facts and general principles. In the initial stage of the improvement project, induction was used together with an abductive approach to predict underlying causes for the purpose of choosing new study subjects.

This way induction was combined with elements of abductive reasoning, and together used to explore patterns in the data for the purpose of creating a tentative hypothesis. The tentative hypothesis evolved into a theory which was used to answer the research questions. The figure below describes the inductive approach.

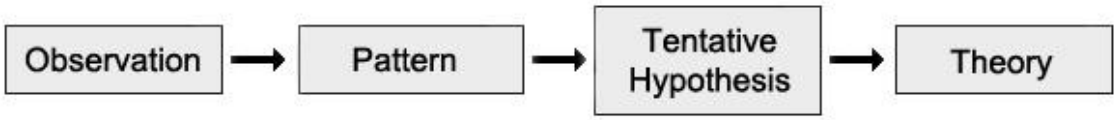


Figure 1: Inductive Approach

The observations will be described in the next section, while patterns of the empirical material are presented in the case study chapter.

2.3 Data collection

After the initial exploratory phase where data were collected in an informal manner, the mapping and documentation of processes of interest (see 2.3.1.1) started. To be able to

draw reliable conclusions from the collected data it was important that the data that were used for the analysis were trustworthy. According to Handfield et al (2002), several authors such as Cook & Campbell (1979), Kidder & Judd (1986) and Yin (1989) define reliability as a measure of to which extent the study could be repeated with the same results.

To achieve a data collection which represented the reality in the best way possible, several sources of data was collected for each studied process. Jack and Raturi (2006) explained that the reason for this was that one single data collection method would likely have flaws, and complementary methods could therefore be used to counterbalance the weaknesses of the others. Similarly, Dubois and Gadde (2002) wrote that "multiple sources may contribute to revealing aspects unknown to the researcher" (page 556). This way of combining sources data is often referred to as triangulation (Dubois & Gadde, 2002; Jack & Raturi, 2006).

2.3.1 Three types of data sources

Since access to the actual manufacturing workshop was possible, examples of data collection methods suitable for this particular case were interviews, direct observations, questionnaires for the employees, active participation and archival studies.

After a week of introduction at the company and informal observations of the workshop, it was concluded that big parts of the company's manufacturing process consist of processing that required a degree of handcraft. Since an important part of the mapping included monitoring of lead times of different sub processes, it was decided that active participation would not be performed as it would have a significant impact on the measured times and the collected data would thus be unreliable.

In addition the company had no routine of documenting their work. There was thus not much consistency in the information on earlier ways of working, such as data over e.g. lead times, inventory depletions and history of orders, which is a direct result of the company's informal way of working. Some documentation of previous order histories existed, which helped with choosing observation subjects for studies of machine utilization and investigating of the need of component preparation.

Due to the possibility to access the company's facilities, the main methods that were used for the data collection consisted of observations and questions to the employees. Because of the current high workload in the workshop, only a few opportunities for interviews were offered. In order to get the most out of these, the selection of interviewees and observation objects was based on areas of responsibility and frequency of the product that they were responsible for manufacturing. The most frequently ordered products by the customer are also the ones most responsible for putting constraints and allocating resources in the manufacturing process, and were thus suitable for being observation subjects.

The selected methods for data collection were thus *observations, interviews and studies of documents* provided by the company. The subsequent sections describe each of these methods separately.

2.3.1.1 Observations

Most of the formal observations represented the gathering of quantitative data in terms of lead times and setup times. Furthermore, waiting-line analysis of each machine was made in order to identify their degree of utilization. Another purpose of the observations was to understand the work flow logic and creating a process map of the manufacturing process. This was done by charting the flow of material and personnel in the workshop (see Figure 11: Flow for the product Diskbänk, page 32).

Since quantitative data often contain some sort of numerical values, the data themselves can be seen as unambiguous. Although, if the method of performing the observation interfere with the environment of the test subject there is a risk that it will influence the properties of the collected data. It was therefore important to investigate how the observations could be carried out without significantly affecting the employee and the way he or she worked. This is discussed in section 2.3.2.

2.3.1.2 Interviews

According to Kvale (1996), an interview seeks to understand the meaning of central themes in how the interviewee experiences it's surrounding in a particular context. In comparison with mail surveys and questionnaires, interviews are carried out by direct interaction between the interviewer and the subject. This gives the interviewee opportunity to ask questions when something is unclear, and the interviewer has the possibility to ask follow up questions in order to clarify and understand ambiguous answers.

The interviews with employees at Rancold AB which were carried out in a semi-structured manner represented the gathering of qualitative data. They helped with extracting information on differences in working methods and problems in general experienced by the employees.

Representatives from the management were picked to interview regarding strategically issues, while job shop workers and technical staff were interviewed to gain details about the manufacturing. The interviews were an important part of the data collection as the employees held information about the manufacturing process and strategically approaches that could not be observed directly.

Despite this, the qualitative data from the interviews can in some cases assumed to be ambiguous. The reason for this is that the answer to an interview question reflects contradictions in the world of the interviewee, and may depend on the knowledge of the subject or interpersonal interaction between the interviewer and the interviewee (Kvale, 1996). The formulations of questions put in the interview were therefore of high importance in order to avoid unnecessary ambiguity in the answers.

To steer the direction of the interview an interview guide was prepared. The interview guide contains pre-decided topics for discussion and questions (Lindlof and Taylor, 2002) that will work as a road map during the interview (see Appendix).

2.3.1.3 Archival studies

The little documentation that existed was a combination of qualitative and quantitative data. Most of the available archived data were histories of ordered products, which helped with in analyzing the relation between different products and bottlenecks in the manufacturing flow. The historical relation between urgent, customized and standardized products helped with understanding the requirements on manufacturing flexibility.

The archived information only concerned shorter periods of time and the inconsistencies in the method of collecting the data resulted in difficulties in estimating seasonal variations etc.

2.3.2 Keeping bias in mind

When performing research, it is important to identify any kind of bias that might influence the collected data. As previously mentioned, the data from archival studies which mainly consisted of historical records of ordered products were only available for certain periods of time. The data themselves was although assumed to be trustworthy due to the fact that it was automatically recorded. For the case study in this thesis, the data extracted from interviews and observations was estimated to be most likely to be subject for bias.

The main reason for suspecting that data collected from interviews and observations were subject for bias was the fact that the processes of collecting them required user involvement. According to Hawk and Aldag (1990) user involvement allows the interviewee or observation subject to manipulate the extracted information to conform to their preferences. In the context of this case study, this mainly relates to the observational studies of the manufacturing process and the interviews with both machine operators and management personnel.

The objective of measuring the manufacturing process was to document lead times of sub processes (see figure 6: Lead time distribution of 3 products in Appendix). It was thought that the situation of feeling observed would affect the workers execution of his job assignment by for example working extra hard in order to show a good performance.

Similarly with the interviews, bias was thought to occur when the interviewee answer questions in way that (consciously or unconsciously) make them "look good". Hawk and Aldag (1990) wrote that "both empirical evidence and common sense suggest that the experience of success is more likely to be attributed to oneself than is the experience of failure" (page 607). They refer to this as "self-serving bias". Other types of biases were also discussed such as "sample bias" and "question bias". Sample bias means that information might be biased due to an inappropriate interviewee while questions bias refers to biases due to misunderstood, unanswerable or leading questions (Hoets, 2009).

The solution for minimizing bias when performing observations was to interact with the work shop personnel informally in an early stage of the project. When the employees had become used to our presence, observations could be carried out discretely without notifying or interacting with the observation subject.

For the interviews an 'interview guide' was constructed. Hoets (2009) suggested that general questions should be put before specific ones, positive questions before negative ones and behavior questions before attitude ones. The interview guide was constructed accordingly while emphasizing open-ended and well formulated questions for the purpose.

3 Theoretical Framework

In this chapter we will lay the theoretical foundation of the thesis by presenting the theoretical areas that will help us in analyzing the case company. We start by discussing about the small companies and the growth. While growing small companies try to implement standard processes but at the same time don't want to compromise on the flexibility that they offer.

The main focus of the thesis is to explore the changes in the operation strategies so we will discuss about the strategies adopted by the small companies and how do these strategies change during growth. As our case company is in manufacturing industry so we will focus specifically on the manufacturing operation strategies. Later on we also discuss the details of make-to-order operating environment as most small companies within manufacturing industry are part of the MTO sector.

In the end we will summarize and discuss all the theoretical sections and mention the important highlights based on which we will analyze our case company.

3.1 Small companies and Growth

There exist many definitions which describe a small business. According to the European Union legislation (2003), a small company has between 11 and 50 employees and an annual turnover of less than ten million Euros. Small firms are usually characterized by lack of resources and management skills and usually have an owner-centric form of management (Stevenson and Gumpert 1985; Handy, 1976). As the number of employees in a small company is less and all the authority and decision making power lies with the owner-manager of the company, the structure is highly centralized. Mintzberg (1979) and Carter & Jones-Evans (2000) wrote that small companies also often have a rather unorganized structure with an informal way of working. Cohn & Lindberg (1972) described the planning process in most small businesses as unstructured and sporadic.

As a small business grows, the informal culture and structure often proves inadequate to facilitate pace of development (Carter and Jones-Evans, 2000). 'Growth' can have many meanings and is defined differently depending on the context in which it is discussed. According to Penrose (1959), growth can imply an increase in the amount of output, export and sales. Levin & Weström (2003) defined growth as an increase in the number of employees and/or increased economic activity. Some authors talk about growth as in terms of increased market share (Covin et al, 1990), while others talk about geographic expansion (Greening et al, 1996). McMahon (2001) presented a general framework with factors for small businesses growth and distinguished between internal and external growth. Globalization or increased market share are examples of external growth (McMahon, 2001). Covin et al. (1990) formulated and labeled four different strategies for increasing market

share; “cooperate with other producers”, “positioning the product in the market, “reducing the risk of adoption” and “win market support” (meaning to establish a superior reputation). Internal growth on the other hand is related to development of capabilities related to the business itself, e.g. employee development, department restructuring or enhanced products or services.

Hrebiniak & Joyce (1985) and Kelmar & Wingham (1995) wrote that small firms’ growth performance depend to a high degree on the development of internal factors such as organizational structure and processes. McMahon (2001) has discussed both internal and external growth strategies, but argued that internal factors are more important than the market variables. Not so differently, Holt and Macpherson (2007) highlighted the importance of structuring the firm in preparation for growth by introducing standard ways of working. Mintzberg (1979) categorized and distinguished between standardization of work ‘processes’, ‘skills and knowledge’, ‘output’ and ‘norms’. Standardization of work processes means specifying the work content in rules or routines to be followed. Standardization of output is done by communicating and clarifying expected results, but the individual work process executed to obtain a goal is not defined. Standardization of skills and knowledge is achieved by standardized training and education and standardization of norms implies establishing common values and beliefs in order for people work toward common expectations. While standardization of norms can be seen as a means for achieving efficiency, it concerns intangible values such as social norms and common values which are not within the scope of this thesis. Standardization of output is more linked with achieving consistency in the output than promoting efficiency.

Covin et al (1990) wrote that a typical response by the owner-manager during growth is to gradually formalize the structure and introduce processes for the purpose of increasing control and stability and also to improve efficiency over long term. Münstermann et al (2010) presented process standardization as a potentially powerful tool for successfully managing and monitoring improvements of the “process efficiency”. Further, they wrote that standardization is also often used to establish uniform quality or for the sole purpose of understanding the process in order to find potential areas of improvement. Jang and Lee (1998) defined process standardization as “the degree of work rules, policies, and operating procedures are formalized and followed” (page 69) and Ungan (2006) stated that with standardization, the production or service process becomes routine with well-defined tasks.

For companies in manufacturing industry, introducing standardization can also be linked to lean manufacturing as these companies aim to remove wastage of all types in their manufacturing process. Pattanaik and Sharma, (2009) defined lean manufacturing as an applied methodology formed by scientific and objective techniques that in consequence decreases as much as possible an organizations non- value adding activities. As described by Pattanaik and Sharma, (2009), one of the important aspects of lean is its relation with a pull production system; this means that the shop floor is driven by the demand, which is the case with many of the small manufacturing companies which operate with a make-to-order strategy. Any standard process for such companies should provide this operational flexibility to make changes in production volume according to demand.

Seemingly, much of the issues of managing small business growth that are discussed in the literature relate to the transition of going from an informal structure to a more organized way of working. Authors like Münstermann et al (2010) and Ungan (2006) advocated process standardization for achieving efficiency and process control. On the contrast, some authors' state that the lack of standard processes in small companies is not an absolute disadvantage instead it is considered as an advantage. Cohn and Lindberg (1972) wrote that the key advantage of small businesses is their flexibility in relation to customer service and making product changes, an ability that according to Carter and Jones-Evans (2000) sometimes can be inhibited by introducing standard process formats.

Upton (1997) concluded that "enhanced flexibility has been consistently cited as one of the primary objectives in manufacturers' improvement paths" (page 1079). Ngamsirihit (2008) similarly wrote that as the awareness of being able to cope with dynamic and uncertain business environments increased, many companies have realized the importance of working with flexibility improvements in order to stay competitive. Ngamsirihit (2008) further stated that researchers and companies have during the past decades been interested in developing systems for working in a proactive way i.e. using flexibility to accommodate uncertainty.

Manufacturing flexibility is considered to serve both offensive and defensive purposes (Swamidass, 1988). It can be done by, as suggested by Swamidass (1988), using one company's flexible capability to obstruct competitors manufacturing strategies, but it may also be done by pursuing preventive measures to reduce uncertainty. Gerwin (1993) wrote that flexibility management is not only "a passive reactor to environmental cues; it can also seize the initiative and try to bend the environment to its will" (page 396). Thus, flexibility can play an important role when it comes to staying ahead of competitors and altering the conditions under which everyone must compete.

According to Kim (1991), a flexible manufacturer can rapidly adapt in response to changes in product volume demands, changes in customer tastes, variations in lead times from suppliers, and emergence of new process technology. Other examples of benefits that may come from being flexible is the ability to adjust production volume according to changes in customer demands, which may help with increasing expected sales and better utilization of capacity (Jordan & Graves, 1991). Kim further (1991) stated that in the long run, a flexible manufacturer might also have the possibility to offer lower prices, fast and dependable deliveries and more easily adapt to changes in the production plan.

In summation, both flexibility and standardization seem to be presented as two means for achieving competitive advantage. At the same time, authors present a contradiction in combining of the two capabilities as some authors claim that standardization may inhibit required flexibility. This can be explained by the fact that flexibility is presented as a capability particularly for small businesses, while standard process development more often is discussed in the contexts of medium to large sized companies. The challenge faced by many small companies during growth is thus to find a fit between standardization and flexibility while transitioning between the stage of being a small business and a medium sized one. Besides formalizing and structuring of processes, other patterns in new strategic choices taken by growing small companies when growing are discussed in the literature.

Subsequent section will describe how a small business' Operation Strategy might develop further in conjunction with the new environmental changes that comes with growth.

3.2 Manufacturing Operation strategies

Companies invest in a wide range of functions and capabilities in order to design, make and sell products at a profit. The degree to which a company's functions are aligned to the needs of its markets will significantly affect its overall growth in sales and profits. To maintain profitable growth over time requires sound direction, with the relevant functions providing support for the needs of the agreed markets. (Hill & Hill 2009)

Johnson, Scholes and Whittington (2008) define strategy as follows: "*Strategy is the direction and scope of an organisation over the long-term: which achieves advantage for the organisation through its configuration of resources within a challenging environment, to meet the needs of markets and to fulfil stakeholder expectations*". Strategy is about asking two questions: "What business(es) should we be in? and "How do we compete in a given business?" (Hofer 1975). Drucker (1977) referred to these two challenges in terms of effectiveness and efficiency. Strategy researchers traditionally focus on large organizations. However, differences in resource endowments and organization structure between large businesses and small businesses mean that many strategy prescriptions appropriate to large businesses are inappropriate to small businesses. Small business differs from large businesses in their perception of opportunities and their commitment of resources to new opportunities (Stevenson and Gumpert 1985).

Having a well-defined strategy assists in providing a clear competitive advantage. A competitive advantage is an advantage that is valued by customers and which distinguishes the business from its competitors, Carter and Jones-Evans (2000). Porter (1985) identifies two types of competitive advantage, which he termed as *cost leadership and differentiation*. Based on these two advantages and on the competitive scope of the business, which he classified as either industry-wide or focused, he developed three generic competitive strategies namely:

Cost-leadership: This strategy involves the firm winning market share by appealing to cost-conscious or price-sensitive customers. This is achieved by having the lowest prices in the target market segment

Differentiation: In this strategy the company differentiates the products in some way in order to compete successfully

Focus: In this strategy an organization focuses effort and resources on a narrow, defined segment of a market.

According to Porter business must choose one of these generic strategies – failure to do so results in below-average profitability. Porter (1985) suggested that a Focus strategy is most appropriate for smaller businesses. According to Porter the business pursuing a focus strategy competes by selecting a segment or group of segments in its industry and by tailoring its strategy to serve these segments to the exclusion of others. A company could use either a *cost focus* or a *differentiation focus*. With a *cost focus* a firm aims at being the lowest cost producer in that niche or segment. With a *differentiation focus* a firm creates competitive advantage through differentiation within the niche or segment. By optimizing its strategy in the target segment the business with a focus strategy achieves a competitive advantage even though it does not possess a competitive advantage for the whole market. Hill and Hill (2009) further mentions that the businesses can choose to focus their operations around resources, markets or a combination of the two. Several researchers (see for eg Wernerflet, 1984) have suggested adopting the "Resource Based View (RBV)" for attaining competitive advantage. In RBV approach, the primary goal of the strategy is to develop and leverage resources in order to gain competitive advantage by creating new market qualifiers and order winners (Gagnon, 1999).

Developing an operations strategy involves two broad decision categories: 'Structural decisions' and 'Infrastructural policies and systems'. 'Structural decisions' are defined as those which shape the "building blocks" of the operation, they define its overall tangible shape and architecture; it includes the broader issues related to the facility layout, capacity planning, choice of process and supply chain related issues. 'Infrastructural decisions' on the other hand affect the people, systems, and culture that lubricate the decision-making and control activities of the operation category; it includes the internal management issues related to the development of the policies and procedures which could assist in the smooth functioning of the organisation. Figure 2 presents the framework for operation strategies system design decisions developed by (Hayes and Wheelwright 1984, Hayes et al 2005).

Structural decisions	Capacity Sourcing and vertical integration Facilities Information and process technology
Infrastructural policies and systems	Resource allocation and capital budgeting systems Human resource systems Work planning and control systems Quality systems Measurement and reward systems Product and process development systems Organisation structure

Figure 2: Operation Strategy Decision Categories

Adapted from Hayes and Wheelwright (1984)

Corbett (2008) in one of his research paper takes inferences from the already existing literature and suggests that, in the resource-based view, the routines, resources, capabilities, and systems that need to be reconfigured as companies' operations strategies evolve in response to changes in the business environment are those that appear in the list of infrastructural decision areas in the Hayes and Wheelwright (1984) framework. Nelson and Winter's (1982) classic theory of firm evolution gives the central role to 'routines' and define them as 'all regular and predictable behavioural patterns of firms'. According to them, routines play the role of coordinating interdependent activities within the organization. Routines foster specialization and thus lead to efficiency. Routines are also the primary mechanism through which firms accumulate their evolving experiences. As inferred by Corbett (2008), in the RBV, the basic building block of organizational capabilities seems to be skills and routines.

In a comprehensive review of the research on manufacturing strategy configurations, Cagliano et al (2005) classified the strategies into four different categories. Figure 3 represents the strategies and the associated competitive priorities.

Manufacturing strategy configurations	Competitive priorities
Market-based strategy	Quality Service Flexibility Product variety
Product-based strategy	Product variety Quality (Price)
Capability-based strategy	Quality Flexibility Service Price
Price-based strategy	Price Quality (Flexibility)

Figure 3: Manufacturing Strategy Configurations and Competitive Priorities

Adapted from Cagliano et al (2005)

They found that the set of four strategic configurations is relatively stable, that at the individual firm level many firms do appear to change from one strategy to another, and that over the time period of the study (1992 – 2001), "product-based strategy is the most widely spread and most stable strategy. Capability-based competition is the rising star. The market-based strategy is struggling and price based competition is on its way out".

As can be observed from the above figure, the competitive priority 'Flexibility' exists in most of the strategies, which highlights its importance for the manufacturing companies. In the strategy literature, Teece and Pisano (1994) provided an explicit statement of the dynamic aspects of the RBV, which they called the 'dynamic capabilities approach'. Dynamic capabilities have been defined as 'the firm's ability to integrate, build, and reconfigure

internal and external competencies to address rapidly changing environments' (Teece et al. 1997). This demands that the manufacturing system be able to produce effectively a large variety of products and to be reconfigurable to accommodate changes in the product mix and product design (Gunasekaran 1998, Gunasekaran and Yusuf 2002).

3.3 Make-to-Order Environment

Increased demand for specialized products has led to a large growth in the number of MTO companies, leading to greater competition amongst these companies and the increasing strategic importance of lead times. As mentioned by Stevenson et al (2005), Small and medium sized enterprises (SMEs) are a very important part of the make-to-order (MTO) sector. These companies have to cope with many uncertainties related to customer orders (e.g. product specification and due dates) and production order progress.

Stevenson, Hendry, and Kingsman (2005) asserts that MTO approach suits markets with low-volume, wide-ranging special products. Operations uses a Jobbing or Low volume-batch process, manages changes in sales volume and product mix with order backlog and reschedules order to meet delivery speed requirements. MTO companies cannot accurately forecast demand, order materials and produce in advance or effectively apply batch production methods. In addition, the material and production requirements of a job may be vastly different to those of other jobs in the factory, hence a lack of parts commonality and variable job routings add to the difficulties of planning and control.

As said by Amaro et al. (1999), in the case of a MTO company, when an order is placed, the basic design is available and the remainder of the work is in manufacturing and assembly. The MTO companies have an earlier Order Penetration Point (OPP) - the stage at which a product is linked to a specific customer order (see Olhager, 2003) - than Make-to-Stock (MTS) or Assemble-To-Order (ATO) companies. The earlier OPP means that a greater degree of customization can be offered and this capability is an important strategic objective for many of these companies (Spring and Dalrymple, 2000; Hendry et al 2003).

However, customization invariably leads to non-standard product routings on the shop floor, and without the insurance of a Finished Goods Inventory (FGI), lead times are naturally longer as compared to MTS companies. Soman et al. (2004) explains that the competitive priority for small MTO companies is often shorter delivery lead times. Firms, especially in service and make-to-order manufacturing sectors, are increasingly using explicit delivery time guarantees as a marketing strategy (Hammer, 2004; Zhao et al, 2008). Hill & Hill (2009) asserts that operations could trade lead time for inventory and move from, say, a make-to-order situation towards assemble-to-order situation.

The job shop is still an appropriate configuration for many MTO Companies (Muda and Hendry 2003). Pure job shop routing sequences are irregular and random; jobs can start and finish at any work centre allowing complete freedom and customization. However in reality a dominant flow direction usually exists (Oosterman et al. 2000) which is a characteristic of a general job shop. The General Job Shop is defined as providing for multi-directional routing, but with a dominant flow direction. Enns (1995) meanwhile argues that the real life job shop is similar to the theoretical general flow shop. In a general flow shop work still travels in one direction but jobs are allowed to visit a subset of work centres, permitting limited customization. In a Pure Flow Shop, work travels in one direction through a sequence of work centres in a strict order, unlikely in a MTO company.

According to Hill & Hill (2009), manufacturing companies can choose from five different types of generic manufacturing processes, namely:

Project: Companies that produce large-scale, one-off unique, complex products will normally provide these on a project basis. Examples include: large scale dam, nuclear reactors, bridges etc.

Jobbing: The Jobbing process is designed to meet the one-off (unique) requirements of customers where the product involved is of an individual nature and tends to be of smaller size and thus transportable than those produced using a project process. Examples include: furniture, purpose build machine equipment etc.

Batch: This process is used when making similar items on a repeat basis and usually in larger volumes than associated with jobbing. Examples includes: injection mouldings, machine parts etc.

Line: In a line process, products are passed through the same sequence of operations as products are of standard nature. Examples includes: automobile manufacturing.

Continuous: In continuous processing, a basic material is passed through successive stages or operations and refined or processed into one or more products. The volume of the material handled is very high. Examples include: petrochemical processing.

In the manufacturing companies, there exists a relation between the volume of the work and the process used for handling it. The Product-Process Matrix proposed by Hayes and Wheelwright (1979a, b, 1984) exhibits this relation.

Process structure Process life cycle stage ↓	Product structure Product life cycle stage →	Low volume Unique (one of a kind)	Low volume Multiple Products	Higher volume Standardized product	Very high volume Commodity product
(Project)	(Project)				
Jumbled flow (job shop)		Job shop			
Disconnected line flow (batch)			Batch		
Connected line flow (assembly line)				Assembly line	
Continuous flow (continuous)					Continuous

Figure 4: Product-Process Matrix

Adopted from Hayes and Wheelwright (1979a, b, 1984)

The Product–process matrix integrated two life cycle theories: the product life cycle and the process life cycle. The primary Hypothesis of this matrix is that the fit between the process structure and the product structure results in superior performance. The underlying point is that, with the increase in the volume of work a process shift is essential to achieve better efficiency.

The focus of this approach is on product and process structure, it is blind to other dimensions such as organizational scope. Kotha and Orne (1989) criticized the Product–process matrix and argued that its two dimensions did not adequately account for the influence of the market upon manufacturing. Kotha and Orne (1989) generic manufacturing strategies model takes this a step further by adding a third dimension of organizational scope to the existing two dimensions of product-process matrix. They hypothesized that, in certain cases, organizational scope will moderate the relationship between product structure, process structure and manufacturing performance. They did not explicitly define organizational scope, but linked its meaning to the relative breadth of operations-related activities. Thus, organizational scope would be greater when a manufacturer operated in broader geographic regions (“geographic manufacturing scope”), or produced for broader geographic markets (“geographic market focus”), or used more marketing and distribution channels (“customer–market scope”).

However in this thesis we are specifically focusing on small companies, which usually are a single entity based in one facility and serving a single market and more than often doesn’t have different business units or plants. So it’s safe for us to ignore the third dimension of organizational scope and use the basic product-process matrix as a reference.

3.4 Discussion of the Theoretical Framework

Small companies usually have under-developed and informal business processes and in general there is a lack of standard procedures and routines while conducting the day to day work (Cohn & Lindberg, 1972). These companies usually focus on a specific market segment and operate with a very high flexibility towards the customers (Porter, 1985). As the business starts to grow there emerges the need of adopting standard business practises (Carter and Jones-Evans, 2000). Many authors (see for e.g. Ungan, 2006) have advocated the use of standard business process and establishment of routines to achieve efficiency in the operations. While many authors (see for e.g. David M. Upton, 1997) are in favour of the flexible approach and discusses the advantages of flexibility. The challenge faced by the small growing companies during growth is that these companies don't want to lose the flexibility as it is their core competitive advantage and at the same time they want to achieve standardization in the processes, so it becomes a question of establishing a balance between standardization and flexibility.

The small companies operate with a strategy that is very much focused towards the markets (Porter, 1985). Once the company is established within its market and enters the growth phase then the management should start shifting the focus towards better utilization of the resources in an efficient manner. These resources should be utilized to develop capabilities which could help in establishing new order winners and qualifiers and thus establish a niche in the market and face the competition (Gagnon, 1999). In this thesis we are focusing on the case company which is in manufacturing industry and the most important growth parameter for them is the increase in the number of orders. For the manufacturing companies operating within the make-to-order sector one of the competitive priorities is to shorten the lead time (Soman et al; 2004). This can be achieved by building an inventory of intermediate parts and moving towards Assemble-to-Order strategy (Hill and Hill, 2009).

Most of the small manufacturing companies use Jobbing as a manufacturing technique (Muda and Hendry 2003). But while growing the number of orders and thus volume of work increases, so the current process doesn't remain sufficient. According to the product-process matrix (Hayes and Wheelwright, 1979a, b, 1984) there has to be a match between the volume of the work and the process used to achieve optimum performance, so such companies which are experiencing increased volume of work should start considering adopting a disconnected batch process.

According to the literature, a small growing manufacturing company within the MTO sector can achieve efficiency by establishing standard business processes and routines and by efficiently utilizing the available resources and reducing wastages. The manufacturing process could be changed to a batch process to improve efficiency and handle large number of orders. If shortening the lead time is a priority then Assemble-to-Order strategy could be adopted.

4 Empirical Data: A Case Study at Rancold

All the information in this section has been provided by Rancold either in form of documents or verbally. The information has been extracted after conducting interviews, making observations and analysing archival data. The sections, figures and tables presented in this chapter have been developed by us after combining the information gathered from various sources.

4.1 About the Company

Rancold AB is one of the larger manufacturer and supplier within the Swedish restaurant equipment business in southern Sweden. This company was established in 1990. As of now (2011) the company has 33 employees and in the financial year-2010 the company had a turnover of approximately 45 million SEK. The company manufactures and sells a large variety of products and operates its business from one single facility located at Ringön in Gothenburg, Sweden. It is primarily involved in manufacturing large kitchen equipment and also supplying restaurant accessories and products to the clients. The customer group ranges from cafes and diners to big hotels. Customers are mostly regional and national but the company aims to have international operations. Two major competitors of the company are ASKO and ROYAL. The company works with a motto of: Right product to the right customer at the right price. More information about the products and the company can be found on their official website www.rancold.com .

4.2 Growth of the company

Initially, when established, the company had a focus on servicing large kitchen products and trading within second hand products. But later on as the business started to grow, they also started to manufacture the products on their own and also supply other accessories. Rancold has been steadily growing since past few years. There has been an increase in the number of orders received, total sales volume and also the number of employees. The following table shows the steady growth the company has experienced over past few years. This data has been extracted from the records provided by the company.

	Year 2007	Year 2008	Year 2009
Net Sales (SEK)	21,786,000	27,745,000	30,150,000
Employees	16	24	31
Total Orders	367	413	474

Table 1: Growth Statistics

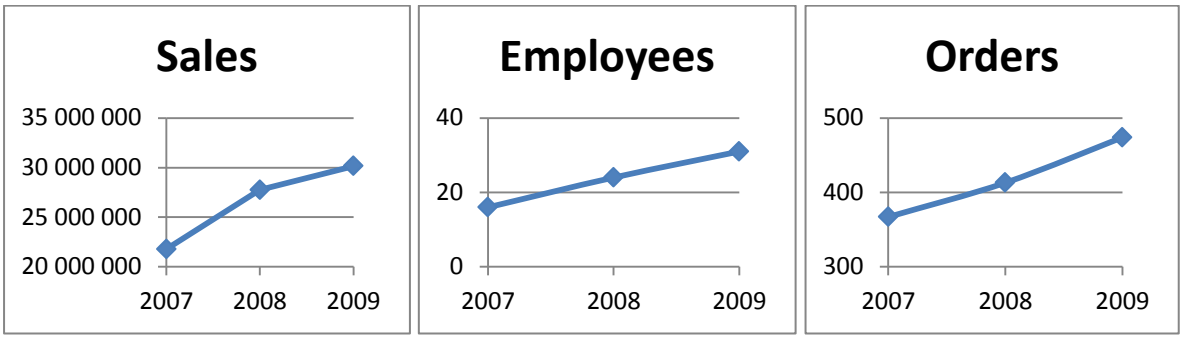


Figure 5: Growth Statistics

4.3 Business Process

In order to get an understanding of the business flow we need to understand the core business process as well as the functioning of the production department (described later). The business processes in this organization are not very advanced and just consist of simple elements. As the company is involved in manufacturing business so it has to satisfy the demands of the customer and the production department starts functioning only after receiving a confirmed order from the customer. After making observations and conducting interviews with the management we learnt about the core business process of the company which could be depicted by the following figure:

Figure 6: Core Business Process

This process seems very simple and linear but the elements overlap and there are no clear lines of separation. The middle element of the core process is the one that is most relevant for this thesis so it is important to understand the functioning of the production department. As can be understood from figure 6 (core business process), the production department receives the signals from the sales team. Figure 7 shows how an order is processed within the production department.

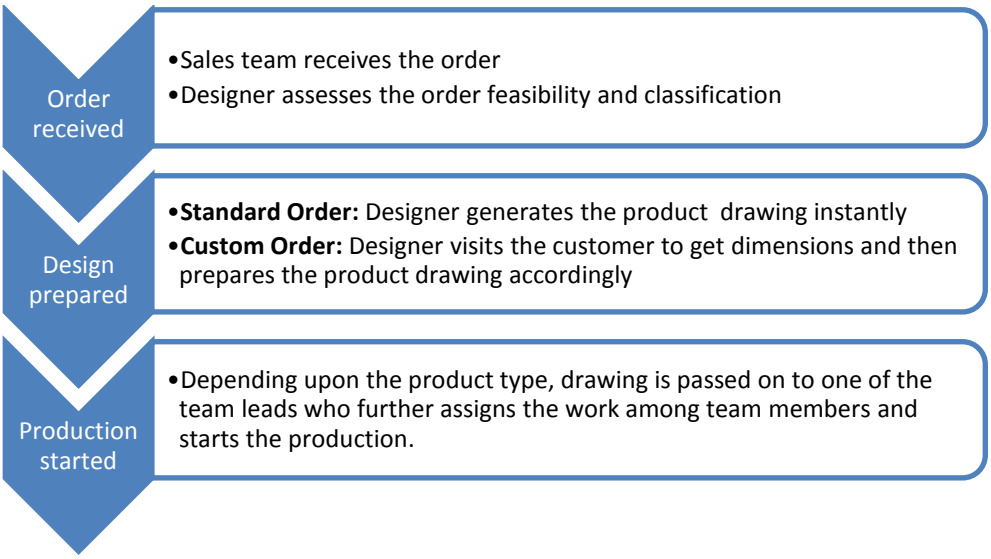


Figure 7: Ordering Process

The orders received by Rancold could be divided into two priority classes:

- Normal orders with usual lead time.
- Emergency orders where customer demands considerably short lead time

The prioritization of the orders by the production team is done after taking the following things into consideration:

- Order Priority received as an input from the designer
- Order arrival date
- Due date

4.4 Current Situation

4.4.1 Focus towards markets

After conducting interviews with the people from sales and the production department we understood that Rancold has lot of focus towards the market and the customers. Our observations also confirmed this fact. According to the owner-manager, the needs of the industry and the urge to maintain a competitive edge requires Rancold to accommodate the needs of the customer and be flexible towards them. According to the head of the sales department, “the competitive advantage of the company is to offer highly customized products with full installation at a reasonable price”.

4.4.2 Manufacturing Strategy: Make-to-Order

Rancold operates with a Make-to-order strategy. The orders received by Rancold could be classified in two categories:

- *Standard Orders*: Orders which have pre-defined design and dimensions.
- *Custom Orders*: Orders for which the design and dimensions needs to be prepared by the designer after consulting with the customer.

The production is started only after the order is confirmed. At the in-house production facility most of the products are manufactured from the scratch and the design and dimensions of the products are according to the costumers need. The raw material is usually purchased from the outside vendors / suppliers and its inventory is maintained, however no inventory of product specific sub-assemblies or parts is maintained.

4.4.3 Manufacturing Process: Jobbing

According to the manufacturing process classification provided by Hill and Hill (2009), the manufacturing process at Rancold is 'Jobbing'. The production department at Rancold is divided into 5 groups. The following figure illustrates the structure and hierarchy within the Production Department.

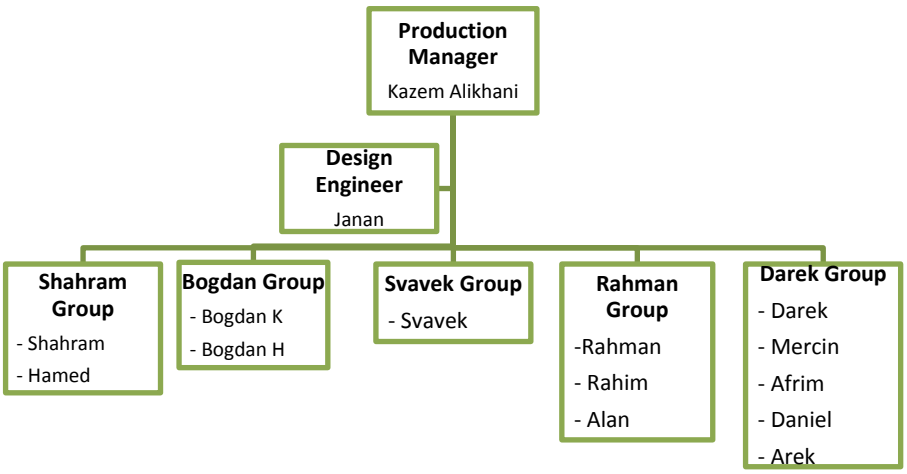


Figure 8: Current Structure of Production Department

These groups have been divided based on the product type / families; each group specializes in making products which are similar in nature and function and thus have many common activities in their manufacturing process. The following figure illustrates the division of the products among the teams.

Product division among teams				
Shahram Group - Kitchen sink - Casings / Shells - Support / Machine body - Ventilation - Stainless table	**Bogdan Group** - Display boxes - Buffet wagon - Heating wagon for buffet trays	**Svavek Group** - Servicemen / Onsite	**Rahim Group** - Support / Machine body - Pressing / Punching - Small and Fast Jobs / Quick fix - Emergency Jobs	**Darek Group** - Refrigeratiors - Configurators / Blenders - Buffet wagon - Heat cabinet - Heating wagon for buffet trays

Figure 9: Product division among teams

Within the teams, there is no division of labour based on specialization; all the individuals within each group do all types of work. For example a person from X team can do the sheet cutting, moulding, welding as well as fitting accessories. Whenever a team receives an order, either one person or a small group of people within the team do all the related activities to finish the product.

The important thing to note is that the overall manufacturing process of all the products (irrespective of the group which makes the products) is very similar. Fabrication of all the products at this company usually includes the following main activities:

- Sheet cutting
- Bending / Moulding
- Welding
- Fitting accessories

4.4.4 Layout of the Work shop area

As per our observations and according to the inputs from the management, there is actually no defined layout as of now. It is just the arrangement of machines according to the space availability. The actual flow of material and man is in a very disorderly fashion which is typical of 'Jobbing' work methodology. The current layout of the job shop / production area is represented by the following figure.

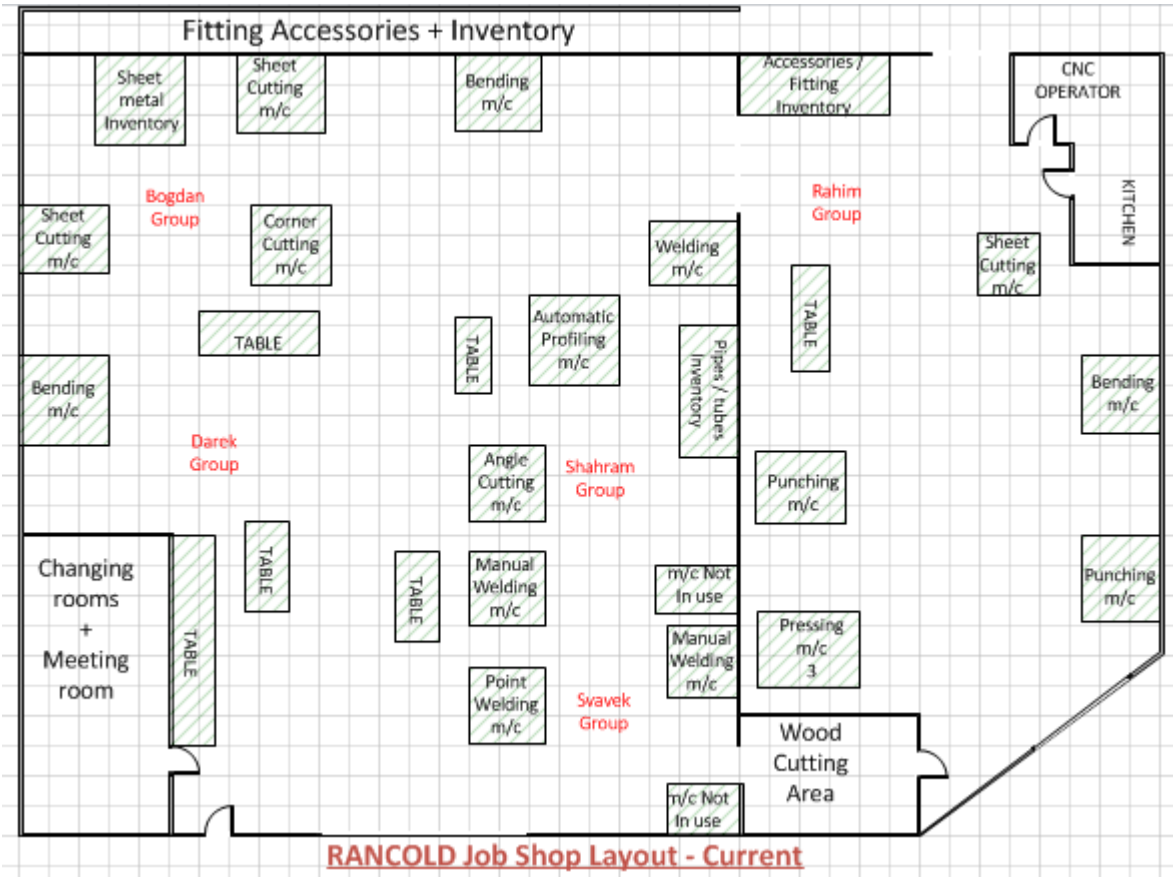


Figure 10: Production Area Layout

Please note that the figure is not to scale.

4.5 Challenges faced by the company

According to our observation and as well as according to the information extracted from the interviews, some of the problems faced by the company are as follows:

1. High production lead times in comparison to the competitors within the same industry. According to the production manager this can be attributed to the make-to-order situation and lack of a standard process for order handling.

2. High costs due to frequent interruptions in the manufacturing operations to handle 'emergency orders' and also because of the irregular routing of the product to accommodate unique requirements of customers.

3. Production teams are not able to provide a defined delivery dates for the products in many cases.

4. In the current ordering process there is just one way flow of information which sometimes results in conflicting scenarios. Because of the pressure of keeping customer happy the sales team promises too much and sometimes provides too optimistic delivery date without even consulting the production department.

5. As we observed, with the current division of the production department into teams based on the product types, one of the major problems faced is that of differential work load between different teams. Sometimes due to varying nature of the type of orders, some teams have excess work load and some have less products to make. Workers are reluctant in such situations to help each other as they have an excuse that this work belongs to another team, which results in inefficiency.

6. The current manufacturing process of "Jobbing" seems inefficient to handle the increase in the number of orders as workers are not used to handle larger number of orders by their current way of working. This results in order planning and prioritization issues and further increase the delivery lead times.

7. We observed that in many cases, the customers have been reaching out in the production floor and asking the workers to make changes in the order during the development phase.

8. High priority orders interferes with the production of other orders as the resources are diverted towards them which in turn spoil the overall schedule.

9. The teams seem to be specialised according to the products but within the teams there is lack of specialization according to an activity specific skill i.e cutting, welding etc. As of now everyone does everything and there are no experts on particular activity.

10. Sometimes same type of product is manufactured by two different teams. As each team has different way of working (because of lack of standardization), it results in a non-uniform quality of the products.

11. Because of the unplanned layout of the workshop there is a lot of wastage of time due to irregular movements. To get an idea of the degree of inefficiency we decided to observe the movement of man and material inside the workshop, so when a new order came we tracked its movement right from the beginning till it is completely manufactured and moved out of the workshop. The figure below describes the flow of a product which is manufactured very commonly in this production area.

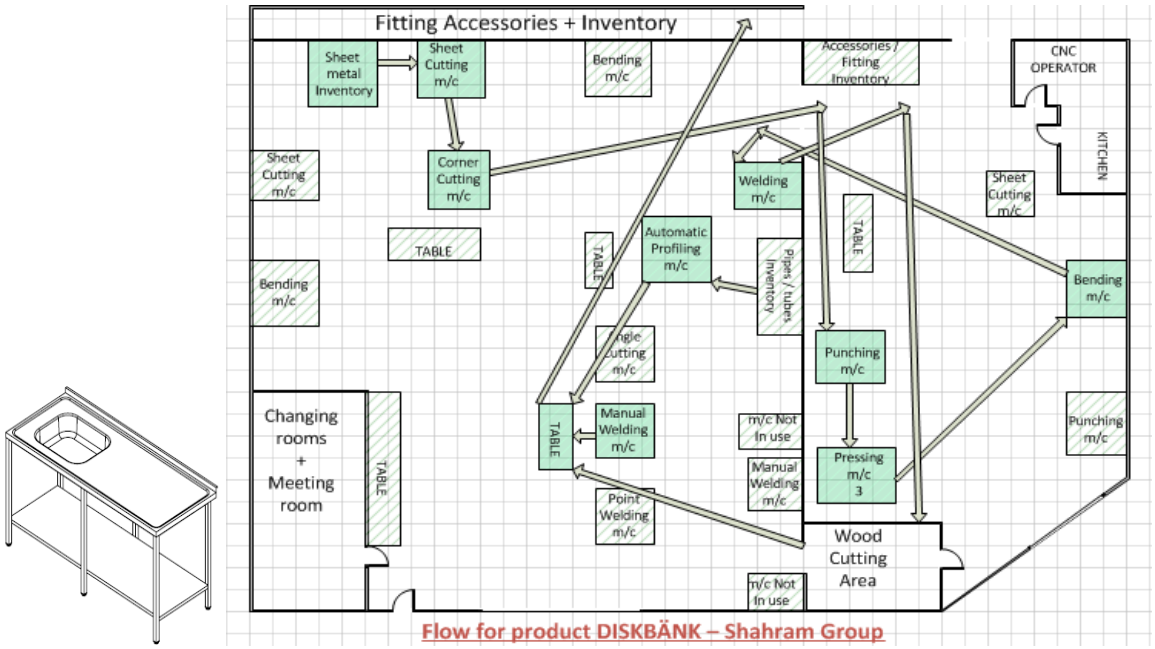


Figure 11: Flow for the Product DISKBÄNK

As we can observe that there are lot of zigzag movements, which cannot be considered as an efficient way of transporting the product between machines. And this is a flow representation of a simple product. We don't have to stretch our imaginations very far to understand the pattern of movements involved in manufacturing a complex product with many components.

4.6 Improvement Project at Rancold

In an attempt to resolve the above mentioned problems and to introduce standardization, the management at Rancold decided to initiate an improvement project. For this purpose we (authors) were asked to investigate the current situation and provide some suggestions. After three weeks of initial analysis and discussions with the management and other staff of the company and also keeping in mind the scope and time limits of the project; we agreed to focus on the following three areas:

(a) Restructure the production department and establish a standard process for order processing to improve the process efficiency.
(b) *Redesign the work shop layout to reduce wastages and support the new process*
(c) *Reduce the product's customization levels to reduce the manufacturing lead time.*

In this section we will present only very limited details of the project. For complete details and analysis, please refer to the appendix.

4.6.1 Restructuring the production department and establish a standard process

Based on our analysis and after taking into consideration certain restrictions, we decided to group some activities depending upon the nature and similarity of the work. Each group of activities was assigned to a team. The table below shows the division:

	Team 1	Team 2	Team 3	Team 4	Team 5
Activities	Sheet Cutting	CNC Operations	Corner Cutting	Welding	Brushing / Grinding
	Pipe Cutting	Sheet Punching / Pressing	Bending	Joining	Finishing touches
	Wood-board cutting		Angle Cutting	Fitting Accessories	
No. of people	2	1	2	7	1

Table 2: Proposed Team Structure

This division helped us in developing a standard process for order handling as all these teams could be connected in a sequential manner such that the work done by one team actually becomes the input for the succeeding team. The following figure shows the process structure and the linkages between the teams.

Figure 12: Work Flow and Connection of teams

The proposed team structures when connected in a sequence to make a process are capable of handling all type of orders.

4.6.2 Redesign the workshop layout

The main motivations for developing a new layout of the work shop area were to reduce the unnecessary movements of men and material and also to assist in the functioning of the

new proposed process flow and team structure. After completing our analysis and taking into consideration certain restrictions we proposed the following layout.

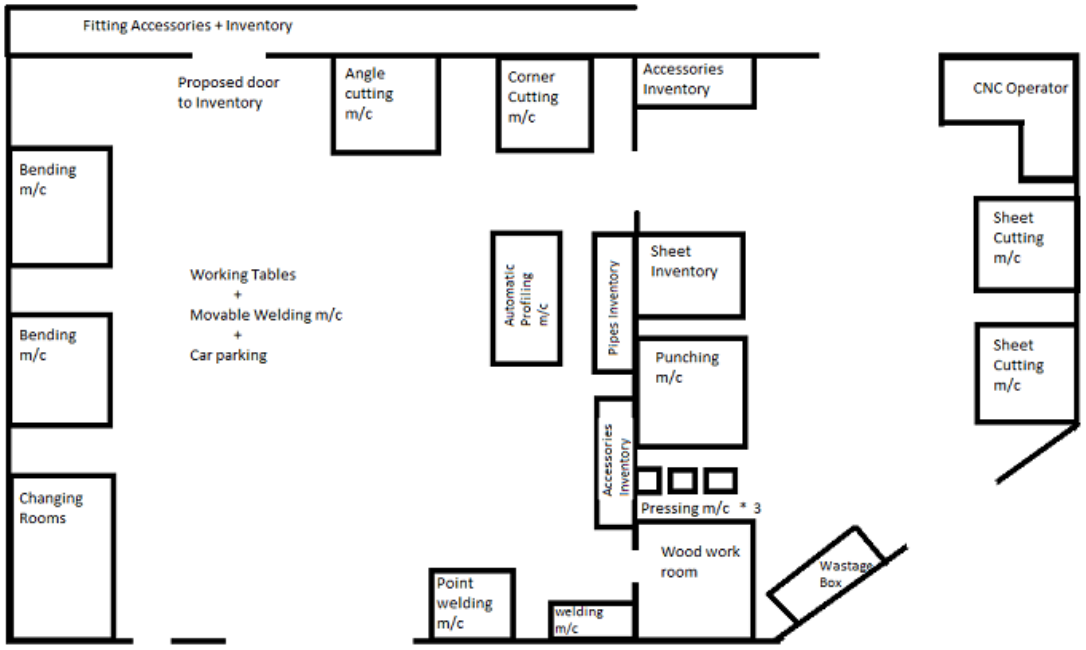


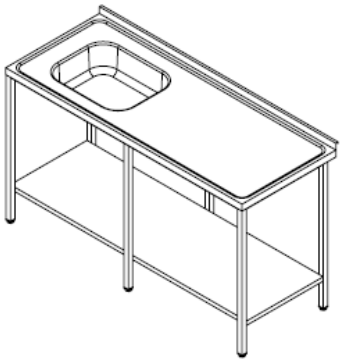
Figure 13: Proposed workshop Layout

In this layout the machines are arranged in such a manner that they contribute to a sequential flow of material from one work area to another.

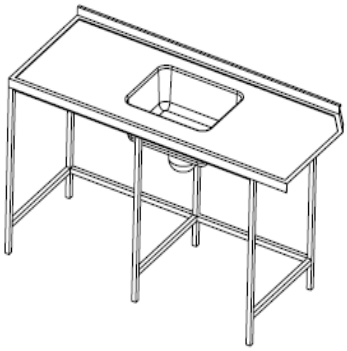
4.6.3 Reducing Product's customisation level to reduce lead time

Preparing the products with a make-to-order strategy requires more time. We provided some suggestions which can help the company in moving towards the Assemble-to-order situation and thus reduce the lead time. Main point of this exercise was to provide some ideas and examples as a starting point. Using our suggestion, the company can try to implement similar exercise among other products as well.

As the number of products is high, it was practically infeasible to do a detailed analysis of each and every product within the time limits of this project, so we decided to focus our efforts on few products with a high frequency of production. After discussing with the management of the company we identified 5 such products which were divided into two groups or product families according to the similarity of their structures (look at the figures below).



(a) DISKBÄNK

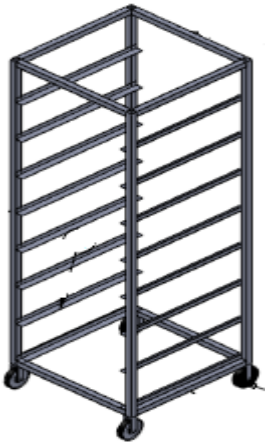


(b) INMATNINGSBÄNK

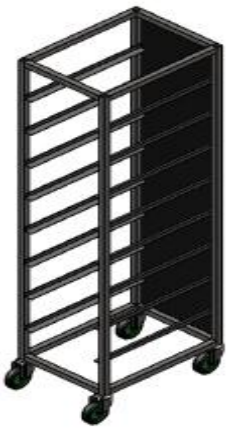
(c) UTMATNINGSBÄNK

Figure 14: Product Figures – Family 1

Courtesy Rancold AB



(a) DISKKORGVAGN



(b) BRICKVAGN

(c) Use of the products

Figure 15: Product Figures – Family 2

Courtesy Rancold AB

By observing the manufacturing process of all these products we got an understanding about which parts are customised and which parts have scope of standardisation. Then we found out the common parts within these products which could be subject to standardisation.

For the product family 1, the upper portion (working table and sink) is always customised but there is a scope of standardization in the lower supporting structure. So we suggested that the following structure be used as standard across all the products of the family 1.

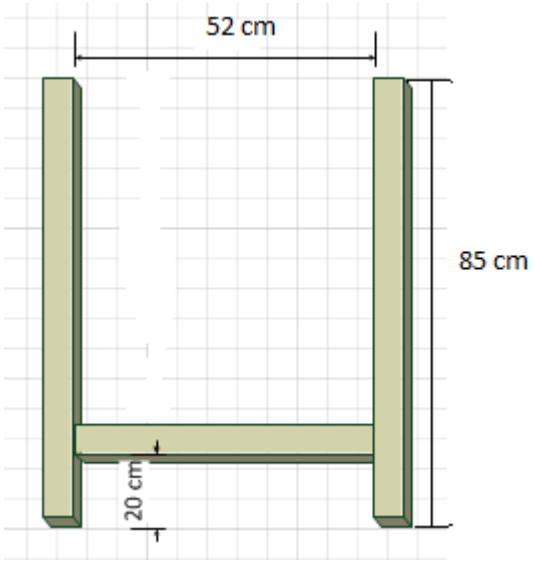


Figure 16: Proposed structure for Family 1

Figure 17: Height Adjustment Screw

The biggest motivation for proposing this structure is the fact that legs (made of steel pipes) being used in all the products have a small variation in the height. This variation could be adjusted by using the adjusting screw at the bottom of the legs. Just by maintaining a 1 week inventory of the legs required by different products, the company can save approximately 4 hours per week in order processing. The detailed analysis and motivation are available in the appendix.

For the product family 2 we proposed the following structure after taking into consideration the dimensions of the product.

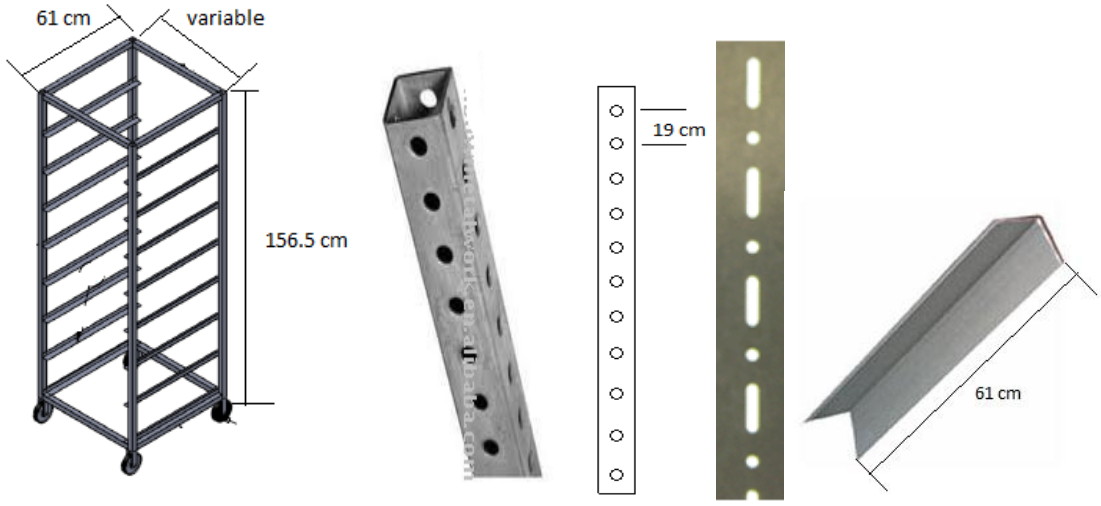


Figure 18: Proposed design – Family 2

We also proposed making some changes in the manufacturing of the product by using an alternate method of joining the supporting rods. Right now, riveting method is used to join

the supporting rods to the pipes; this method requires making accurate measurements while joining the rods which are permanently fixed to the pipe. We suggested that pipes with perforations be used and probably screws could be used to join the supporting rods. This is an easier way and will also make the adjustments between the rods possible (if required), instead of having a fixed structure. The detailed analysis and motivations are available in the appendix.

5 Analysis

In this section we analyzed the empirical data (case company as well as the improvement project at Rancold) from the theoretical perspective. We will discuss how the company is changing its strategies during growth.

5.1 Growth of the company

According to the definition of small company provided by European Commission, the company Rancold could be classified as a small company as it has 33 employees and revenues totaling 45 million SEK (2010). Levin & Weström (2003) define growth as an increase in the number of employees and/or growth in economic terms. As can be observed from the statistics available in table 1, the case company is growing as its revenues, employees and number of orders is steadily increasing over past few years.

Being a family owned and owner centric company, there is a widespread informality in the business processes. The 'power culture' described by Handy (1976) is well exhibited within Rancold as most of the control and decision power lies in the hands of owners. There is a lack of standard processes within the company but at the same time flexibility towards the customers exists and this is what the management considers as their main competitive advantage. This is in accordance to what Cohn and Lindberg (1972) said "the key advantage of small businesses is their flexibility in relation to customer service and making product changes."

As described by Mintzberg (1979), the structure of Rancold could be classified as simple. Recently, an organization structure has started to evolve within Rancold. The overall organization is divided into several departments which are more or less a reflection of work responsibility. The following figure represents the organization structure and the distribution of employees within various departments.

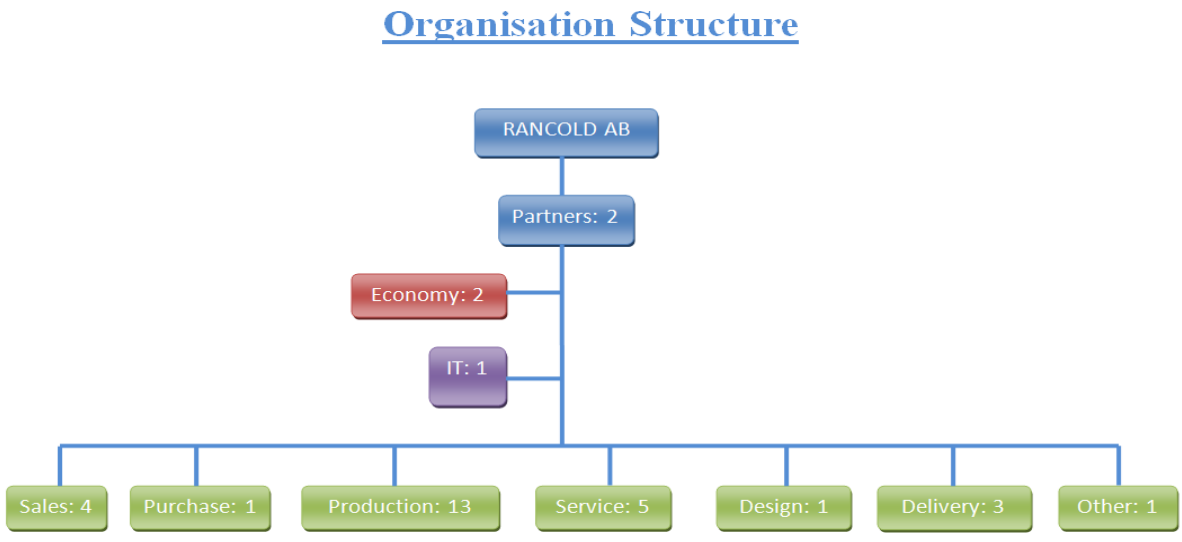


Figure 19: Organization Structure and Employee Distribution

The division seems clear in this figure but the job functions are not so strict; the boundaries between the departments are fuzzy and the work functions usually overlap as people from one department sometimes take up work of another department. This structure is in a development phase.

McMahon (2001) in his framework distinguished between internal and external growth parameters. Rancold is experiencing growth both internally as well as externally. The company is experiencing an increase in number of orders and the client base; this aspect can be classified as external growth. Through the improvement project the company wants to develop internal capabilities by department restructuring, developing processes and enhancing the services (reduced delivery time and increased quality for example), which is a reflection of internal growth.

Covin et al. (1990) formulated four different strategies that small companies usually adopt for growth in order to increase the market share: "cooperate with other producers", "positioning the product in the market, "reducing the risk of adoption" and "win market support" (meaning to establish a superior reputation). All these strategies aim at achieving the external growth. According to this classification of strategies, Rancold seems to adopt the strategy of winning the market support by establishing the superior reputation; they are doing so by promoting the customization aspect of the products, promising quicker delivery times and higher quality. Rancold understands that to achieve this objective they have to focus on developing their internal capabilities and that's why the improvement project was initiated. Several researchers like McMahon (2001) and Ungan (2006) have highlighted the importance of the internal factors and consider them to be more important for a firm's growth and survival.

5.2 Change in Operation Strategies

5.2.1 Shift in focus: From Market to Resources

Rancold operates in a market which is dominated by large manufacturers. These large companies have better resources in terms of advanced processing machines which may give them an advantage to produce and deliver standard size products with a shorter lead time to a competitive price. According to Rancold's management, the company cannot compete with these manufacturers on standard products as it doesn't have the required resources. Instead they focus on a market niche interested in customized products. The biggest competitive advantage of the company is to offer high degree of customization which equates to the "differentiation competitive advantage" as mentioned by Porter (1985). Porter (1985) also advocated that small companies should have a "focus" strategy which Rancold seems to follow appropriately. The target segment group of the company is the customers which cannot be satisfied by the standard offerings of the large competitors. The company has focused its efforts onto the client base which requires these customized products so Rancold has lot of "focus" around customers and markets.

As said by Hill and Hill (2009) companies can choose to focus either around resources or around the markets, the current strategy of Rancold is to focus around markets. According

to the classification of Manufacturing Strategies done by Cagliano et al (2005), the strategy followed by Rancold seems very similar to "Market based strategy" with product variety and flexibility towards the customer as main competitive priorities. Quality and service are also considered important by Rancold management to remain in competition.

In the case of Rancold, the strong focus towards the customers and the markets sometimes induce interruptions and inefficiencies in the business process. An example of this is when an 'emergency order' enters the system which often means that re-planning of order priorities in manufacturing has to be done. The improvement project carried out at Rancold was focused very much around leveraging the use of existing resources in order to better utilize them and thus improve the overall process performance by following the route of product and process development. The process development part includes the development of an organization structure and establishment of some standard routines. Also through this project the company wanted to strengthen its competitive position by establishing a new order winner i.e. shorter order-processing and delivery lead times. All the elements of this project can be found in the list of infrastructural decision areas in the Hayes and Wheelwright (1984) framework. This project can be seen as a response (in terms of reconfiguration of operation strategies) towards the challenges faced in the business environment during the evolution and growth of the company. All these facts provide a good indication of the fact that Rancold is moving towards a "resource based view" to attain some competitive advantage.

5.2.2 Change in Manufacturing Strategy: From Make-to-order to Assemble-to-order

Rancold follows a make-to-order strategy which is even extended to design to order in many cases. In most of the cases an order is processed as and when it arrives. The only inventory maintained is that of the raw materials i.e. metal sheets, pipes and accessories. Low volume of orders justifies this approach.

One of the expectations of Rancold from the improvement project was to shorten the lead time during the manufacturing of the products. As mentioned by Hill and Hill (2009), operations could trade lead time for inventory and move from, say, a make-to-order situation towards assemble-to-order situation. In the improvement project carried out at Rancold we tried to apply this methodology on certain products. We divided 5 products into two product families and then found out the common parts between the products belonging to same product family. We suggested that these common parts be manufactured earlier (if possible) and an inventory of these parts be held so that whenever an order arrives, instead of making it right from scratch certain already available parts could be assembled, this way the number of steps in its manufacturing could be reduced; all this could be equated to an assemble-to-order situation. As our preliminary and exemplary calculations show that by following this strategy the company could save on the total lead time and thus promise quicker delivery.

5.2.3 Changes in Manufacturing Process

The process used for manufacturing the products at Rancold is "Jobbing". As described by Hill and Hill (2009), jobbing process is usually used for special products (customized) whose demand is irregular and the work on such products is usually done by one person or a small group of skilled people who do everything. This is exactly similar to the work situation at Rancold. Due to the less number of orders and hence less volume of the work, the use of this process was justified.

Recently Rancold has experienced an increase in number of orders and the current process seems inefficient to handle this increase in volume of work. Before spending money on increasing the number of men or machine to handle this increased volume of work, the management at Rancold wanted to explore the feasibility of utilizing the available resources in an efficient manner. As suggested by Hill and Hill (2009), as the volume of the work / number of order increases the change in Process type provides better performance. Getting inferences from the Product Process Matrix proposed by Hayes and Wheelwright (1979a; 1979b; 1984) the suitable process type for low volume and multiple products is a disconnected line flow batch process. As Rancold is experiencing an increase in number of orders and thus the frequency of the repeat orders for similar products is also increasing so we proposed to modify the work process and shift it to the next available process in Product-Process matrix i.e. disconnected line flow batch. Other type of business process such as Line and Continuous could not be implemented because the volume of the orders is not so high to justify the huge investments that might be required to replace existing equipment with highly automatic machines.

As stated by Hill and Hill, 2009, the basic step in moving towards a batch process is to disintegrate the work process into several parts or processes. In our case it was not a smooth transition as the management of Rancold was very keen on preserving the flexibility of the existing process so we have to develop a process which introduces standardization and doesn't compromise the flexibility. To modify Rancold's manufacturing process required two major changes:

- Division of production department into teams where each team is responsible for certain set of activities thus fostering specialization. Also these proposed teams are connected in a sequential manner such that output from one team becomes input for another and thus ultimately resulting in a finished product. This developed a standard process for handling all type of orders. The flexibility or the customization aspect is still maintained because automation was not introduced and the work was done by hand using tools which allowed the workers to make user specific changes.

- Changing the layout of the work shop so that the product flows through machines / work centers and work activities are done on it in an efficient sequential manner. This new layout also supports the new process and team structure.

5.3 Standardization without compromising Flexibility

One of the biggest focus of the improvement project was to introduce the standardization in the processes. According to Jang and Lee (1998), process standardization is defined as "the degree of work rules, policies, and operating procedures are formalized and followed". The new team structure that has been developed formalizes the process to a great extent. The order handling and processing will be handled in a standardized manner. The teams are connected in a logical sequence according to the activities that are supposed to be done on a product resulting in a finished good of consistently the same quality.

Up till now "Jobbing" process has been used extensively within Rancold which is highly informal and has a focus on generalization instead of specialization as one or few people do the entire job. As stated by Mustafa C. Ungan (2006) "with standardization, the production or service process becomes routine with well-defined tasks". In the proposed new process, batch methodology will be followed which divides the work into certain set of activities and thus fosters specialization as the product flows from one work center to another and only the specialized team doing only the related activities.

The standardization of the process will provide Rancold a chance to monitor the process and manage efficiency which is also stated by Münstermann et al (2010), who present process standardization as a potentially powerful tool for successfully managing and monitoring improvements of the "process efficiency". As of now Rancold is not pursuing to achieve ISO certifications but that definitely is a plan in the long run and this project seems to be a first step in that direction.

Rancold also plans to introduce standardization within the product manufacturing by dividing the products into product families and thus maintaining an inventory of components which could be assembled to make a standard product quickly. The orders received by Rancold are both Standard as well as Custom.

As Rancold considers Flexibility towards customers as their main competitive advantage, they are not willing to compromise that by introducing new inflexible standards. Instead, process standardization should be used to create a flexible system. Some authors talk about standards as a threat to small business flexibility, but others like Rantakyrö (2004) concluded that flexibility towards customers requires internal stability, pointing out that the implementation of standardization includes more than just creating rigid inflexible standards.

Even though the new to-be-introduced process is batch but the number of orders is not so high so the process is still classified as Low volume disconnected batch. In majority of the cases the batch size will be 1 and not all the orders follow the same routing through the machines, this gives a complete flexibility to manufacture the product according to the wishes of the customer.

Moreover the concept of emergency orders is still retained by Rancold which it plans to handle to prioritizing and rescheduling the orders by doing negotiations with customers.

Even though the concept of Assemble-to-Order (ATO) is less flexible as compared to Make-to-Order (MTO), ATO for the most frequently sold products is expected to create an overall more efficient process and reduces the total lead time as it enables better possibilities for batch production. Not all the components that are supposed to be used within the products have been subjected to standardization. The parts which are frequently asked for customization are still planned to be made only when the order arrives. The aim is to design a process with capabilities of being just as adaptive as needed, not more or less.

6 Conclusion and Discussion

6.1 Research Question 1

How are Operation Strategies of small manufacturing companies adjusted while growing?

While growing the company must make certain changes in its strategies in order to survive and grow. From the beginning small companies have focus around the markets and customers; this fact was also evident in our case company which had a focus on product variety and flexibility towards the customer. This is in accordance with the market focus strategy proposed by Hill and Hill (2009) and the 'Market based strategy' presented by Cagliano et al (2005).

But as the companies grow, being so adaptive to customer demands starts resulting in several problems. For example, in the case of Rancold besides other issues this flexibility resulted in high costs and high lead times due to frequent interruptions in the manufacturing and irregular manufacturing operations that are associated with the requirements on unique product characteristics.

At this stage the "market focus" starts to prove inappropriate for the new conditions. The lack of resources to expand the manufacturing capabilities leads the owner manager to start focusing on the better utilization of the resources to improve the process efficiency. The organization structure also starts to develop and manager starts thinking of introducing standard processes to carry on the work. In the case of Rancold, the response of the management was to launch an improvement project with a focus on introducing standard order manufacturing process and better utilization of resources.

Small companies don't want to inhibit their flexibility by introducing standardization. The companies still want to differentiate themselves and stay attractive to the customers so they start developing new competitive priorities and promote new order winners and qualifiers. As our case company was in manufacturing industry it started to promote "shorter lead-times" and "improved qualities". To support this they have to make changes in their manufacturing strategy and move away from make-to-order strategy towards assemble-to-order strategy.

For companies involved in manufacturing sector, the growth also implies an increase in number of orders. To handle this change most small companies use 'Jobbing' process as that is justified because of the low volume of the work. But when the volume of the work starts increasing they have to bring out changes in their manufacturing process. In the case of Rancold they started to move towards a disconnected flow batch process which was a logical step away from jobbing to support increased volume of work and multiple product types.

6.2 Research Question 2

In what way can business processes in small manufacturing companies be standardized without compromising the desired levels of flexibility?

In accordance with the literature, the results from the case study indicated that being highly adaptive to variations in customer's demands puts requirements on flexibility of the manufacturing company. Although it has been concluded (both from the case study and the literature review) that small companies in general are good at being flexible, this adaptive ability often seem to be a result of the small business ability to quickly reallocate its resources and thus often require interruption of ongoing processes.

This ability to put low-priority orders on hold in favor of urgent ones often yields favorable results in terms of customer relations but affects the consistency of process execution and flow. It becomes evident that there is a big difference between being flexible towards the customer and being flexible internally. Rancold is flexible in terms of being able to satisfy a wide range of uncertain customer demands regarding product specifications, and it is also willing to reallocate resources in order to handle varieties in demands on lead time. This means that Rancold in a sense can be seen as an externally flexible manufacturer. When it comes to the adaptability of internal resources, Rancold's manufacturing can be seen as rigid with little capabilities of effectively handling these uncertainties without compromising overall production efficiency. This can be attributed to the fact that being a small company it has limited resources. This is also the case with many "flexible companies", most of them are flexible externally but don't have internal flexibility instead they have informality inside which should not be confused with flexibility.

The literature discussing flexibility in the context of small companies present the informality of small business processes as an advantage in terms of being able to accommodate to environmental changes, but does not distinguish between the two capabilities of being internally and externally flexible. This differentiation is important as the two capabilities have two different performance objectives.

Authors like Cohn and Lindberg (1972) stated that the key advantage of small businesses is their flexibility in relation to customer service and making product changes. Carter and Jones-Evans (2000) argued that flexibility sometimes can be inhibited by introducing standard process formats. However, based on these statements it is unclear if the authors refer to internal or external flexibility, a distinction that neither of the authors seem to do.

The statement by Carter and Jones-Evans (2000) seem to be true when referring to external flexibility; certainly a manufacturers reputation of being flexible (i.e. being able to offer customized products) would most likely disappear if they started to offer standard products only. Looking at the internal flexibility of a manufacturing company, the relation of process standardization and flexibility is not as obvious. While external flexibility has a direct

connection to customer satisfaction, the capability of being internally flexible has not, as long as it successfully enables flexibility towards the customer. Instead, internal flexibility can be seen as supporting capability to help reducing the cost of being externally flexible. In other words, standardization of internal processes does not necessarily inhibit what Cohn and Lindberg (1972) refers to as flexibility since the two concepts have no direct connection.

As mentioned earlier, both flexibility and standardization seem to be presented in the literature as two means for achieving competitive advantage. At the same time, authors have presented a contradiction in combining the two capabilities. Seemingly, to be able to discuss the relation between standardization and flexibility one must first untangle the meaning of the term flexibility.

After distinguishing the concept of internal and external flexibility it seems that external flexibility is a capability of satisfying the market niche while internal flexibility is about managing the use of a company's resources. It is thus suggested that process standardization can be used while integrating internal flexibility in the company's processes, without disabling the capability of being flexible towards the customer.

6.3 Contribution

From this thesis, small manufacturing business owners will get an insight of the practical consequences and hurdles when growing. It gives an overview of important concepts related to small business growth, such as flexibility, process efficiency and requirements on changes in strategy when growing. It summarizes proposed frameworks and models from earlier works in the field, and highlights the inconsistency of defining and measuring terms like growth and flexibility.

To explain how flexibility and standardization can be combined, a distinction between internal and external flexibility is introduced. Earlier attempts to define it seem to include solely internal or external flexibility, or a combination of the two. While external flexibility indeed is an important capability, it should be seen as a necessity rather than a competitive advantage for a small company manufacturing customized products. The distinction between internal and external flexibility is not only necessary for the purpose of understanding the concept of flexibility, but also to explain how organizational standards and flexibility are connected.

The conclusions suggest that flexibility and process standards do not necessarily inhibit each other. In fact, for a company sensitive to environmental variations (e.g. a small growing business), flexibility towards customers may in some cases not be possible without internal stability.

6.4 Prospect of future research

Although much of the earlier work within the field of small business development address flexibility or adaptability as an important competitive advantage, the number of definitions of the concept is almost as many as the number of attempts to define it. The various ways of defining flexibility together with the fact that flexibility is a potential rather than a performance makes it hard to measure and consequently hard to perform research on.

The distinction between internal and external flexibility serves a pedagogic purpose by untangling the previous diverse definitions, facilitating future research that wants to investigate the measurability of flexibility. It also helps with understanding that, although not how, small business strategies can be formalized and standardized without compromising required flexibility – a field that seems relatively unexplored, probably due to the reason that previous research has declared the combination of standardization and flexibility as inappropriate.

7 References

Amaro, G., Hendry, L., & Kingsman, B. (1999). Competitive advantage cusomisation and a new taxonomy for non make-to-stock companies. *Internationa Journal of Operations and Production Mangement, Volume 19*, 349-371.

Bordoloi, S. K., Cooper, W. W., & Matsuo, H. (1999). Flexibility, adaptability, and efficiency in manufacturing systems. *Production and Operations Management, Volume 8, Number 2*, 133-150.

Boyer, K. K., & Lewis, M. W. (2002). Competitive priorities: Investigating the need for trade-offs in operations strategy. *Production and Operations Management, Volume 11*, 9-21.

Cagliano, R., Acur, N., & Boer, H. (2005). Patterns of change in manufacturing strategy configurations. *International Journal of Operations & Product Management, Volume 25, Number 7*, 701-718.

Carter, S., & Jones-Evans, D. (2000). *Enterprise and Small Business: Principles, practice and policy.* Edinburgh: Prentice Hall.

Chen, M.-J., & Hambrick, D. C. (1995). Speed, Stealth, and Selective Attack: How Small firms differ from large firms in competitive behavior. *Academy of Management Journal, Volume 38, Number 2*, 453-482.

Churchill, N., & Lewis, V. (1983). The five stages of business growth. *Harvard Business Review, Volume 61, Issue 3*, 31-38.

Cohn, T., & Lindberg, R. (1972). *How Management is Different in Small Companies.* New York: Harper& Row.

Cook, T., & Campbell, D. (1979). *Quasi Experimentation: Design and Analysis for Field Settings.* Boston: Houghton Mifflin Company.

Corbett, L. M. (2008). Manufacturing strategy, the business environment, and operations performance in small low-tech firms. *International Journal of Production Research, Volume 46, Number 20* , 5491 — 5513.

Covin, J. G., Slevin, D. P., & Covin, T. J. (1990). Content and performance of growth-seeking strategies: A comparison of small firms in high- and low-technology industries. *Journal of Business Venturing, Volume 5*, 391-412.

De Groote, X. (1994). The Flexibility of Production Processes: A General Framework. *Management Science, Volume 40, Number 7*, 933-945.

Devaraj, S., Hollingworth, D. G., & Schroeder, R. G. (2004). Generic Manufacturing strategies and plant performance. *Journal of Operations Management, Volume 22*, 313 - 333.

Drucker, P. F. (1977). *People and performance: the best of Peter Drucker on management.* New York: Harper's College Press.

Enns, S. (1995). An economic approach to job shop performance analysis. *International Journal of Production Economics, Volume 38*, 117-131.

Gagnon, S. (1999). Resource-based competitiion and the new operations strategy. *International Journal of Operations and Production Management, Volume 19*, 125-138.

Gerwin, D. (1993). Manufacturing Flexibility: A Strategic Perspective. *Management Science, Volume 39, Number 4*, 395-410.

Greening, D. W., Barringer, B. R., & Macy, G. (1996). A quality study of managerial challenges facing small business geographic expansion. *Journal of Business Venturing, Volume 11*, 233-256.

Gunasekaran, A. (1998). Agile manufacturing enablers and an implementation framework. *International Journal of Production Research, Volume 36*, 1223-1247.

Gunasekaran, A., & Yusuf, Y. (2002). Agile manufacturing: a taxonomy of strategic and technological imperatives. *International Journal of Production Research, Volume 40*, 1357-1385.

Hammer, M. (2004). Deep Change: How operational innovation can transform your company. *Harvard Business Review, Volume 82, Issue 4*, 85-93.

Hawk, S., & Aldag, R. (1990). Measurement Biases in User Involvement Research. *International Journal of Management Science, Volume 18, Number 6*, 605-613.

Hayes, R., & Wheelwright, S. (1979). Link manufacturing process and product life cycles. *Harvard Business Review, Volume 57*, 133-140.

Hayes, R., & Wheelwright, S. (1984). *Restoring our Competitive Edge - Competing Through Manufacturing.* New York: Wiley.

Hayes, R., Pisano, G., Upton, D., & Wheelwright, S. (2005). *Operations Strategy and Technology: Pursuing the Competitive Edge.* Hoboken, NJ: Wiley.

Hendry, L., Kingsman, B., & Amaro, G. (2003). Product customisation and competitive advantage: an empirical study. *EUROMA-POMS Conference Proceedings 1*, 119-128.

Hill, T., & Hill, A. (2009). *Manufacturing Operations Strategy.* Palgrave Macmillan.

Hoets, H. (2009). *Instant Focus Group Questions*. Retrieved May 28, 2011, from Focus Group Tips: http://www.focusgrouptips.com/instant-focus-group-questions.html

Hofer, C. W. (1975). Towards a Contingency Theory of Business Strategy . *Academy of Management Journal, Volume 18, Number 4*.

Hrebiniak, L. G., & Joyce, W. F. (1985). Organizational Adaptation Strategic Choice and Environmental Determinism. *Administrative Science Quarterly, Volume 30, Number 3*, 336-349.

Jack, E. P., & Raturi, A. S. (2006). Lessons learned from methodological triangulation in management research. *Management Research News, Volume 29, Number 6*, 345-357.

Jang, Y., & Lee, J. (1998). Factors influencing the success of management consulting projects. *International Journal of Project Management, Volume 16, Number 2*, 67-72.

Johnson, G., Scholes, K., & Whittington, R. (2008). *Exploring Corporate Strategy (8th Edition).* Prentice Hall.

Johnson, G., Scholes, K., & Whittington, R. (2008). *Exploring Corporate Strategy: Text and Cases 8th Edition.* Pearson Education.

Jordan, W. C., & Graves, S. C. (1991). *Principles on the benefits of manufacturing process flexibility.* Miami: General Motors Research Laboratories.

Kelmar, J. H., & Wingham, D. L. (1995). Determining the Relevant Factors in the Success Strategies of Small Ente. *Journal of Entrepreneurship, Volume 4*, 215-236.

Kidder, L., & Judd, C. (1986). *Research Methods in Social Relations (5th Edition).* New York: CBS College Publishing.

Kim, C. (1991). Issues on Manufacturing Flexibility. *Integrated Manufacturing Systems, Volume 2, Number 2*, 4-13.

Kotha, S., & Orne, D. (1989). Generic manufacturing strategies: a conceptual synthesis. *Strategic Management Journal, Volume 11*, 211-231.

Kvale, S. (1996). *Interviews: An Introduction to Qualitative Research Interviewing.* California: Sage Publications.

Legislation, E. (2003). *Definition of micro, small and medium-sized enterprises*. Retrieved 06 11, 2011, from European legislation: http://europa.eu/legislation_summaries/enterprise/business_environment/n26026_en.htm

Levin, H., & Weström, A. (2003). *Tillväxt i småföretag - Företagens villkor och verklighet.* Stockholm: Nutek.

Lindlof, T., & Taylor, B. (2002). *Qualitative Communication Research Methods (Second edition).* Thousand Oaks, CA: Sage Publications.

Macpherson, A., & Holt, R. (2007). Knowledge, learning and small firm growth: A systematic review of the evidence. *Research Policy, Volume 36*, 172-192.

Majumdar, S. (2010). How do they plan for growth in auto component business? A study on small foundries of western India. *Journal of Business Venturing, Issue 25*, 274-289.

McCutcheon, D. M., & Meredith, J. R. (1993). Conducting case study research in operations management. *Journal of Operations Management, Volume 11*, 239-256.

McMahon, R. G. (2001). Growth and Performance of Manufacturing SMEs: The Influence of Financial Management Characteristics. *International Small Business Journal, Volume 19, Number 3*, 10-28.

Meredith, J. (1998). Building operations management theory through case and field research. *Journal of Operations Management, Volume 16, Number 4*, 441-454.

Mintzberg, H. (1979). *The Structuring of Organisations.* Englewood Cliffs, NJ: Prentice Hall.

Muda, M., & Hendry, L. (2003). The SHEN model for MTO SME's: a performance improvement tool. *International Journal of Operations and Production Management, Volume 23*, 470-486.

Münstermann, B., Eckhardt, A., & Weitzel, T. (2010). The performance impact of business process standardization: An empirical evaluation of the recruitment process. *Management Journal, Volume 16, Number 1*, 29-56.

Nelson, R., & Winter, S. (1982). *An Evolutionary Theory of Ecomonic Change.* Cambridge, MA: Harvard University Press.

Ngamsirijit, W. (2008). *Manufacturing Flexibility Improvement: Case studies and survey of Thai automotive industry.* Nottingham: University of Nottingham.

Olhager, J. (2003). Strategic positioning of the order penetration point. *International Journal of Production Economics, Volume 85, Number 3*, 319-329.

Oosterman, B., Land, M., & Gaalman, G. (2000). The influence of shop characteristics on workload control. *International Journal of Production Economies, Volume 68*, 107-119.

Penrose, E. (1959). *The Theory of the Growth of the Firm.* London: John Wiley.

Polo-Redondo, Y., & Cambra-Fierro, J. (2008). Influence of the standardization of a firm's productive process on the long-term orientation of its supply relationships: An empirical study. *Industrial Marketing Management*, 407-420.

Porter, M. E. (1985). *Competitive Advantage: Creating and Sustaining Superior Performance.* Free Press.

Rantakyrö, L. (2004). *Still searching the Best Way...* Luleå: Luleå University of Technology.

Schafersman, S. D. (1997, January 15). *An Introduction to Science - Scientific Thinking and the Scientific Method*. Retrieved April 27, 2011, from Stony Brook State University of New York: http://www.geo.sunysb.edu/esp/files/scientific-method.html

Scott, M., & Bruce, R. (1987). Five stages of growth in small business. *Long Range Planning, Volume 20, Number 3*, 45-52.

Soman, C., Van Donk, D., & Gaalman, G. (2004). Combined make-to-order and make-to-stock in a food production system. *International Journal Production Economics*.

Spring, M., & Dalrymple, J. (2000). Product customisation and manufacturing strategy. *International Journal of Operations and Production Mangement, Volume 20*, 441-467.

Stevenson, H., & Gumpert, D. (1985). The heart of entrepreneurship. *Harvard Business Review, Volume 64, Number 2*, 85-94.

Stevenson, M., Hendry, L. C., & Kingsman, B. G. (2005). A review of production planning and control: the applicability of key concepts to the make-to-order industry. *International Journal of Production Research*, 869-898.

Stevenson, T. H., & Barnes, F. C. (2002). What industrial marketers need to know now about ISO 9000 certification: A review, update, and integration with marketing. *Industrial Marketing Management, Volume 31*, 695-703.

Stevenson, T. H., & Barnes, F. C. (2002). What industrial marketers need to know now about ISO 9000 certification: A review, update, and integration with marketing. *Industrial Marketing Management; Volume 31*, 695-703.

Stuart, I., McCutcheon, D., Handfield, R., McLachlin, D., & Samson, D. (2002). Effective case research in operations management: a process perspective. *Journal of Operations Management, Volume 20*, 419-433.

Swamidass, P. M. (1998). *Manufacturing Flexibility.* Texas: Operations Management Association Monograph Number 2.

Teece, D., & Pisano, G. (1994). The dynamic capability of firms: an introduction. *Industrial Corporporal Change, Volume 3*, 537-556.

Teece, D., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Sloan Management Review, Volume 18*, 500-533.

Trochim, W. M. (2006, 10 20). *Deductive and Inductive Thinking*. Retrieved April 27, 2011, from Research Methods Knowledge Base: http://www.socialresearchmethods.net/kb/dedind.php

Ungan, M. C. (2006). Standardization through process documentation. *Business Process Management Journal, Volume 12, Number 2*, 135-148.

Upton, D. M. (1997). Process Range in Manufacturing: An empirical study of flexibility. *Management Science, Volume 43, Number 8*, 1079-1092.

Walker, E., & Brown, A. (2004). What Success Factors are Important to Small Business Owners? *Internationall Small Business Journal, Volume 22, Number 6*, 577-594.

Weick, K. (1969). *The social psychology of organizing (First edition).* Addison-Wesley.

Weick, K. (1979). *The social psychology of organizing (Second edition).* New York: Random House.

Wernerfelt, B. (1984). A resource-based view of the firm. *Strategy Management Journal, Volume 5*, 171-180.

Wettig, J. (2002). New developments in standardisation in the past 15 years — product versus process related standards. *Safety Science, Volume 40*, 51-56.

Yin, R. (1989). *Case study research: Design and methods (Second edition).* Newbury Park: Sage.

Yin, R. (1994). *Case study research: Design and methods.* Thousand Oaks: Sage Publications.

Zhao, X., Stecke, K., & Prasad, A. (2008). *Lead time and price quotation mode selection: Uniform or differentiated?* Dallas, Texas: The School Of Manamgenet, The University of Texas.

Appendix

A. Improvement Project Report Submitted to Rancold

1. Restructuring of the production department and develop a process

Before starting on with our analysis, we received inputs from the company about their expectations on how they want the new organisation structure to look like in production department. So it is important to get an understanding of that.

1.1 Team structure expected by Rancold

Rancold wants to divide the production department into several teams which are part of a process / work flow and hence connected in a sequential and logical manner. As per the inputs received from the company, the company wants to have an organisation structure for the production department which looks something like as shown below:

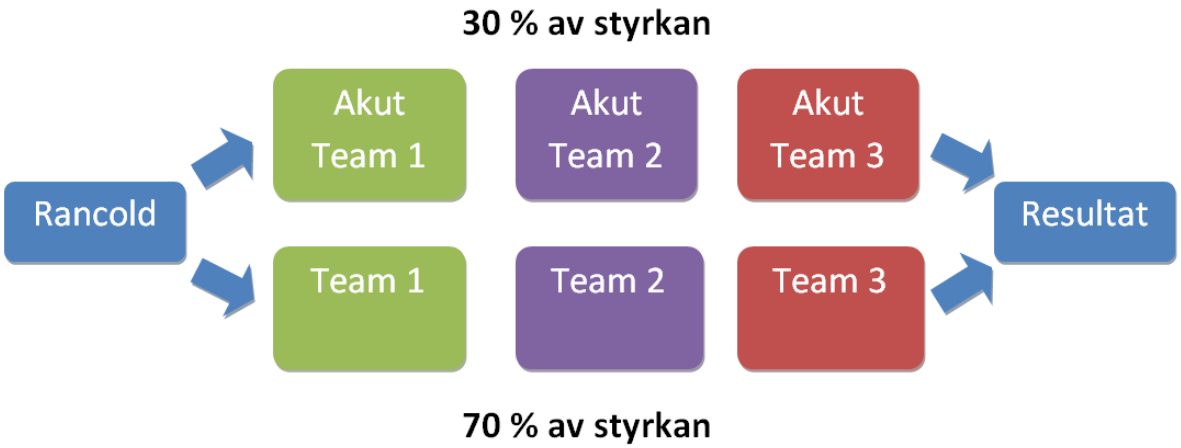


Figure 1: Expected Team Structure

Courtesy Rancold AB

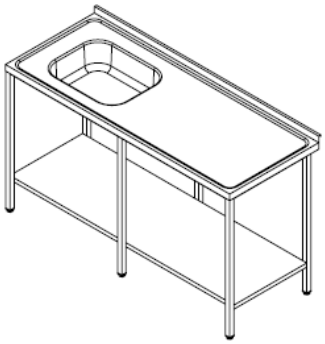
1.2 Analysis

To start with, we decided to gain an understanding of the manufacturing process of the products. We decided to analyse the work done by existing teams. We started by observing the most commonly manufactured product by each team and noted down all the steps involved in their production. We also noted down the time spent at each process. During our observations we found out that the most of the products involve all or several of the following process steps:

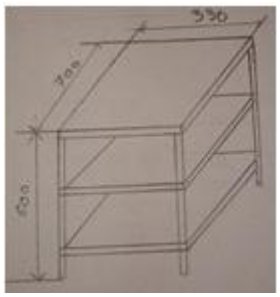
- Sheet cutting

- Cutting pipes for making supporting legs
- Sheet moulding / bending to give shapes
- Corner cutting
- Angle Cutting
- Welding joints
- Wood cutting for making frames to provide support to the surface
- Brushing / Grinding to smoothen the edges.
- Sheet Pressing / Punching
- Fitting accessories
- Operating CNC machines
- Servicing onsite / offsite

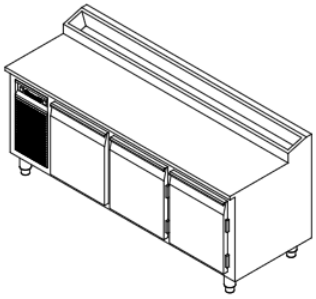
To do a detailed analysis we choose the following three products:-



1. Diskbänk



2. Stativ



3. Pizzabänk

Figure 2: Products for Analysis

Courtesy Rancold AB

The reasons for specifically choosing these 3 products are:

- They have high frequency of production
- Manufacturing of these products include most of the above listed steps
- These products have different complexities and production times

The following table gives an idea of how the total processing time is divided among various activities for these three products.

Activity	DISKBÄNK	STATIV	PIZZABÄNK	DISKBÄNK	STATIV	PIZZABÄNK
	Time in mins	Time in mins	Time in mins	% of total time	% of total time	% of total time
Sheet Cutting	15	25	47	9.8	20.83	3.76
Pipe Cutting	5	15	18	3.26	12.5	1.44
Wood-board cutting	20			13.07		
CNC Operations	30		30	19.6		2.4
Punching / Pressing	18		10	11.76		0.8
Corner Cutting	5	5	30	3.26	4.16	2.4
Bending	10	15	66	6.53	12.5	5.28
Welding / Joining	30	45	813	19.6	37.5	65.14
Fitting Accessories		5	168		4.16	13.46
Brushing / Grinding	20	5	39	13.07	4.16	3.12
Finishing Touches		5	27		4.16	2.16
Total	153	120	1248	100	100	100

Figure 3: Processing time for 3 products spread among various activities

Courtesy Rancold AB

This table tells us the relative time consumed by each activity and thus gives us an idea of the related volume of the work at each stage.
At this stage we also conducted some interviews both formally as well as informally. We asked some people from each team about the activities in which they are involved in and what they consider as their specialization. In the end, as expected we found out that many people were doing multiple activities and in some cases a complete product is prepared by one person right from the beginning till the end.

The following considerations were taken into account:

1. Only 1 person is qualified (has knowledge) to work as CNC Machine operator.
2. Manufacturing of certain high complexity products require some sort of practical specialization (which has been attained by experience) in the assembly stages i.e. during parts joining, welding and fitting accessories.
3. Most people are experienced and comfortable with working on different activities. So with a little training they can work on production of any kind of product.
4. As we can see from the table above, the activity that consumes most of the processing time is the welding / joining. And also the percentage of the time consumed in this process goes up with the complexity of the product because the number of parts to be joined increases.
5. The number of machines is also a restriction.
6. Darek has to be moved to a lead role and made more responsible for controlling the quality of all the products.

As the work volume (Order Quantity × Amount of work) increases then moving towards the Batch process is the best alternative. At Rancold the usual batch size is 1.

1.3 Our suggestion

Based on our analysis as well as suggestions from Rancold personnel we decided to group some activities depending upon the nature and similarity of the work. The above mentioned processes were divided into the following groups which could be assigned to a team. The table below shows the division:

	Team 1	Team 2	Team 3	Team 4	Team 5
Activities	Sheet Cutting	CNC Operations	Corner Cutting	Welding	Brushing / Grinding
	Pipe Cutting	Sheet Punching / Pressing	Bending	Joining	Finishing touches
	Wood-board cutting		Angle Cutting	Fitting Accessories	
No. of people	2	1	2	7	1

Figure 4: Proposed Team Structure

The teams could be connected in a sequential manner such that the work done by one team actually becomes the input for the succeeding team. This way a process could be established.

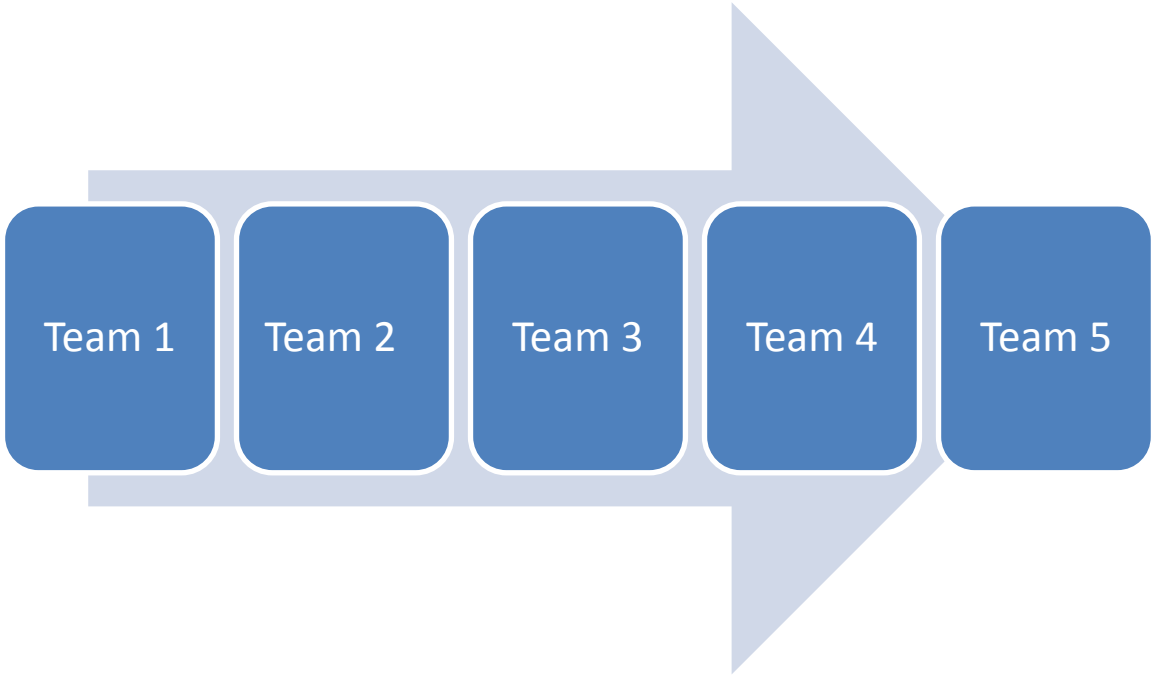


Figure 5: Work Flow and Connection of teams

1.4 Motivations

APPENDIX

Team 1

1. Sheet and pipe cutting is one of the basic starting activity in the manufacturing of most of the products. Moreover there is a similarity in the nature of the cutting process and in the machines used.
2. Team 1 can handle and manage the inventory of the raw material (sheets, pipes and wood boards). It will be much easier for just 1 team to manage the inventory as they will be the only ones taking the material away from it.
3. In the case of multiple orders, the team can plan their work in such a manner so that wastage can be reduced by planning the cutting of the sheets and pipes in an efficient manner.
4. 2 persons can efficiently handle the activities involved in the cutting process and also there are only 2 efficient machines
5. The percentage of time consumed by the cutting process is not so much.
6. Cutting of the support wood board require taking and marking dimensions from the actual sheet.
7. Designer needs to interact with only 1 team and explain the order and the involved technicalities.
8. In the case of idle time they can actually cut some pieces which could be stored in inventory and later on used in the assembly stages.

Team 2

1. Once the sheet has been cut into appropriate dimensions then some products require some punching and perforations on some profile of the sheets.
2. This work is usually done by CNC machine and there is only 1 person who can do that. One person is sufficient for this job because not all products require these operations.
3. Setup times of the CNC machines are comparatively high so if the operator is aware of several incoming orders from the previous team then he can plan his work in such a manner that setup / program change overs can be reduced.
4. Punching / Pressing of the sheet has to be done before doing further operations.

Team 3

1. Bending of the sheet around the edges requires that corner be cut from the rectangular / square piece of sheet.
2. As the dimensions of the corner will define the profile and the points from where the sheet can be bend, so these operations are best suited to be done together.
3. Angle cutting on the sheet is required in certain products and this is a specialized operation.
4. The number of sub-parts of a products requiring these operations are high so volume of work can be bit high but as the processing time are relatively small so we believe that existence of 2 people in this team is justified.
5. In the case of high workload people from other teams can be borrowed.

6. Arguments of work planning also holds valid here as the bending machines require setup operations. If the operator knows his work (and thus dimensions on which bending needs to be done) then he can plan in such a manner that the number of setup changes be minimized.
7. The number of team members in this team is also restricted by the number of machines.

Team 4

1. As we can see from the table in figure 3 above, the activity that consumes most of the processing time is the welding / joining and fitting accessories because this work is done mostly by hands using certain tools. And also the percentage of the time consumed in this process goes up with the complexity of the product because the number of parts to be joined increases.
2. The volume of the work is high in this stage so a high number of employees in this team are justified.
3. Manufacturing of certain high complexity products require special knowledge during the assembly stages. Moreover the differentiation of the products also takes place during the stage. So within this team there could be further sub-division of the team members according to the product type.
4. The work done by this team will define the overall quality of the work so Darek (current production lead) will head this team and do the task of coordinating work.
5. Darek will assure the quality of the final products
6. Fitting accessories themselves requires activities like welding and joining.

Team 5

1. Final finishing of the product usually requires activities like grinding the welded edges, brushing the metal parts for smoothening and removing the plastic film from the steel sheet. So the amount of the work required is also not so high which justifies the use of just 1 person in handling the activities.
2. The activity like grinding by machines produces metal sparks which makes it unsafe for 2 people to coordinate work in order to avoid injuries.
3. The size of certain products also put restrictions on employing more than 1 person for doing such activity on a single product.
4. In the case of higher volume of work, people could be borrowed from other teams to assist.
5. The person in this team can be given an extra responsibility of managing the finished goods inventory.

1.5 Emergency Orders

Reality Check: According to the initial demand by company of reserving 30% of the workforce for handling the emergency orders, 4 persons out of the total 13 would have to be taken away to make another parallel team. This implies that the “normal” work orders be handled by just 9 people, which would have for sure affected the performance and also increased the work burden.

After looking at the order histories and having discussions with the designer and the production Lead (Darek) we found at that less than 10% of the total orders could be classified as actual emergency orders. Moreover the demand of the emergency orders is pretty irregular which means work load on the “would be emergency orders team” would be very unbalanced.

Suggestion: Keeping the above facts in mind we decided not to have any special dedicated team for the emergency orders. We suggested that emergency orders be handled by prioritizing the work within the team and negotiating the lead time with the customer. Also there is a kind of buffer (work-force of 7 people) available within the team 4 which handles the major portion of the work so emergency orders could be handled.

Moreover the current sequencing rules can take care of priority of orders.

2. Redesigning the Job shop Layout

2.1 Analysis

Our initial motivation and hypothesis to adjust the layout of the workplace was to reduce the wastage in movements of material and machines. And also to arrange the machines in such an order that a Batch Process can be sustained. We started to gather data about the lead times of certain products.

We considered the lead time as the combination of 4 components:

Lead Time = Setup Time + Processing Time + Transporting Time + Waiting Time

	DISKBÄNK	STATIV	PIZZABÄNK
Waiting Time	40	10	95
% of Total Lead Time	16.33	5.71	6.49
Transporting Time	5	5	30
% of Total Lead Time	2.04	2.86	2.05
Setup Time	47	40	90
% of Total Lead Time	19.18	22.86	6.15
Processing Time	153	120	1248
% of Total Lead Time	62.45	68.57	85.30
Total Lead time	245	175	1463

Figure 6: Lead time distribution of 3 products

Courtesy Rancold AB

As can be observed from the above table, the processing time makes a huge percentage of the total time. The main reason for this is the nature of the work which involves much of the handwork. The transport time is still a very minute percentage of the overall time.

2.2 Restrictions

There exist certain restrictions in designing the layout of the area. We cannot just put the machines here and there in order to get a layout. The following restrictions need to be considered:

1. The dimensions of the work shop. We don't have an unlimited area
2. The partition wall exists, which is a useless structure but exists because that area of workshop was purchased separately later on.
3. The position of the wood working area
4. The positioning of the CNC operator room.
5. The dimensions of the machines, some machines are big in dimensions.
6. Also some machines need huge operating areas on both sides; front as well as back
7. Sheet metal inventory should be close to the cutting machines
8. There needs to be an open space in the middle of the work shop in front of the gates so that the space could be used for parking cars and trucks in the evenings.

2.3 Our Suggestion

Keeping the above mentioned restrictions in mind we proposed the following layout.

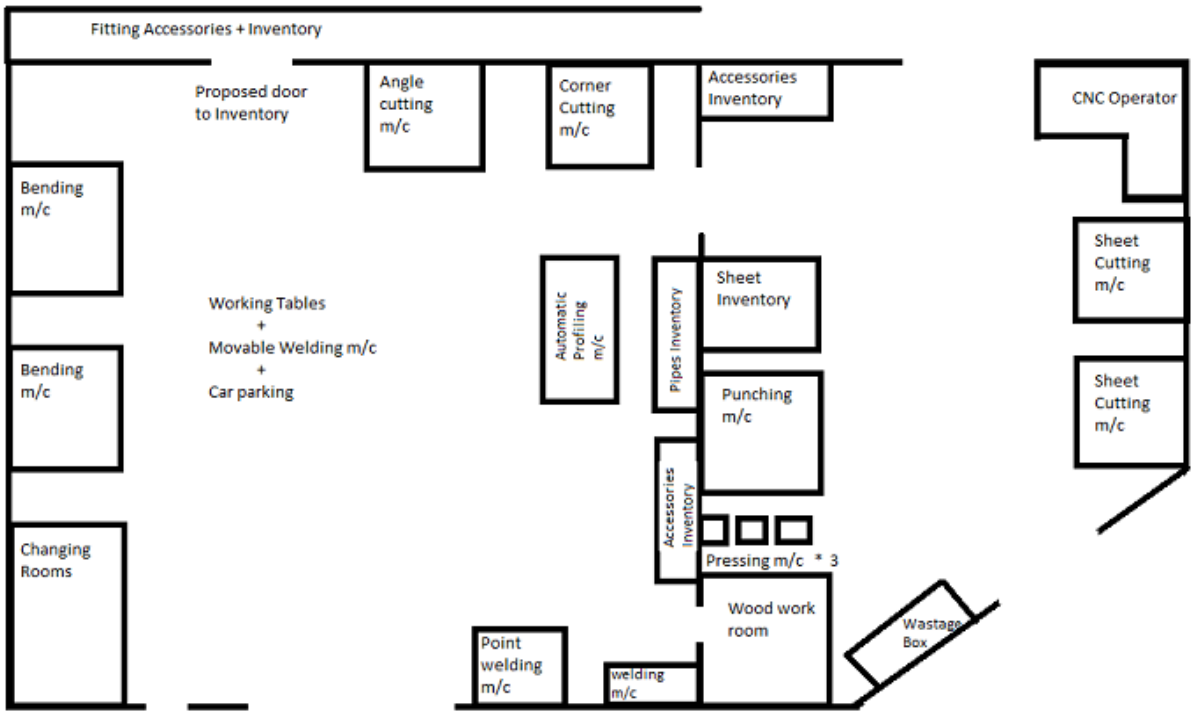


Figure 7: Proposed workshop Layout

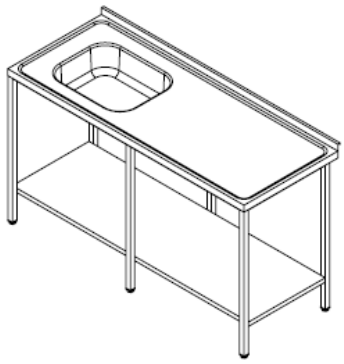
2.4 Motivation

1. The proposed layout of the workshop has been designed by keeping in mind these restrictions as well as to support and assist the smooth functioning of the new organisation structure.
2. The machines are arranged in such a manner that they contribute to a flow from one work area to another and the material flows in a sequence.
3. If one person does all the related similar activities then he can plan his work efficiently. Effects of practise and specialization.
4. Company initially asked for designing an appropriate layout.
5. As the volume of the work (Order Quantity × Work Content) increases, Jobbing process becomes insufficient and thus moving towards flow / batch is considered a good alternative.
6. Some machines were taken away by company as they were old, so this gives some room to some adjustments.

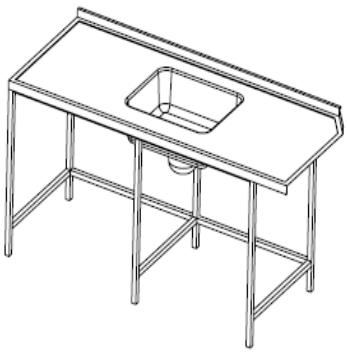
3. Reducing the level of customization of products

We focused this exercise just on the products which have maximum sales and frequency of production. As per the inputs from the management of the company we identified 5 such products. These five products could be divided into two groups or product families according to the similarity of their structures (look at the figures below). Today, all these products are built up from scratch. It could be considered as a Make-to-order scenario. There is very high level of customization of the products. Except for the accessories that are fitted in the last stage of the product, everything else is customized (including the design). Preparing the products the way it is being done today takes lot of time. So we decided to provide some ideas which can help company in moving more towards the Assemble-to-order situation. Main point of this exercise was to provide some ideas and examples as a starting point. Using our suggestion, the company can try to implement similar exercise among other products as well.

3.1 Analysis - Product Family 1



(b) DISKBÄNK



(b) INMATNINGSBÄNK

(c) UTMATNINGSBÄNK

Figure 8: Product Figures – Family 1

Courtesy Rancold AB

After observing the manufacturing process of all the products in this product family we found out that all these products are manufactured in two stages, based on which we can disintegrate the products into two parts:

- The upper sheet / working table

- The lower structure / support

Both the parts are then welded together to make the final structure.

The upper portion i.e. working table cannot be subject to standardization because of the following reasons:

- The upper working table is available in 5 different length sizes of 120, 140, 160, 180, 200 cm with all sizes being sold with a relatively equal probability. However the width is fixed for all length sizes: 65cm.
- Some of the products require sinks to be fitted into them. Sinks are available in 14 different varieties depending upon the dimensions, depth and the position of the drainage hole. However only few of them are used more frequently.
- The customers require sink to be placed in any of three positions on the sheet: left, centre and right.
- The customers can choose the steel sheet from two different varieties: smooth and matt finish.
- The total volumes of these products are not so high to justify the storage of inventories of all different options. It is better to make the upper structure as and when the order comes.

The only recommendation we can make about the storage of inventories of the sub parts is upto the stage of sheet cutting.

The lower portion i.e. supporting structure however has a possibility to be subjected to standardisation. Taking the following things into consideration:

- The minimum height of all the products is fixed by the directions from health ministry i.e. 87 cm.
- Height requirements across the products don't vary so much and usually small variations in height are handled by using the adjustment screw provided at the bottom of the legs.
- The adjustment screw has base / head of 2 cm and the threaded length of 9 cm. But for safety reason the screw is used to adjust height variations up to 7 cm only.

Figure 9: Support Screw

Courtesy Rancold AB

- The cross section of the steel pipes used for making legs is 3 × 3 cm.
- Upper structures having lengths of 140 cm and beyond require 6 legs whereas less than that requires 4 legs.

3.2 Our suggestion – Product Family 1

Keeping the above information into consideration we proposed the following structure which could be used as a standard across all products in this product family.

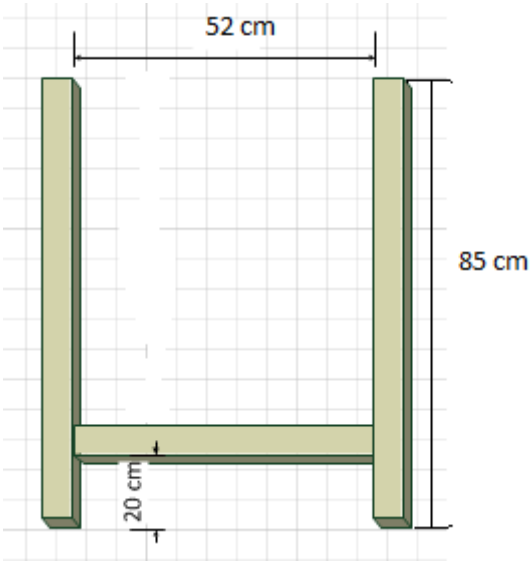


Figure 10: Proposed structure for Family 1

3.3 Motivation – Product Family 1

1. The legs used in all the three products are almost of same height so that's a great opportunity to implement standardization. As of now the legs are cut only when a new order comes, no inventory is maintained.

2. The pipe-cutting machine available for making legs has the capacity of cutting 4 parallel pipes at the same time with no extra setup or processing time required. But as of now only 1 pipe at a time is cut because no inventory is maintained. 1 pipe usually makes 4 legs. In a week they require between 75 -80 legs, which are then used in making of several products. Doing some calculation we tried to figure out the amount of time that can be saved:
   Current situation: Cutting 1 pipe at a time to make 4 legs
   Setup time required for cutting 1 pipe = 5 minutes
   Processing time required to make 4 legs out of 1 pipe = 7 minutes
   Total time required to make 4 legs = 12 minutes
   Total time required to make 80 legs = 20 × 12 = 240 minutes

Proposed situation: Cut 4 pipes at a time to make 16 legs
Setup time required for cutting 4 pipe = 5 minutes
Processing time required to make 16 legs out of 4 pipe = 7 minutes
Total time required to make 16 legs = 12 minutes
Total time required to make 80 legs = 5 × 12 = 60 minutes

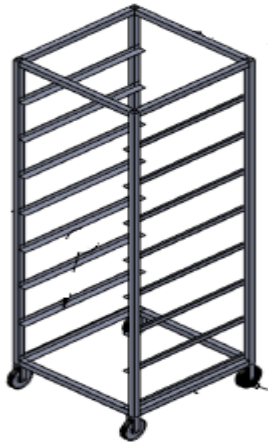
This time can be further reduced if all the inventory of legs is made in 1 go, this way the setup times can be eliminated. Total time required in this scenario becomes:
5 + (7 × 5) = 40 minutes

So the **total saving** of time that can be achieved in 1 week = 240 – 40 = 200 minutes if we cut pipes keeping in demand for just 1 week. So just by maintaining an inventory for legs, theoretically we can save more than 3 hours per week.

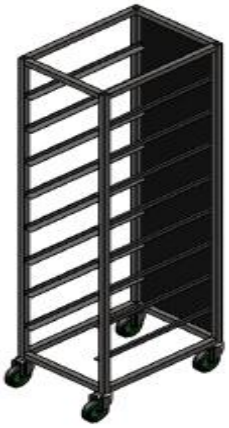
3. As mentioned above the height of the products cannot be less than 87 cm. So if we cut the steel pipe 85 cm and then fix an adjusting screw at the bottom then height can be adjusted to up to 94 cm, which meets the requirements of most of the orders. The minimum requirement of height is met by 85 cm length of pipe + 2 cm height of base / head of screw.

4. The connecting / supporting pipe to make the above proposed structure should be 52 cm. The length of this pipe is calculated as follows : 52 = 65 – 5 -2 -3 -3
   - 65 cm width of upper structure
   - 5 cm clearance on back side
   - 2 cm clearance on front side
   - 3 cm thickness of each pipe

3.4 Analysis - Product Family 2



(b) DISKKORGVAGN



(b) BRICKVAGN

(c) Use of the products

Figure 11: Product Figures – Family 2

Courtesy Rancold AB

A shown in figure 23, these products are usually used to hold and pile up the food platter trays or the cartels of glasses and bottles. The number of trays that can be stored in one Brickvagn depends upon the height of the product demanded by the customer and also upon the height of the glass or utensils used by that particular restaurant. So this factor is completely variable and every product needs to be customised.

Looking at the production of these products, we found out that the manufacturing process of these products is pretty simple. The products are basically composed of two components:

- Steel pipes which make the frame
- Angle bars which acts as supports for trays.

The manufacturing process could be described as follows:

Step 1: The metal pipes (4 pieces) are cut up to the desired height.

Step 2: The pipes are then joined together to make the outer frame using plastic fixtures to hold them in shape.

Step 3: The required number (and appropriate length) of angle bars is picked up from the inventory. The angle bars / supporting rods which are purchased as such from outside vendors are available in 3 different lengths.

Step 4: The angle bars / supporting rods are fixed on the frame using rivets as the joining technique.

Step 5: The wheels are then attached to the bottom to finish the product.

3.5 Our suggestion – Product Family 2

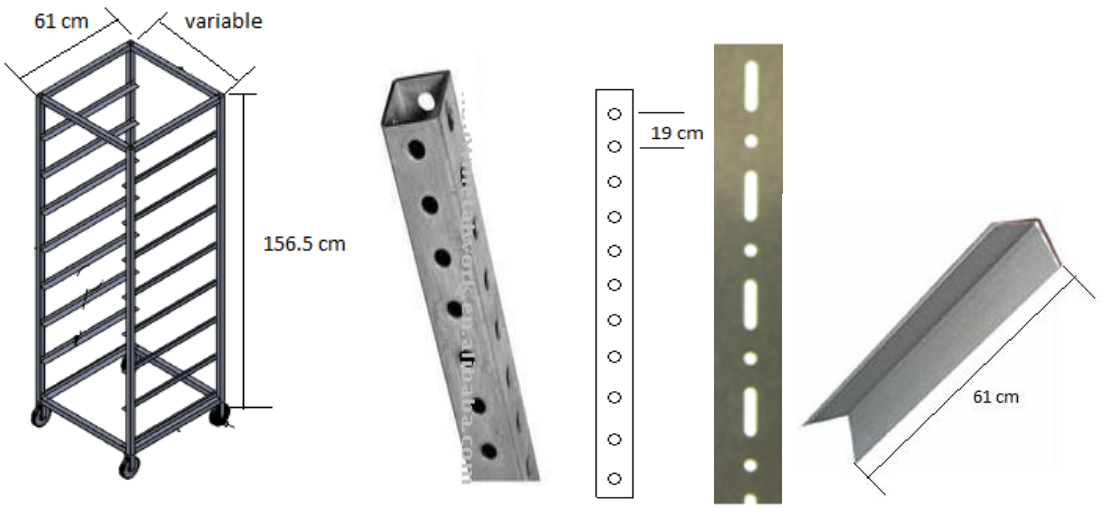


Figure 12: Proposed design – Family 2

3.6 Motivations – Product Family 2

1. The long metal pipes could be cut into a height of 156.5 cm. The reason being, height of most of the products is approximately same i.e. 168.5 cm, this height includes the height of the wheels which is 12 cm. So the length of the pipe used is 168.5 – 12 = 156.5 cm.

2. The number of supporting rods / angle bars could be kept as variable depending upon the requirement. To support this we need to have rods which support variable fixtures. The pipes used as of now have smooth cross section i.e. no perforations. We suggest using perforated cross section as shown above in figure. The reason being that with such cross sections it becomes easy to adjust and vary the heights of the bars. Also it takes away the need to do the measurement and alignment in the case where rivets are used. This saves time.

3. The gap between the holes / perforations is suggested to be 19 cm as this is the minimum gap between the bars expected by customers for different products.

4. Instead of using the rivets as joining technique an alternative could be to use the screws as it is an easier joining process and doesn't require specialized tools and techniques.

5. As said earlier, the supporting rods / angle bars are purchased in 3 lengths: 20, 37.2, 61 cm. We suggest that only the bars of 61 cm be used. Supporting logic being the fact that the longest one can easily hold the shorter length items whereas shorter length rods may or may not hold longer items tray.

6. The longest bar of 61 cm could hold 2 or smaller size trays / utensils.

7. There is no much difference in the cost of different angle bars. Whatever the small difference that exists could be compensated by buying only one type of product in bulk. Negotiations with the supplier might be required.

8. Length of half of the shorter pipes (4) making the sides of the frame has to be necessarily equal to 61 cm. The remaining 4 pipes cannot be fixed in dimensions because they will define the width of the products which is different depending upon the item it holds.

9. Following the same logic (as described for product family 1) of pipe cutting and maintaining inventory will help in saving time.

B. Machine Dimensions

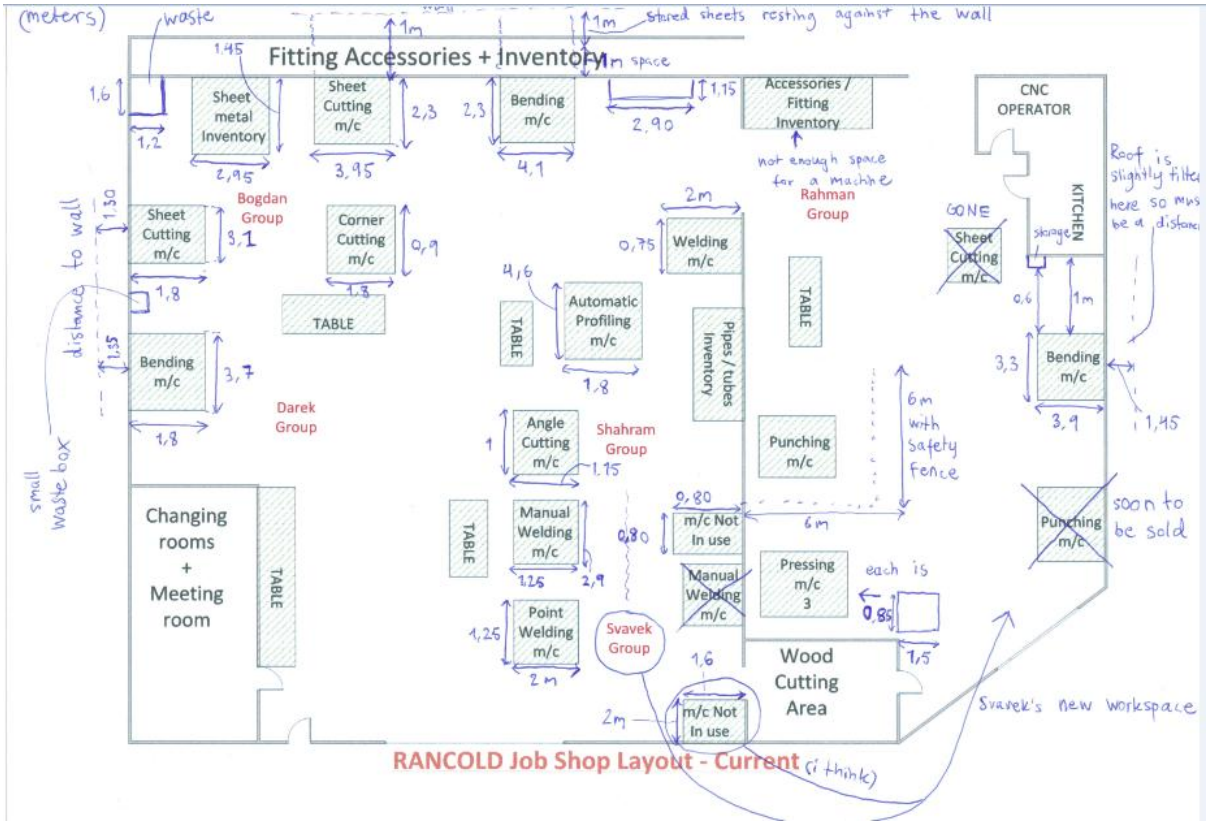


Figure 13: Machine dimensions

Courtesy Rancold AB

C. List of all the products made at Rancold

1. Buffevagn Varm/kall
2. Imkåpa
3. Utmatningsbänk
4. Inmatningsbänk
5. Diskkorgsställ
6. Diskkorgvagn
7. Fettavskiljare
8. Hyllor
9. Pizzakylbänkar
10. Grillkylbänk
11. Barkylbänk
12. Kylbrunn på stativ/lös
13. Kylbänk med brunn
14. Kylbänk med Ho
15. Smörgåskylar
16. Arbetsbänkar
17. Diskbänk m. Ho
18. Brickvagn
19. Degvagn
20. Drickbacksvagn
21. Värmeskåp
22. Nedkylningsskåp
23. Stativ
24. Diverse Plåtslageri

D. Interview guide - workshop personnel

1. Which group are you in and what is your specialization?
2. Do you find your work stressful?
3. Do you find it hard to keep up with the production schedule?
4. Do you find your job assignment repetitive?
5. What happens when an “emergency order” enters the production?
6. Do you often get the chance to plan your work?
7. Do you ever prepare components for later use? If so, how is this arranged?

8. Is there anything particular that you think should be different with the jop shop layout?
9. Do you often have to wait to use certain machines? Which ones?
10. Is there any operation that you experience as more difficult/troublesome than the others? Why?
11. How many of the machines in the job shop do you know how to operate?
12. Do you know how to change program settings on the sheet cutting and bending machines?
13. Is there any machine that you find difficult to use?

E. Interview guide - management

1. How many employees do you have in total (management + job shop)?
2. In what way how you grown during the past years?
3. Do you have any pronounced desired growth objectives?
4. What have your efforts been so far to adjust to the increase in work load?
5. What would you say is your main competitive advantage?
6. How does an order travel through your system?
7. Which products do you sell the most of?
8. How many percentages of your orders are ”emergency orders”?
9. How long is the normal delivery time?
10. For how long is an order normally pending before it is manufactured?
11. Do you normally deliver products on time?
12. Do you keep any products in stock?
13. What are the motivations for the current job shop layout? Machine placements etc.

F. Some Definitions and Abbreviations

Strategy

Strategy is the direction and scope of an organization over the long-term: which achieves advantage for the organization through its configuration of resources within a challenging environment, to meet the needs of markets and to fulfill stakeholder expectations.

RBV – Resource Based View

In RBV approach, the primary goal of the strategy is to develop and leverage resources in order to gain competitive advantage by creating new market qualifiers and order winners.

Dynamic capabilities approach

Dynamic capabilities have been defined as ‘the firm’s ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments.

Cost-leadership (strategy)

This strategy involves the firm winning market share by appealing to cost-conscious or price-sensitive customers. This is achieved by having the lowest prices in the target market segment.

Differentiation (strategy)

In this strategy the company differentiates the products in some way in order to compete successfully.

Focus (strategy)

In this strategy an organization focuses effort and resources on a narrow, defined segment of a market.

Structural decisions

Defines the shape of the "building blocks" of the operation, they define its overall tangible shape and architecture; it includes the broader issues related to the facility layout, capacity planning, choice of process and supply chain related issues.

Infrastructural decisions

Decisions affecting people, systems, and the culture that lubricate the decision-making and control activities of the operation category; it includes the internal management issues related to the development of the policies and procedures which could assist in the smooth functioning of the organization.

Market-based strategy

A manufacturing strategy that emphasizes the competitive priorities quality, service, flexibility and product variety.

Product-based strategy

A manufacturing strategy that emphasizes the competitive priorities quality, product variety and price.

Capability-based strategy

A manufacturing strategy that emphasizes the competitive priorities quality, service, flexibility and price.

Price-based strategy

A manufacturing strategy that emphasizes the competitive priorities quality, flexibility and price.

MTO – Make-to-Order

A manufacturing strategy where the products are manufactured from scratch upon order arrival.

ATO – Assemble-to-Order

A manufacturing strategy where product components are pre-manufactured and sometimes put into modules for direct assembly upon order arrival.

MTS – Make-to-Stock

A manufacturing strategy where products are manufactured based on forecasted sales and stored in stock.

Project (manufacturing process)

Companies that produce large-scale, one-off unique, complex products will normally provide these on a project basis. Examples include: large scale dam, nuclear reactors, bridges etc.

Jobbing (manufacturing process)

The Jobbing process is designed to meet requirements of being able to offer customers customized products. The products are often unique and the manufacturing is considered to be somewhat inefficient. Examples include: furniture, purpose built machine equipment etc.

Batch (manufacturing process)

This process is used when making similar items on a repeat basis and usually in larger volumes than associated with jobbing. Examples includes: injection mouldings, machine parts etc.

Line (manufacturing process)

In a line process, products are passed through the same sequence of operations as products are of standard nature. Examples includes: automobile manufacturing.

Continuous (manufacturing process)

In continuous processing, a basic material is passed through successive stages or operations and refined or processed into one or more products. The volume of the material handled is very high. Examples include: petrochemical processing.

Jumbled flow / Job shop

This layout is suitable for high variety production and is characterized by an informal routing of materials in the manufacturing. It is considered to be low in efficiency but has good flexibility.

Low volume batch process / Disconnected Line Flow

Although being slightly less flexible than the job shop, the disconnected line flow is a somewhat flexible process that allows low batch production of customized products.

Connected line flow / Assembly line

The connected line flow processes uses a fixed sequence, connecting the activities and paces them. Commonly used in automobile plants.

Continuous flow

Similar to the assembly line, but uses a continuous flow in relation to the assembly line which is divided into sequenced steps.

OPP - Order Penetration Point

The stage at which a product is linked to a specific customers order.