

# **Implementation of Lean methods on a daily basis by small and medium sized manufacturers**

Master's thesis in Chalmers University of Technology

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small and medium sized manufacturers

*Master's Thesis in the Master's Programme International Project Management*

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CHALMERS UNIVERSITY OF TECHNOLOGY

Göteborg, Sweden 2019

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## **Abstract**

Amount of manufacturing SMEs is increasing and their contribution to the economy is significant. In order to increase their productivity, manufacturing SMEs implement lean methods on a daily basis. Based on the lean methods theories which is originally from the manufacturing company in Japan, this thesis aims to investigate the implementation of lean methods in small and medium size manufacturing enterprises through three interview companies and a case company in Sweden. The study refers to lean method, lean activities, small and medium sized manufacturers, implementing preferences, challenges and advantages. The data is collected with three interviews and one single case study of Swedish companies in Gothenburg. The results explained two discussion points. Initially the most frequently applied lean activities in SMEs under current situation and secondly the reasons that SMEs are implementing lean methods. The most utilized lean methods are waste eliminating and error detection, while the least easily utilized ones are visual factory which call more for money and technology investment for SMEs. SMEs would benefit from the successful implementation of lean methods in different stages of lean methods to achieve their expected outcomes. Furthermore, on ground of the delimitations and relevant findings from this thesis, some recommendations to explore the implementation of lean methods in more comprehensive industries and business sizes are put forward.

**Key words:** SMEs, Lean Methods, Manufacturers, Production line, Lean Implementation, Lean activities

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# 1 Introduction

## 1.1 Background

In the era of globalisation, organizations are facing more severe challenge of surviving from intense competition than ever before. Among the challenges faced by organizations, one especially sharp challenge is that customers are always seeking for reasonable-priced products which are delivered on time and equipped with high quality (Begam et al., 2013). Along with the global challenges is the rapid development of Small and Medium-sized Enterprises (SMEs). Moreover, the development of SMEs is one of the reasons developing countries gain international focus. On the other hand, SMEs make huge contribution to the Gross Domestic Product (GDP) (Muneer & Al-Mubarak, 2016). All over EU, SMEs represent 99% of all business. In terms of EU commission, the definition of a small or medium sized enterprise is judged by two criteria: (1) staff headcount is  $\leq 250$  and (2) either turnover or balance sheet total is  $\leq 50$ m Euros. From this aspect, an SME could be concluded as an organization with limited human resource and budget. There is no doubt that SMEs have the common challenge as other organizations—seeking for the solution on how to deliver their products swiftly at low cost and maintain high quality of their products at the same time. In addition to this, SMEs are under pressure to find proper solutions in an efficient way while improving their performance, otherwise each unsuccessful attempt would cause big loss to them.

Manufacturing SMEs are expected to produce with high efficiency and reduced waste, in order to increase their productivity and lower their production costs. Therefore, there is a desire to study lean management in manufacturing SMEs which first appeared as lean manufacturing almost 100 years ago in Ford (Levinson, 2013) and then got developed by Toyota in the past decades. It is a general realization that Toyota is the most famous and most successful enterprise using Lean management. Although the principles of Lean management are no longer a secret and the Lean designs are not difficult to implement nowadays, the outcome when organizations implement Lean management can hardly meet the expectation of stakeholders (Mann, 2015). Therefore, it is not easy for organizations aiming to improve productivity performance with use of lean methods. The importance of paying effort on studying the implementation of Lean methods in organizations especially in SMEs with limited resources and high necessity of estimating waste and improving efficiency has caught the attention of researchers in recent years.



Lastly, it is a common phenomenon that project managers in SMEs combine some Lean activities whether they are intentional or not. Stem from that, it will be interesting to discover the most suitable and efficient Lean method for SMEs in demand by this paper.

## **1.2 Purpose and research questions**

Lean is mainly focused on improving process flow as well as reducing waste and variability (Timans et al., 2011). Based on the lean methods theories which is originally from the manufacturing company in Japan, this thesis aims to investigate the implementation of lean methods in small and medium size manufacturing enterprises through three interview companies and a case company in Sweden. These Lean methods are ought to be already in use in other industries or other types of organizations other than SMEs in the manufacturing industry.

Also, the researchers seek to find what contribution lean methods can induce in the work of SMEs. It is to investigate in what way implementation of a Lean method can affect the organizational procedures, processes and principles. The question is whether it is for the better or for the worse if implementing it in a specific way. That is, if the right Lean method is chosen what factors can affect the actual implementation in a non-desirable, non-beneficiary way. These issues entail that this thesis will be useful for the academics studying lean methods in SMEs as well as SMEs who are planning to implement lean methods (O'Gorman & MacIntosh, 2015).

Following the purpose mentioned above, two research questions are developed:

1. Which lean method are implemented by SMEs?

The first research question aims to identify which lean methods are used frequently by SMEs. In addition to this, it would be beneficial from this perspective to discuss obstacles of implementing lean methods in SMEs.

2. Why do manufacturing SMEs implement Lean methods?

By asking the second research question, it becomes possible to analyze why SMEs implement lean methods. With the comparison of varied outcomes from already-implemented lean methods on different levels, the benefits of lean methods for SMEs could be well explored and explained.

## 1.3 Delimitations

The scope of interviewees selection is limited to SMEs in the manufacturing industry in Sweden. Interviewees working with products or product relevant positions rather than services are preferred. Thus, the empirical data will be limited by the working area these individuals present. In other words, the chosen organizations share common principles, procedures, process and potential challenges.

In addition, lean methods are part of the whole lean management system. However, this research will narrowly focus on lean methods while not relating to broader. As suggested by the title, the emphasis is put on daily based activities.

Given more delimitations of this study, the lean methods are part of quality management systems (Bacoup et al., 2018). However, the thesis is limited to only lean methods but not other types of quality management systems such as International Organization for Standardization (ISO). The discussions between implementation of lean methods on a daily basis and implementation of lean methods to change existing work procedures, processes and guidelines is included in this thesis.

## **2 Methodology**

This section is formed to describe the approaches and design for this study process. Followed by the methods of data collection to support it, which are interviews and case study. Then the ethical considerations are also claimed.

### **2.1 Research approach and design**

The research is started from the literature review, to analysis the implementation on lean methods, the initial step is to make clear the normal used lean methods. Afterwards, together with the present demand to analysis the relationship between SMEs and lean methods, two research questions are put forward. Three interviews in the form of one-to-one conversations were conducted to collect the data for with the purpose to answer both the first *which* and second *why* question. After the interview, with these data gained from the interviews, more specific data in a certain environment was considered needed. Compared with carrying out more interviews to do a quantitative research, the qualitative one was chosen based on the need and purpose. As illustrated by McLeod (2017), qualitative research collects data through “participant observation and interviews” rather than through “measuring things” (Minichiello et al., 1990). This means that the researchers can obtain data from the interview to direct observation, the analysis of these data can also be from text to visual imagines or demonstration of personal experience (Guba & Lincoln, 1994). Thus, following this, the research first conducted three interviews and then a single case study was preferred as the next level of the research, which is a good way to collect data from another point of view that provides more thorough data. To conduct a case study, the data could be collected in both interview and observation techniques. For the interviews of the case company, the questionnaire is similar to the one for three interview companies, since both research questions rely on both findings. Additionally, there is an extra acquisition of this case study that is a test implementation of certain lean methods in this case company and the results offer possibilities for further research.

### **2.2 Data Collection**

The data collection is providing the basis and support of the research approach. Interviews and case study are the two main methods for data collecting for this research.

### **2.2.1 Interviews**

The first method to collect data is by interviews, and more specifically, semi-structured interviews. The semi-structured interview, which is recognized as SSI by William (2015), contains closed- and open-ended questions, and usually alongs with certain follow-up why or how questions. The appropriate time for a semi-interview is about one hour for both interviewers and interviewees (William, 2015). Based on this Blandford (2013) discussed the concept of Semi-structured qualitative studies (SSQS), which is highly applicable for this research since it is a quantitative research. To conduct the interviews, the questionnaire was generated following research questions. Then the questionnaire was sent to interviewers before the interview and the interviewees were asked for permission to record the interview. A set of interview questions which consists of 10 questions, shown in the appendix was listed. The questions started with a very general and broad topic and then narrowed down to specific lean methods and the situations of implementation.

Three companies were selected as interviewees and the selection criteria of enterprises are: first of all is to be SMEs, which means the headcount of total employees is expected to be under 250. Secondly, Swedish-style local enterprises are preferable as typical samples for this research field. Lastly, while doing research in lean concept, it could present clearer impression on how lean activities improve enterprises' performance when research takes place in manufacturing industries.

### **2.2.2 Case Study**

Case study design is a efficient researching method for researcher to not only collect but more deeper to examine the data within the background context of the data. Generally the case study usually prefers choose small group or a limited number of participants for a specific subject (Zainal, 2007). Thus together with the subject of SMEs, the Case Company Delta is chosen as a very small-sized manufacturer in Gothenburg. In this thesis work, Case Company Delta is the only case since the research conduct a single case study. Compared with multiple case studies, single case studies are applicable in this type of research where there is a need to highlight deeper interactions between processes and actors under certain circumstance and less money-consuming as a school research (Gustafsson, 2017). Besides, Yin (1994;2003;2009) explained and further agreed that case study is functional tool since the analysis of data is most often conducted within the context its employed in. Apart from the general meaning of a case study, the specific significance of the conducted case study is to provide data and information in a smaller size, a different industry type as well as more thorough situation to be compared with the results

of three interviews. This way, the final research could be more objective and convincing.

The case company is also chosen according to similar standard in order to keep the comparability with interview companies, thus SMEs employing six persons and Swedish-style and local company. On the other hand, according to what has been mentioned in the case study design, to be more convincing and with a need for implementing certain necessary research findings, the company chosen is of a very small size. This was done in order to clearly examine and easily control the improvements and changes by lean methods in different fields.

Besides, observation with a long history allows the researchers to analyze human behaviours on daily basis in a considerable stay time period and acting certain roles (Baker, 2006). Thus, the case was studied firstly by means of observation, which was that the interviewers asked for a one-day stay in the factory and retail store. After being familiar with this business, totally four interviews to the owner and other three employees were then conducted.

## **2.3 Ethics**

Validity and generalisability will be taken into account if necessary in order to make the thesis credible and in consideration of ethics. While the research is conducted, it is important to consider the morals and ethics especially with the data privacy to the company and how to deal with all the participants ethically. It is stated that every information regarding the company is confidential, so that we anonymized every information regarding the organization.

Initially, the confidentiality of all participants is protected by form of anonymity. For the interviews, the interviewees in interviews were chosen according to the need of research but all the participants engaged in the research were by their own willingness to accept the interview invitations. For the case study, the interviews and observation were allowed and well-explained to everyone working in the company, with no disturb to manufacturing and selling. The photos of production line of case company in Chapter 4.2.3 were not the whole system for the sake of this company and the photos were provided by owner of it. Additionally, once the participant agreed to take the interviews and observation, the questionnaires with detailed questions were sent beforehand to allow the time of preparation. Then the appropriate time to conduct interviews and observation were chosen according to the most convenience of participants.

Afterwards, all data will be ethically managed through getting the approval from the interviewee, to allow the researchers taking part in his or her knowledge

and experience. This will be accomplished by sharing a written consent letter between the researchers and the interviewees. Furthermore, the data will be used according to the rules and regulations of Chalmers University of Technology.

## 3 Theoretical Framework

### 3.1 Lean Methods

In this section, necessary theory on lean methods are covered including lean history, the definition of lean methods, most common lean methods and the process of implementing lean is presented.

#### 3.1.1 The origin of lean

It is unavoidable to mention the Japanese company Toyota while analyzing the roots of lean. However, Toyota was not the company which firstly implemented the lean concept although it is the most well-known one depending on broader definition of *Origin*.

The history of lean can be found as far back as Ford and his production lines for Model T Ford. Ford synergized many thoughts equipped with the concept of lean within his production lines. For instance, he witnessed the hourly production through continuous flow processing, which is like the combination of visual factory and value stream mapping in modern lean activities. However, the production lines in Ford were far from new and Ford did not really invent nor put new ideas inside the model.

Date back to the beginning of the twentieth century, it was the root of Lean, produced by Sakichi Toyoda, Kiichiro Toyoda, Eiji Toyoda and Taiichi Ohno, the fathers of TPS which is the abbreviation of Toyota Production System (Dekier, 2012). In 1910, Sakichi Toyoda visited automotive industries in the United States and realized that the new era in this industry was beginning. After the visit, he started to improve the existed production systems in his company Toyota Motor Company combining with the thoughts come up during his trip in United States. After World War II, automotive industries in Japan were suffering the same dilemma: on the one hand, demands from public were reduced due to the severe financial situation, which resulted in less orders were made from the market and became extremely difficult to maintain the same scale of assembly lines. On the other hand, Japanese local brands were facing the challenges from European and American companies. All these elements made Kiichiro Toyoda realize it was a selection question to Toyota: change or die.

Not surprisingly, Kiichiro chose to change. He strongly believed that it was necessary to them to build a fast and flexible production line to meet the requirement of producing high-quality products swiftly and selling with reasonable prices (so-called *The Iron Triangle*) - only if he found the balance between these three elements, he would solve the problem. Based on this

background, “Just-in-time System” was established and then got developed between 1948 and 1975. The spirit of this system is to increase the production efficiency and decrease the waste - including waste of material, time and human resources - during production process. After the first successful improvement in production lines, Taiichi Ohno raised another concept called “pull-flow production”, came from an old practice in American supermarkets. The core of this concept is to prepare as much, or as less to some extents, raw material as expected to be consumed in the production process. Consequently, this could avoid the risk of overproduction and decrease the waste of storage.

“Just-in-time system” and “pull system” constituted the cornerstone of TPS in the twentieth century. As time flows, more practical activities have been added to TPS. Such as visual factory, error detection and value adding, in order to complete the TPS. As a result, Toyota becomes the most famous enterprise implementing lean and catching the interests from all over the world.

### **3.1.2 Regular lean methods**

In this section, regular lean concepts are introduced in order to provide readers with first impressions on how lean is working and what activities are related to lean.

#### **(I) Visual Management**

Definition: From organizational perspectives, Visual Management is a management system that proposes to improve organizational performance by connecting organizational vision, core values, goals and culture with other management systems, work processes, workplace elements, and stakeholders which directly come from one or more of the five human senses (sight, hearing, feeling, smell and taste) (Liff & Posey, 2004) A motorway can be used to make explanation easier. On a motorway, traffic lanes are designed to divide cars from each other. Rumble strips alert drivers against possible dangers by causing vibration and noise. Speed bumps contribute in limiting speed. And traffic policemen can be easily recognized by their uniforms. A motorway is a typical visual structure and that is actually what Visual Management performs. (Tezel et al., 2009)

Function:

- ❖ Transparency: The ability of a production process (or its parts) to communicate with people.
- ❖ Discipline: Making a habit of property maintaining correct procedures.
- ❖ Continuous Improvement: An organization-wide process of focused and sustained incremental innovation.



- ❖ Job Facilitation: Conscious attempt to physically and/or mentally ease people's effort on routines, already known tasks by offering various visual aids.
- ❖ On-the-job Training: Learning from experience or integrating working with learning.
- ❖ Creating Shared Ownership: A feeling of possessiveness and being psychologically tied to an object (material or immaterial).
- ❖ Management by Facts: Use of facts and data based on statistics.
- ❖ Simplification: Constant efforts on monitoring, processing, visualizing and distributing system wide information for individuals and teams.
- ❖ Unification: Partly removing the four main boundaries (vertical, horizontal, external and geographic) and creating empathy within an organization through effective information sharing.

## **(II) Kaizen, Muda and Gemba**

Definition: The father of Kaizen, Masaaki Imai, said that "Kaizen strategy is the single most important concept in Japanese management – the key to Japanese competitive success. Kaizen means ongoing improvement involving everyone – top management, managers and workers." (Imai, 1986) The word, "Kaizen" is consisted of two Japanese words: Kai – change, and Zen – good. The whole word Kaizen can be understood as changing to be better, for further expounding, Kaizen means continuous improvement process.

Term Gemba, means "the actual place" in Japanese, namely the real place inside company where things, processes and problems happen, products are developed or produced. (Dysko,n.d.) This concept can be linked to Visual Management to some extents that higher managers should be able to get the information they want through their five senses – they should go to the actual place where the production lines locate and then get the tangible feedback through watching, seeing, feeling, smelling and tasting. Gemba is a concept that encourages managers to have direct communication with the employees working in the first line. Figure 3.1 presents the concept of how Gemba Kaizen model makes improvement.

Function: Go to the Gemba, detect the error, or waste, do some value adding activities, and carry out. A benign cycle.

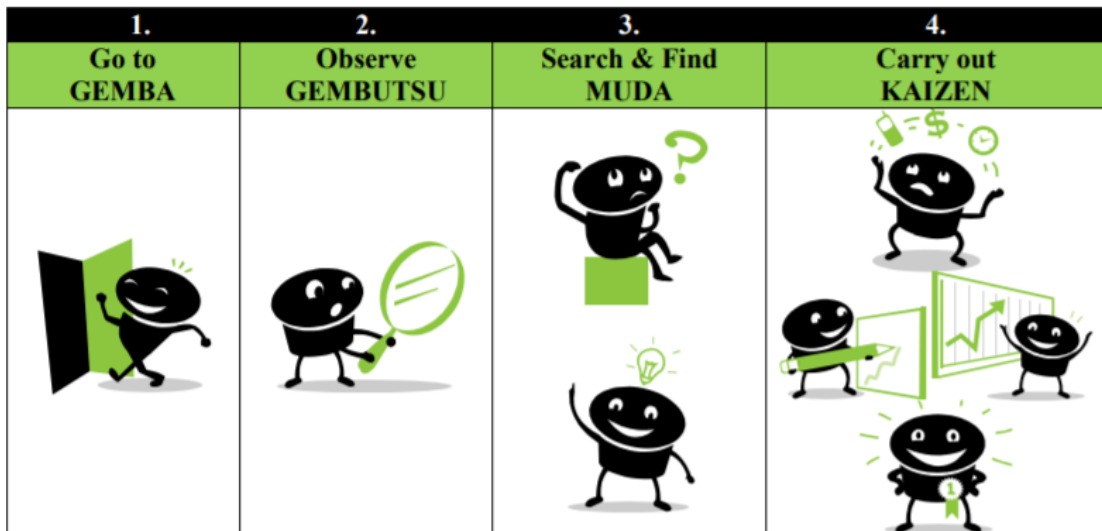


Figure 3.1 Gemba Kaizen improvement principle (Dysko,n.d.)

### (III) Just-In-Time(JIT)

Definition: Just-in-time (JIT) manufacturing is a philosophy as well as a technique which has been applied in Japanese manufacturing industries for the past 20 years. (Yeh, 1988) The definition of this concept in short is that during the producing process, right items of the right quality and quantity should be delivered to the right place at the right time. Based on the background of intense market competition, JIT System has gained focus from old industrial countries like the U.S. A. The most challenging thing to reach the balance of JIT is the Iron Triangle from management knowledge. The ability to achieve higher product capacity without losing the high standard of quality is the most important competence for companies aiming to maintain their competitive in market nowadays. (Kootanaee et al, 2013)

Function: Although companies in manufacturing industries are devoting in JIT System, the function of JIT is more likely to improve the existed manufacturing system gradually rather than thoroughly changing the old system. The functions of JIT can be summarized as following:

- ❖ To be more responsive to customers
- ❖ To have better communication among departments and suppliers
- ❖ To be more flexible
- ❖ To achieve better quality
- ❖ To reduce product cost

(Yeh, 1988)

### (IV) Takt Time

Definition: Takt Time is a concept directly comes from lean production. It represents the average pace of sales over a specific time period. (Shingo, 1989) In another word, "it is the overall available production time in a chosen time

interval divided by the overall forecasted customer demand for the time interval". Its definition is presented by the following formulation:

$$Takt\ Time = \frac{Time\ Available}{Average\ Customer\ Demander\ per\ Time\ Period}$$

$Time\ Available = Total\ Time - (Maintenance\ Time + Time\ Allowances)$   
(Linck & Cochran, 1999)

Function: It can be easily understood that Takt Time is a parameter to show how much productivity is needed to meet the demand from customers. Consequently, with the Takt Time it will be clearer for manager to operate production lines with precise number of workers working in the same time without wasting human resource. Furthermore, Takt Time acts an important role when drawing current state map.

### (V) Value Stream Mapping

Definition: Value Stream Mapping (VSM) is a tool illustrating and analyzing the production process of a specific item. (Langstrand, 2016) A value stream map provides visual overview of a producing process, which would be the foundation for more precise understanding on how processes are operated and how different units are connected. Moreover, it is a good start for further analysis if a company proposes to improve its performance through optimizing manufacturing process. Figure 3.2 shows five main steps to implement VSM.

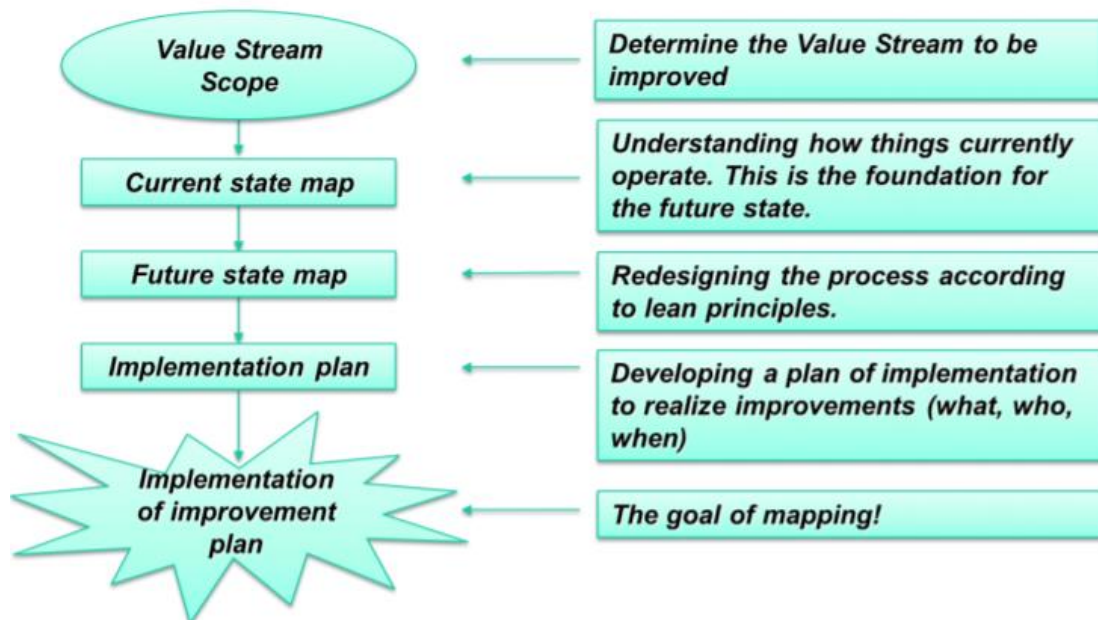


Figure 3.2 The main steps of the value stream mapping methodology (Langstrand, 2016)

Function:

- ❖ To provide an understanding of the operations that are creating value for the customer

- ❖ To provide a clear view of material flow raw materials to finished products and make barriers to smooth flow very visible.
- ❖ To provide an integrated picture of the process, which improves understanding of the interactions between various steps.
- ❖ If the VSM is created by a team representing all process areas and all functions, it builds a strong cross-functional understanding of the overall process and its interconnectedness.
- ❖ To highlight the main forms of waste found in a process operation.
- ❖ To provide some clues to the root causes of the wastes.
- ❖ To tie information flow to material flow, so that the effect of errors, delays and re-work in information processing on smooth material flow becomes visible.
- ❖ To provide a template for the design of an improved future state, and the data to quantify performance improvements.
- ❖ To provide a sound basis for chartering Kaizen Events, with confidence that they are focused on problems affecting process performance.

(King, 2015)

## **3.2 Implementation of lean methods in SMEs in manufacturing industry**

Lean methods are recognized as an efficient way to improve the performance of manufacturing enterprises since the Japanese company Toyota has achieved a big success in the 20th century. It is a modern trend that more and more enterprises pay effort in exploring suitable lean methods for the sake of enterprises surviving or developing. In this section, theories are presented in the order of current situation of SMEs, and then the feasibility of implementing lean methods in SMEs. Lastly, expected outcomes after implementing lean methods in daily production is presented.

### **3.2.1 Current situation of SMEs in manufacturing industry**

SMEs have an important role in a nation's economy: Although the up-to-date data seems difficult to measure, it is noteworthy that an estimation of more than 95% of enterprises all over the world are SMEs which weight approximately 60% of labor force. (Ayyagari et al., 2011). However, many SMEs nowadays are struggling to survive from the competitions caused by rapid development of technology, higher demands from customers and to a great extent, the higher degree of globalization which was both discussed by Ocloo et al. (2014) and Freye & Moekotte (2008). On the one hand, an enterprise could definitely choose to maintain the original status and wait for

the pronounce judgment from the market anxiously. On the other hand, an enterprise could choose to make change happens forwardly.

However, for those SMEs desiring to make changes, they find it more difficult to start such projects compared to large enterprises (LEs). One proposed reason is the lack of resources, which includes human resource and economic resources. SMEs are thought to be equipped with limited productivity and money, hence they need to take every step carefully to avoid causing unaffordable loss. Compared to LEs which have enough resources to make attempts, it might be very costly for SMEs if they fail to do the correct pick at the specific turning point.

### **3.2.2 Reasons why lean methods are suitable for SMEs**

For SMEs aiming to make change in their crossroads, the Lean spirit is assumed to be an applicable choice in such condition. Regarding to Roth et al. (1989), lean enterprises adopt different manufacturing philosophies, strategies and methods, which is thought to be one of the points of difference distinguishes lean enterprises and traditional enterprises. Obviously, implementing lean spirit in enterprise's daily activities provides the feasibility of applying multiple principles and manufacturing philosophies simultaneously. In addition to this, a noteworthy difference between traditional enterprises and lean enterprises is that the former usually/merely seek improvement at specific opportunity such as establishment of new technology or product upgrading, while the latter seek improvement through small but continuous refinements in processes and procedures, and investment in human capital. Briefly, when an enterprise equips lean spirit, it has the capacity to accommodate different methods and activities. Moreover, with the continuous improvement, it could make sure it keeps updating itself in every small step.

There are three main critical problems in SMEs from materials and methods aspects (Dang-Duc, 2011).

#### **(I) Lack of proper record keeping**

Poor accounting management leads to an outcome of improper record keeping. Dang-Duc (2011) finds that SMEs often complain about their high workload imposed by reporting regulations. SMEs think they are forced to obey such regulations while they are just small enterprises. Consequently, the lack of proper record keeping comes up with this ambiguous recognition of enterprise responsibilities.

#### **(II) Lack of ICT usage**

The appearance of Information and Communications Technology (ICT) has already changed the business environment. Hence, organizations should take

an open attitude to the technology development and no longer keep their business transactions manually. Hashim (2015) discovers that the reason for a lack of ICT usage among SMEs is that the respondents often see ICT as difficult to be implemented and choose to use the manual system instead.

### (III) Limited financial resources

To stay highly competitive in the marketplace, research needs to be done from time to time to cater the needs from customers. Hence, investments should be put in enterprises' research and development (R&D) projects in ensuring that their products meet the expectations of customers and that the products' demands continue in the future. It is noteworthy that any shortage in financial resources may hinder SMEs from growing.

The regular lean methods are presented in section 3.1.2. Comparing with the critical problems in SMEs, lean methods could potentially work as solutions to such problems.

Table 3.1 Potential solutions to critical problems in SMEs (Dang-Duc, 2011)

Problems in SMEs	Lean methods	Outcomes
Lack of proper record keeping	Visual management	Visual management provides a visible overview of whole manufacturing process throughout the enterprise
Lack of ICT usage	Gemba, Muda and Kaizen	ICT is not that difficult to implement as some leaders assumed. If team leaders could go to Gemba, they can detect error and guarantee ICT be implemented correctly
Limited financial resources	Just-In-Time(JIT) and Value stream mapping(VSM)	On the one hand, JIT urges enterprises to minimize their storage which mean enterprise could reduce their product cost; on the other hand, VSM makes enterprise realize where

		they consume their resources and help them use their resource more precise
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### 3.2.3 Critical success factors in implementation process

Even if an enterprise decides to start implementing lean methods, one potential reason causing failure is the absence of critical success factors (Hu et al. 2015). When an enterprise transforms from traditional to lean, it is planned to keep steady and under schedule. In most occasions, this action is processing step by step rather than all at once. During the whole project of improving, the demand of evaluating whether the project is operated on the correct track arises. Netland (2016) claims that success factors have various importance which is changed along with the different stage of implementation of lean practices: some success factors are essential in the early stages, while others start acting more important roles as an enterprise continue implementing lean activities in other department. Knol et al. (2018) summarize 12 critical success factors based on a literature review of 16 articles from different countries and industries which are presented in the following table 3.2.

*Table 3.2 Success factors necessary for implementing lean practices. (Knol et al., 2018)*

<b>Critical success factor</b>	<b>Description</b>
Top management support	Top management assume responsibility for and are positively involved in improvements to increase performance
Shared improvement vision	A company-wide long-term direction, objectives and goals for improvement, aligned with the company's vision and strategy, are developed, shared and followed
Good communication	Ideas, information and knowledge are exchanged honestly, clearly and transparently, both orally and in writing, in all organizational directions
Leadership	Team leaders facilitate, coordinate and balance improvements from

	shop-floor employees
People focus	Organizational systems help employees to do their work versus employees being bound to organizational systems
Learning focus	Both positive and negative experiences are shared and mistakes are considered opportunities for improvement rather than punished
Sufficient resources	Sufficient time and money are available for training and improvement activities
Improvement training	Managers and shop-floor employees get training in improvement concepts, tools, techniques and team building
Performance management system	Process data from all levels is measured and displayed to control production, prevent defects and indicate opportunities for improvement
Supplier link	Suppliers provide and get feedback and are rated to select a limited number of suppliers and to improve long-term cooperation for improvement
Customer link	Customers provide and get feedback and cooperate for improvement, e.g. to reduce bulk requests
Support congruence	Employee targets, assessments and rewards of all departments are in line with the improvement vision

### 3.2.4 Expected outcome after SMEs implement daily lean activities

Theories on how to use critical success factors to evaluate the rate of progress are presented in the context above. Nevertheless, it is always inspiring to know what kind of outcomes an enterprise is expected to acquire after its successful implementation of lean activities. Rakesh Kumar and Vikas Kumar (2012)



summarizes 10 benefits of lean manufacturing implementation, 6 of the 10 benefits are thought to be more suitable and precise for SMEs in manufacturing industry which are likewise expected outcome after SMEs implement daily lean activities. Table 3.3 presents 6 main benefits of lean manufacturing implementation.

*Table 3.3 Benefits of lean manufacturing (Kumar & Kumar, 2012)*

<b>Outcome</b>	<b>Description</b>
Reduced cost	Enterprises can achieve reduced cycle times, increased labor productivity and elimination of bottlenecks and reduced machine downtime can be achieved. Enterprises can generally significantly increase output with reduced cost from existing facilities.
Reduced lead time	With the effect of reduced cycle time and work in progress inventory lead time to manufacture and deliver the product is drastically reduced
Waste reduction	All the form of waste i.e. overproduction, defect, transportation, work in progress inventory, over processing, waiting and motion are reduced with lean manufacturing implementation.
Improved productivity	By reducing the idle time of workers and ensuring worker are devoting in work as productive as possible when they are in working.
Improved Flexibility	Have the ability to produce a more flexible range of products with minimum changeover costs and changeover time.
Better Utilization of equipment and space	Use equipment and manufacturing space more efficiently by eliminating bottlenecks and maximizing the rate of production though existing equipment, while minimizing machine downtime.

## 4 Empirical Findings

The following chapter presents the empirical findings acquired through interviews and the case study.

### 4.1 Interviews

Interviews are proceeded among three Swedish manufacturing SMEs: Company Alpha, Company Beta and Company Gamma. Following are some basic information for the chosen enterprises.

#### *Company Alpha*

Company Alpha started out as a traditional machine shop. But over the years they have transitioned into a high-tech company, specializing in concept development, prototypes and processes. They produce a large variety of custom products all within their three business divisions. The number of employees work here is 100. The interviewee from Company Alpha majors in operation improvement and has been working for this enterprise for two years.

#### *Company Beta*

Company Beta focuses in providing the best designed and most profitable forwarders and harvesters for customers. It could be seen as a creative manufacturing enterprise. There are 35 employees working for this enterprise. The interviewee from Company Beta is a production manager who works for this enterprise for one and a half years.

#### *Company Gamma*

Company Gamma is specialized in casting and machining aluminum. They also provide surface treatment and assembly. Their aim is to be customers' flexible and knowledgeable partner for all matters concerning casted aluminum. About 100 employees work for this enterprise. The chosen interviewee is a quality and environment manager who works for Company Gamma for more than two years.

Then the following will demonstrate the interview results comparing three companies with the same sequence of the interview questions and each subject consists of one or more questions.

#### **4.1.1 Most frequently used lean activities:**

Alpha implement many of the common lean concepts in their daily activities such as eliminate waste, value-adding, value stream mapping, error detection, flexible standards, pull system and visual factory. In addition to this, they treasure value-adding most, and set this activity on the highest priority. Similar to Alpha, Gamma also utilize error detection and visual factory however less than Alpha. It is a bit different for Beta who implement flexible standards.

#### **4.1.2 Allocation of lean activities that are used in organization**

Alpha and Beta both mainly use lean activities in their production and assembly line. Gamma don't really have assembly lines but it counts in production. While they apply lean more in Management, production technical production and human although they haven't implemented lean in finance or design yet.

#### **4.1.3 Reasons for implementing lean**

The growing competition in the market, which leads to a severe situation for their company, so the interviewee from Alpha thought this is the biggest reason to start implementing lean. The original motivator for Beta to start this process was that they wanted to have a fully control over the system in order to have higher degree of time management. As for Gamma, at first, the limited resource in their enterprise generates the thought of eliminating waste and producing more. Then they realized that lean methods could not only provide the potential of better application of resources, but also benefit in the quality of products in a long-term perspective.

#### **4.1.4 Barriers and challenges for implementing lean**

Interviewee from Alpha state that they haven't met any challenge so far because they have experienced leaders. They consider to follow rules strictly day by day as the challenge in current stage. That is, it's not that difficult to start implementing lean, however, the difficult point is to keep the organization moving forward to lean continuously and making progress every day. The other two are unlikely them and facing different challenges. The challenge of Beta is the culture, which means that the Swedish culture is not ready for lean on any stage. Swedes understand it is a big issue to start working with lean, and they can understand lean. However, they don't really work about lean. Thus, it is understandable that they stress more since they are still in the extremely beginning level. Interviewee from Gamma insist the challenge is the resource, especially in human resource. Because they don't have any employees that has worked in lean area so far. The interviewee also emphasizes that the way of thinking is key factor. Unlike other implementation inside the enterprise, the implementation of lean methods forces employees to think in different way.

#### **4.1.5 Present approach to lean methods, failure experience, solutions and attitudes to reduce loss when failure happened**

Alpha tend to proceed with lean step by step, and they are satisfied that they haven't really experienced failure during their implementation process.

However, they were disappointed when a project took longer time than they expected at the beginning. It was planned to finish in one year however it took two years eventually. Experience they gained from this accident is that first and foremost, they should have confidence. Many employees need directions and as a leader of the project, he has to be confident enough to guide his team. Nevertheless, accident is unavoidable whilst improvement. In this case, a leader should keep patient and have frequent communication with board members. For Beta, they choose to implement lean step by step. However, they did experience failure even if they made changes carefully. For example, even though the project leader established every procedure to carry forward lean, accidents would arise when the organization isn't truly ready for it which is also caused by the cultural difference. Moreover, although Toyota is one of the most well-known samples as a lean enterprise, a Swedish local enterprise should never try to copy the Toyota mode, never. One factor is the cultural difference, and a project leader should consider the production system in the current company and make it flexible to lean. As the interviewee mentioned above, their organization is still in the very beginning level of lean, there are a lot of things seem new to them. They need to explore their own way of implementing lean from failures. That's why they don't actually have spare plan to avoid or reduce loss when failures arise. Every time they fail, they learn from lessons, and they are being closer to success. Gamma choose to proceed with lean step by step. While they are in a very beginning level, their management team is not set yet, which would result in the lack of preparation in continuous improvement. For short, they have no clue in how to keep the improvement continuously. Furthermore, they do have plan to react to failure during the implementation of lean. Whenever they fail, except for making operation record and reflecting on how they failed, they would try to continue the project in a smaller way -- it just looks like to go on an experiment in a laboratory.

#### **4.1.6 Essences of lean implementation in organizations**

From point of view of interviewee from Alpha, they consider the local cultural background play an essential role when implementing lean methods, and Beta regard education, which means the training process of the employees the essence of lean methods implementation in their organization. Gamma set people on the highest priority. Employees know what exactly they should do is the precondition for an enterprise to get into lean, regarding to the interviewee. Moreover, the educational degree of employees impacts the performance whilst an enterprise moves into lean.

#### **4.1.7 Benefits of lean methods to business operation**

Alpha claim that they pay more attention to daily activities by using lean methods among the organization. Beta believe they would gain more control over their production, and with higher control over their production system, they would provide products in better quality. Gamma have merely implemented error detect and visual factory in their daily activities so far. With the error detect, they can have better view on error daily basis and find out solution as soon as they can. That's one of the contributions from lean methods and they believe lean methods would contribute more with their higher degree on lean throughout their enterprise.

#### **4.1.8 Different ways of implementing lean assuming working for a large size enterprise than SMEs**

Compared to working in bigger organizations, working in SMEs provides more direct communication between project managers and board members. Board's cooperation is the key for running a successful project. Consequently, it is easier for SMEs to implement lean methods, explained by Alpha. Beta state that it's similar on the ground floor, no matter LEs or SMEs. The main difference happened on the top floor. For bigger enterprises, they need to establish statement to inform all their employees that they start implementing lean now, because it is impossible to start lean on the production line while the other parts of the company are not working with lean. From this perspective, LEs have advantages from more strict rules, more experienced employees and more budget to implement lean. Whilst in smaller enterprises, this process is easier because of the smaller scale of enterprise make this information spread process easier and faster. It is hard to judge which type of enterprise is easier to implement lean because both of them has their unique advantages. From the interviewee's perspective of Gamma, it would be easier for bigger enterprises to implement lean methods because there are more resources, including human resource and financial resource, in bigger enterprises. Bigger enterprises can have made the data collection more precise and more detailed which would result in less mistake in decision making process.

#### **4.1.9. Comparisons of implementing lean methods in SMEs with LEs**

Alpha state that small enterprises have higher demand and they are more urgent to implement lean methods, due to limited resources. Agree to them, Gamma think that even though it is more difficult to proceed with lean at the beginning for SMEs, they will still gain more benefit after successfully implement "lean revolution". With the view of the future, it is necessary for SMEs to keep continuous improvement and get in touch with lean in order to maintain their competitiveness in market. On the contrary, Beta claims that the bigger enterprises have higher demand. Even though both types of enterprises would

gain benefit such as saving money, saving time or products in better quality, after successfully implement lean methods. LEs magnify the outcome dues to their base number is larger than SMEs.

## 4.2 Case study

The name of case company is Delta which has more than one hundred years of history transforming from the old-style family bakery. It is a small-sized biscuits producer, so another type of manufacturing industry. The owner who has taken over this company for fifty years and all the other employees are also interviewees or participants for this case study.



*Figure 4.1 The product of Delta*

### 4.2.1 Background

The small-sized biscuits manufacturing factory in Gothenburg is chosen as the case study. It is different from the previous industrial manufacturing companies while it is on purpose to make this diversity. As it may imply from the size, there are totally six persons employed in this factory and the owner is also one of the working team, who can also be regarded as the most important employee. The factory is divided into mainly three parts which includes manufacturing, warehousing and retail selling. There are basically two people mainly responsible for each part while one feature of this factory is that everyone is precisely familiar with each step of the whole process from manufacture to selling. On one side, to know every step of the manufacturing is good for each employee to be better involved in their own specific position. Additionally, it is also beneficial for the case where one is not available for one position, so the

others can be substituted. In other word, to work both separately and as a whole is their character in spite of a small size.

#### **4.2.2 Historical development**

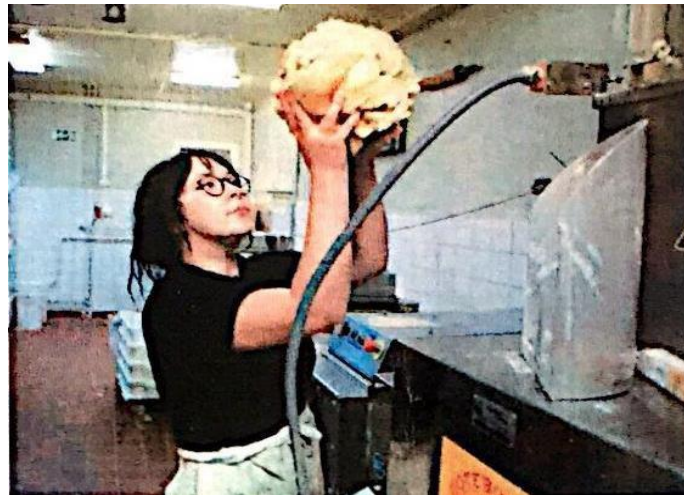
This factory has a quite long history of originating from 1915 and there is a relatively big change from 1954 when the present owner officially took over the factory. From that time the original type is in form of a family bakery which is founded by the owner's parents who met each other in a large size and old-style biscuits manufacturing bakery. In the beginning of 1915 when the bakery started, they provided several different types of flavors which has been largely different from today. As told by owner, it was from 1954 they decided to narrow down to only one flavor which could benefit them to concentrate more on the most worth-developing flavor. Therefore, they became biscuits bakery who only manufacture English ginger biscuits. This will be discussed further in the changes part as one big change in relation to the lean management in their small factory. The present owner has been keeping the type of production and manufacturing from his parent until 2006, one thing has made him to start considering some changes. His son, who can also be regarded as the third generation of this factory had a small accident when doing the handmade work of dome. The owner has thought of changing to machine while it is the more obvious demand that help him to finally make this decision, which means not only a large amount of money investment but also a change of the most important part of manufacturing. Once this decision of transforming to machinery has been made, the owner did a research on all the available machines at that time throughout the whole Europe. He has traveled to several countries to see and even test the machines, and finally a Swiss bakery machine is chosen and was shipped with lot of efforts from Switzerland to Sweden. As it has been mentioned above, this was a huge decision so it worth this spend of time, efforts as well as money. As told by owner, to export a new machine means to borrow money from the bank and make this investment onto one issue that they were still not hundred percent sure about the influence. After several years of practical working, this big decision has been proved to be really in time and correct. The influence of transform from hand making to machinery will also be further discussed further. Running more than a hundred years, this small biscuit factory has been developed smoothly with no radiant operation structure changes.

#### **4.2.3 Product and Production Process**

To prepare for the deeper discussion on the lean production and lean management, it is generally necessary to give an initial introduction on the product and its production processes. The product is ginger biscuit with only one flavor, which is made from the raw flour material and special lemon oil. It is

usually a small round and crispy biscuits with a diameter of six centimeter. The production line is as following while only some steps are illustrated with photos due to the protection of the whole production line for Delta.

The main process is through the machine as described above, while it starts from the dome making which still needs to be controlled by the owner generally, so the first step is usually making the flour dough one day ahead. This well-prepared flour dough will be put into the machine and then it could be automatically rub, cut into pieces, make into round with certain thickness, place into rows and finally transported to the prepared plates, waiting for the next step baking.



*Figure 4.2 Put the dough into machine*

The whole process of complementing one prepared dough is only five minutes by the machine, according to the owner. The next and also key step is by the help of another important machine which is to bake the shaped dough into required-taste biscuits. It is only eight minutes to fill all the plates on the shelf which consists of around 200 biscuits.





*Figure 4.3 Take out shape-biscuits from machine and put onto baking plates*

The following-up step is to place certain amount of the biscuits into different size of very high-quality cans, which is concerned one part of their lean management (quality insurance and image maintaining) as well. Within this small factory, there exists a relatively large warehouse for the storage where many cans are located and waited to be pick up by their pre-ordered customers. Therefore, for selling, pre-order is normally the main resource and especially during high season Christmas which is usually to serve big customers such as companies or retailers. Meanwhile the factory is connected with a quite small but cozy retail store which somehow represent this brand to the street. Another part of the selling is from private old customers who will come every year. The whole production is not complex, straight-forward but fairly efficient and work well for several years with only slightly changes.



*Figure 4.4 Place the new baked biscuits into the can for sell*

One small but cannot be ignored part of the factory is the place for the owner to make his management by a computer. It is not the most functional part but the core of whole manufacturing. From here the owner can control the whole circle of order-preparing-production-assembling-storing-selling.

#### **4.2.4 Highlights of the interviews and discussions of other employees**

The owner said the other employees have all been working in the factory several years, so it is important to conduct interviews and listen to what they are caring and willing to be improved. Table 4.1 summarizes the result of three individual interviews with the other employees.

*Table 4.1 Interview results of other three employees*

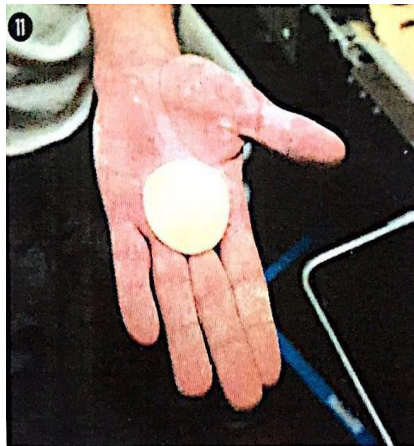
<b>Interview and discussion of other employees</b>					
	Years working here	Heard of lean or not	Most important activity	Which should be test implemented	How do you find lean now

Employee 1	Six	No	Error detecting	Visual factory	Great
Employee 2	Seven	No	Eliminate waste	Visual factory	Efficient
Employee 3	Eleven	Yes	Eliminate waste	Visual factory	Efficient

#### 4.2.5 Lean Methods and Lean Production

About the concept of lean, it is understandable this small size manufacturing which is originally transferred from a family bakery is not familiar with the conception while if explored more they are somehow following certain lean principles.

(I) Eliminate waste: During the tour visit to this production line, there is one part noticed by the interviewee, the dome of biscuits will be put into machine and then the shape of dome is cut while with a lot of the rest dome flavor is left. If this part of the dome will not be used it is a huge part of waste of both the good material as well as the effort of dome flavor maker. Fortunately, the owner said he has considered it and has thought up a good proportion to mix these left dome flavor together with the new ones in order to make full use of every material and do not lower the quality of dome.



*Figure 4.5 The shape of biscuit in form of dough*

(II) Value-adding: The owner thought they are doing this and taking serious about it by opening the pre-order and pre-make services for customers throughout the year so as to ensure they could get their order even during the high season. Besides, they choose the best quality cans without increasing the price which is also mentioned above to contain the biscuits, so the can is used by customers themselves which is also beneficial in terms of the environment.

(III) Error detection: For the error detection, there are two methods used in these small biscuits manufacturing factory. The first one is human-test which is supported by precious several years of experience by owners and some employees.

(IV) Visual factory: it is not necessary to achieve this and also not so in demand since the physical production process is quite clear. When it comes to which activity is set on the highest priority that is the error detection, and within this topic, they always arrange some meetings around all employees to listen to each other and discuss where they could make it better.

One important factor of the lean management is to improve product or production continuously. This is implemented by meetings among the employees weekly and the owner said everyone is open to listen and improve their way of working. One good example of improving continuously is to buy the machine and then update it with the need of different time period. This calls for huge amount of money support while they still decide to do it from the practical experience, form the opinions from employees and also from the suggestion of this industry.

## **5 Discussion**

In this section, data from interviews and case study are analyzed in combination with the literature review.

### **5.1 The chosen Lean methods for SMEs**

This part focuses on the discussion of the first research questions and is arranged in the sequence from interview and case companies then more broadly to SMEs.

#### **5.1.1 Current situation overview on lean methods implementation in Alpha, Beta, Gamma and Delta**

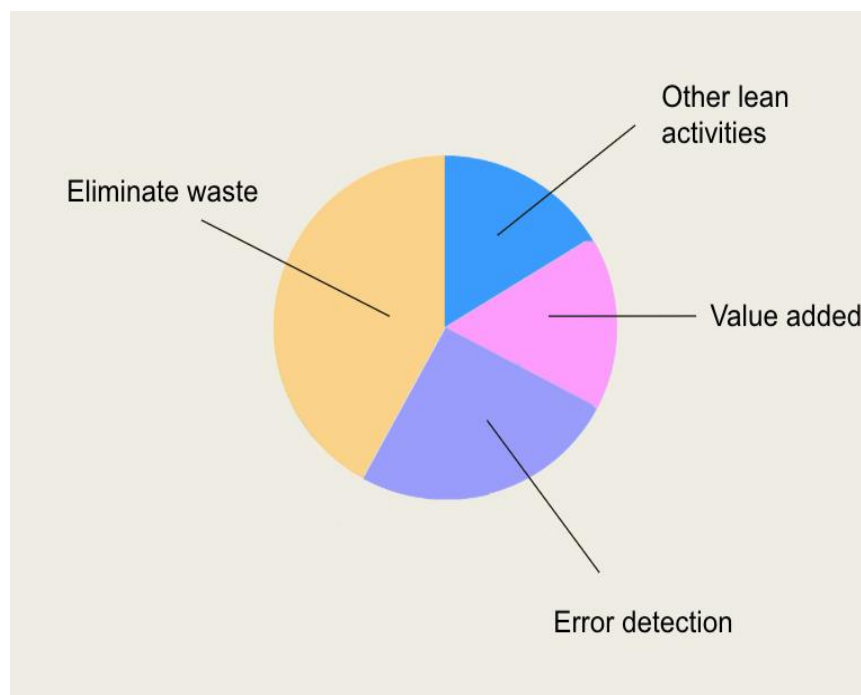
Regarding to interviewees, following lean activities/concepts have already been implemented in the enterprises daily production process: Flexible standards, error detection, visual factory, VSM, eliminate waste, value-adding and pull system, which can be summarized as visual management, VSM (value stream mapping), JIT (just-in-time) Kaizen and Gemba literally (Dekier, 2012). All of these three chosen enterprises implement lean methods in production and assembly lines. The three chosen enterprises are Swedish local manufacturing industries, which is thought to be the reason that they are all implement lean methods in same department. Moreover, it is essential to equip the JIT method to provide overload protection in their warehouses. It is not surprising that they have error detection in daily basis activities because every breakdown root from production process will ceaselessly arise until it gets solved. From this perspective, error detection, visual factory and value-adding should be seen a combined usage of visual management, Kaizen and Gemba. This finding is in line with the opinion of Dekier (2012) that visual factory is of important role of visual management which provide legible view of the operating process. Once error detection alerts breakdown, it is time for Gemba to gets functioned. Furthermore, enterprises are making continuous improvement by adding value to their daily activities, managers are involved in the well-assembled team, and everyone is clear on what is supposed to carry out due to schedule. These could all be seen as the spirit of Kaizen (Imai, 1986).

Since the manufactured product from interview companies and case company is different, which is done on purpose to give a more thoughtful result for this research, the lean methods implemented by case company are slightly inconsistent but not totally different with the above three companies on each aspects of lean methods. From the observation and interviews, the most significant or obvious methods for the biscuit's factory is error detection and break down, which is at the same importance of the other three companies. This is understandable as Klove (2007) has discussed that error detection is important since it is the base to correct the errors and make improvement next steps. The second important one is the awareness of Kaizen which means

continuous improvement. While different from the three industry product manufacturing companies, visual management and Gemba is not used in case company, but it does not mean there is no need to implement while on the contrary, the interview results from three companies which can be classified as next level size of the company the case should grow towards, thus the needs of why manufacturing SMEs implement can benefits from lean methods can be discussed further in the following 5.2.2 part.

### 5.1.2 Most frequently-implemented lean methods in SMEs

From the overview above, the most representative and appropriate lean methods of Alpha, Beta, Gamma and Delta are reviewed and explored so as to put onto practical companies. Then the results or emphasis of interview companies and case company has somehow present certain trends of which methods are more frequently utilized by these SME companies in different fields of manufacturing. Hence, what are the most frequently-used lean methods from both interview companies and case factory, and why it is finally presented as these are the first important point this research has explored. Figure 5.1 presents the in proportion of used lean methods in SMEs according to all the interviewees.



*Figure 5.1 The percentage of interviewees' opinion on which lean methods are most frequently-used in SMEs*

In a nutshell, the most frequently-implemented methods are waste eliminating and error detection, which are considered the most direct and easy to conduct lean methods for the SMEs. From the results of researched companies, waste eliminating will benefit the enterprises by saving unnecessary use of resources

and by save the time and efforts to deal with the extra waste. This was highly agreed by Pedro et al (2016) holding the opinion that the waste can be eliminated by value stream mapping which is considered a lean manufacturing method. Furthermore, eliminating waste is always for the sake of a sustainable environment. This goal is also well-known as one of the targets of all local Swedish enterprises and the United Nations Global Goals as well (UN,2018). As for error detection, the most effective improvement is to save time and money to solve the problem before it happens. With an extra purpose of helping to improve the production and management in the case biscuits company, the visual factory which they have not been involved before is suggested to implement. This thought was analyzed from the output comparison of interview company and case company situation and well inspired by the viewpoint of Rakesh Kumar and Vikas Kumar (2012) explaining the expected outcome of reduced cost, reduced lead time as well as better utilization of equipment and space. In this way, despite being a small-size manufacturing SME, they can achieve the visual management throughout the whole company, which is definitely a positive example for similar SMEs in Sweden and the whole world.

## **5.2 The reasons for manufacturing SMEs to implement Lean methods**

This part focuses on the discussion of the second research questions and is arranged in the sequence from interview and case companies then more broadly to basic SMEs.

### **5.2.1 The reasons of starting implementation of lean methods in Alpha, Beta, Gamma and Delta**

The motivation of starting to implement lean methods in SMEs is a necessary basis to further analyze the reason why SMEs manufacturers will benefit from lean activities. Alpha realize that the market atmosphere is becoming severe since more competitors are emerging, so they are in need of seeking a solution to maintain their competitiveness. Beta and Gamma focus on their resources usage and desire to minimize waste in production. Above reasons lead to a same solution that is to provide better-quality products. This eagerness and behaviour of companies are obviously reasonable according to clearly explained by Rakesh Kumar and Vikas Kumar (2012). Through the implementation of lean methods, it is possible to gain fully control on their producing system which means higher use ratio of resources. However, improvements usually proceed along with challenges. Two of the interviewee's states that their main challenges that experienced during the improvement are culture and resources. Different from the necessity to implement lean in Japanese manufacturers that were facing challenges from American and European companies externally and financial problems internally (Dekier,

2012). They think the Swedish employees in their enterprise are not ready for lean on any stage even though Swedes understand lean and start devoting in lean. And the limited resources is also an obstacle in boosting the development of lean. All of the three interview enterprises consider proceeding lean methods step by step as their first choice.

Besides, during their first attempt to implement lean methods, failure is also an unavoidable aspect to discuss even though they are being quite careful. Failure they have experienced can be summarized in following perspective: losing patience in the long period of evolution, cultural difference and lack of continuous improvement. It is necessary to maintain connection with the board members during the whole project, and it is the key to success to have faith and patience. As explained by Netland (2016), top management support and good communication throughout the whole team are part of critical factors to implementing processes. Although three chosen enterprises have different degrees of lean implementation, they do see the benefit that lean methods bring. For instance, they pay more attention to daily activities among the organization, they gain more control over their production system by achieving some critical factors like good leadership, communication and people focus that Netland (2016) has put forward. Gamma claims that even though they are in a really beginning level of lean enterprise and they merely apply error detect and visual factory in their daily activities, these two methods provide them better views of what is really happening in their production line and they can solve problem as soon as it arises. They do have faith that they would gain more advantages with a higher degree of lean in the future.

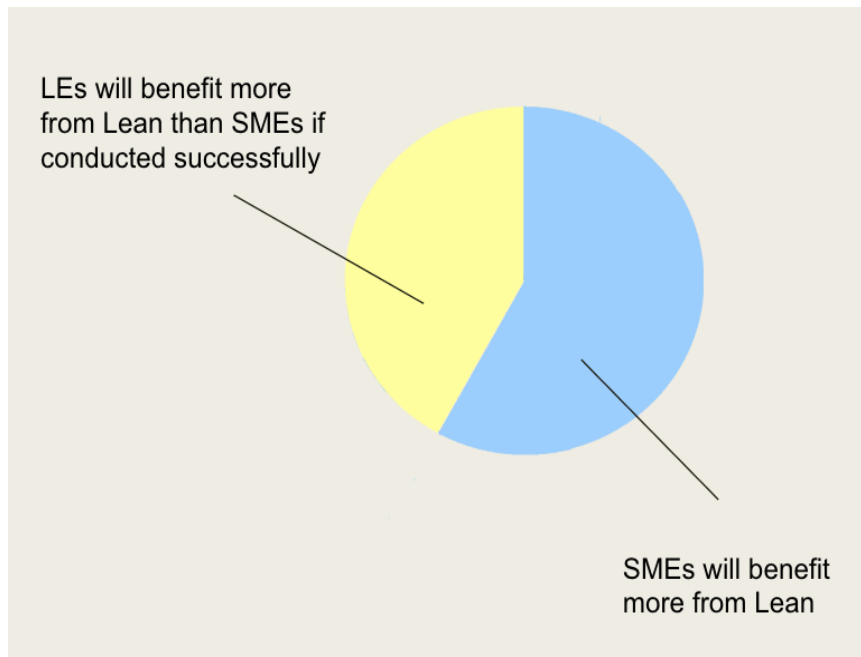
### **5.2.2 The benefits of lean methods for SMEs**

By discussing the most frequently-implemented lean methods and the reasons of starting to implement lean methods in SMEs theoretically and practically, it is more sufficient to explore the benefits for them to use lean methods. More explicitly, another researching result from the discussion is that SMEs is more in need of implementing lean management and lean methods in spite that it may take more efforts and resources at initial stage for them to set up the system.

These consist of the first point to support why SMEs manufacturers can benefit from implementing lean methods. From the motivations of starting lean activities, they are expecting the positive outcome lean could bring, which are reduced cost, reduced lead time, improved flexibility and utilization of space and equipments (Kumar & Kumar, 2012), by most frequently-implemented lean methods. Then the most frequently-implemented lean methods proofs that these methods of error detection and waste elimination are helping to achieve the expected outcome, and furthermore to improve the performance of company to improve competitive abilities.



Besides, it is also necessary to compare with the situation of large-size manufacturer companies (LEs) when explain why SMEs can benefit. SMEs are obviously not as abundant as the large-size companies in money and resources as well as risk bearing, lean methods especially the ones used most frequently has direct positive influence on their production, management and also future development. While through the investigation of interview and case companies, there is still a belief that SMEs could benefits more as the proportion illustrated in Figure 5.2.



*Figure 5.2: The Percentage of interviewees opinion on whether lean methods are important to SMEs*

This result comes from an hypothesis that if SMEs are developed into larger size or to imagine the difference between working in LEs and working in SMEs. It is all agreed that LEs have more human resources and financial resources, however, not all of them agree LEs can benefit from these advantages. One insists that even LEs can devote more resources to implement lean, the connection between top managers and employees in the ground level is not as strong as in SMEs. Top management and good communication are of importance according to the critical factors by Netland (2016). Two of the other interviewees think SMEs have higher demands for implementing lean because it is a way to maintain competitiveness and continuous improvement due to their size pressure in the market shares. To overview the above perspectives, from own characteristics of SMEs along with comparison of LEs features, SMEs would benefit from the successful implementation of lean methods in different stages of lean methods. The positive outcome could be as what Rakesh Kumar and Vikas Kumar (2012) has explained about in following perspectives as

reduced cost, reduced lead time, improved flexibility and utilization of space and equipments.

## 6 Conclusion

Based on the lean methods theories which is originally from the manufacturing company in Japan, this thesis aims to investigate the implementation of lean methods in small and medium size manufacturing enterprises through three interview companies and a case company in Sweden. It is possible and also practical for SMEs to implement the lean methods. Among all, the most utilized lean methods are waste eliminating and error detection, while the least easily utilized ones are visual factory which call more for money and technology investment for SMEs. With the goal of making continuous improvement, it is positive to see SMEs are also accepting or attempting more advanced lean methods so as to form the comprehensive lean management system, and eventually realize their improvement on production. Therefore, the conclusion could be that the most frequently-implemented lean methods are error detection and waste elimination and SMEs would benefit from the successful implementation of lean methods in different stages of lean methods to achieve their expected outcomes.

Recommendations for the future study could be put forward regarding the size of the target company. The first direct recommendation for further research is one more narrowed down focus could be explored for how to help the micro-sized manufacturing company to start setting up comprehensive lean system, from the experience of the case company, since the result of very small size company is straightforward. The second recommendation in terms of the size is to explore on the same topic while on larger size companies, the result should be different since the money allocation, resources utilization in large company is more complex, while can be based on some results from SMEs of this paper. Besides, although the conception of Lean methods and lean management originates from manufacturing company, it will also be of certain value for other type of companies or certain departments of a company to discuss the necessity of implementing lean system.

## 7 References

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## 8 Appendix

Interview Questionnaire:

Introductory questions:

- What's your role in the company?
- How many employees are there within your organisation?
- How long have you been working for this organisation?

1. Which of the following concepts are integrated in your organisation's daily activities?

(Multiple choice)

- A. Eliminate waste
- B. Value-adding
- C. Value stream mapping
- D. Error detection
- E. Flexible standards
- F. Pull system
- G. Visual factory

1.1. Which activity is set on the highest priority? (used most frequently)

2. In what parts of your organisation do you use lean activities? E.g. Human resource, Production, Assembly line, Management, Finances and/or Design.

3. What's the motivator/reason to start implementing lean?

4. What barriers/challenges have you faced when you started implementing lean?

5. What do you think is the challenge(s) today when implementing lean?

6. How do you proceed with lean nowadays, all at once or step by step? Which approach is better?

6.1. Have you experienced failure when implementing a lean method?

6.2. How can an organisation avoid or reduce loss when there are failures in implementing lean method?

6.3. How would you describe that failure?

7. Which part is the essence of lean method's/ lean methods' implementation in your organisation? (E.g. People, Method and/or Principle?)

8. How does a Lean method contribute to business-as-usual work? Can you raise some examples?

9. Imagine you are working for a large enterprise, will there be different ways of implementing lean compared to the organisation you currently work for?

9.1. Which has higher demand for implementing lean? Can you explain more on why they have higher demand?