

# A Definition of Lean at Saab Space and a First Step Towards a Lean Handbook

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DISSERTATION

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## 1. Abstract

This dissertation is based upon a request from the Swedish company, Saab Space. The company requested an analysis of the company culture's ability in changing and adapting to the implementation of the Lean thinking concept. A study of the Lean concept, the current state of the company's attitude towards a change and their current working methods were carried out. The research instruments used were: a pre-interview with a Lean consultant, a questionnaire, interviews, external visits to companies working successfully with Lean, a Lean conference and educational visits to different parts of the company. The results showed that Saab Space are fairly well prepared for a implementation of Lean as long as it is thoroughly planned, supported by the entire management, followed through, has visible results and engages co-workers in the process by e.g. improvement groups, visual planning and visual measurements.

## 2. Introduction

In today's western society, almost every branch of commerce is experiencing increasing demands from customers. Companies, manufacturing industries as well as the service industry often have small margins to deal with in order to become strong market competitors. A large number of companies solve the issue by moving their manufacturing site to Eastern Europe or Asia, where labour costs are significantly lower, or cut down on resources, such as labour. Either way of solving the problem is not an ideal option in terms of gaining commitment from staff or in supporting the company's 'home' country e.g. Sweden. This dissertation will discuss a subject which has been, and will be in the future, a turning point for many western countries' industries and businesses to maintain their manufacturing in their own country and still be strong or stronger competitors on the market. The business will also have the opportunity to take advantage of the benefits at their own market, such as the Swedish market, with their strong industrial traditions, the experiences of building systems, well developed infrastructure, broad usage of IT and informal company structure (SIFU, 2006).

After the WW II Toyota suffered from a severe economical crisis. They were forced to seriously rethink their processes and started to develop Henry Ford's theory of how to cut costs and reduce lead time. The Toyota Production System (TPS) was developed, and is today known as Lean production or Lean thinking. The Lean concept aims to eliminate waste in the organisation while focusing on the customer value and develop flexible and sustainable systems while engaging co-workers. The Lean concept outlines different methods and tools in order to help organisations to eliminate waste with concerns for the staff and future development. The concept teaches the organisations to be changeable and constantly improve (SIFU, 2006).

The concept started to spread when Toyota demanded their suppliers and customers to adopt the concept in order to increase the awareness of what they actually paid for.

The concept kept spreading and reached Europe. According to Johansson (2006), there are approximately ten companies in Sweden who have been working with Lean for at least five years. In the past two years, the number of companies starting to implement Lean rapidly increased and the result from these implementations has started to show. Solectron claims that they have decreased the time between order and shipping from six weeks to two weeks. The lead time has decreased from 300 hours to 60 hours and the delivery safety has increased from 70% to 99% for ordered products. Fixturelaser reduced their production area by 40% by implementing a new layout, which was developed through a 5S workshop. Note Torsby bought new materials to mark components for SEK 100 000 and they reduced their assembly time by 70% and changeover time from 30 min to 10 min (Lean forum, online). Thus, the success is noticeable. Verble (2006, Lean Conference) states that “One third or less get traction, take root, survive over time and produce measurable results. One third or more start strong, show potential, produce partial results but gradually fade from use and practices return to the way they were. One third or less never gets past the talking and planning stage”.

This dissertation will help Saab Space, Sweden, investigate their current state, concerning staff and working methods, in order to develop a sustainable implementation of Lean with the expectation, in the future, to belong to the one third who takes root, survive over time and produce measurable results.

## 2.1 Goal

The goal of this dissertation is to investigate how Saab Space (SE) can make their business more efficient and effective by using the Lean philosophy. In order to fulfil this goal, various barriers and opportunities were analysed. The questions answered in this dissertation are: How should SE take their first step to become a Lean organisation:

- with the considerations of their staffs’ attitude towards a change in relations to Lean?
- with the considerations of their current working- and Lean-activities?

The dissertation aims to find a base for the development of a Lean handbook, which intends to describe how to implement, maintain, and use Lean at SE.

## 2.2 Purpose

The purpose of the master’s dissertation is to investigate and interpret the possible effects of using Lean at SE, for its’ staff and culture. The research will be a basis for a future developed Lean handbook. The handbook will allow every member of the company to see their Lean role more clearly.

## 2.3 Saab Space

Saab Space (SE) is a self-governing supplier of highly specific equipment to the international space industry. They specialise in:

- Digital and microwave electronics.
- Antennas for satellite manufacturing.
- Supply payload adapters.
- Separate systems and guidance systems for launch.
- Sounding rocket operators.



SE has two offices in Sweden including their headquarters located in Gothenburg. Other fully owned subsidiaries are located in Vienna, Austria, Austrian Aerospace, and a sales office in Los Angeles, California, which assists in finding new business and provides customer support. The headquarters in Gothenburg are divided up to two different sections; the G-division owner of the construction, project management resources and the P-division, owner of the production related resources. Figure 1 outlines the organisational structure of the headquarters in Gothenburg.

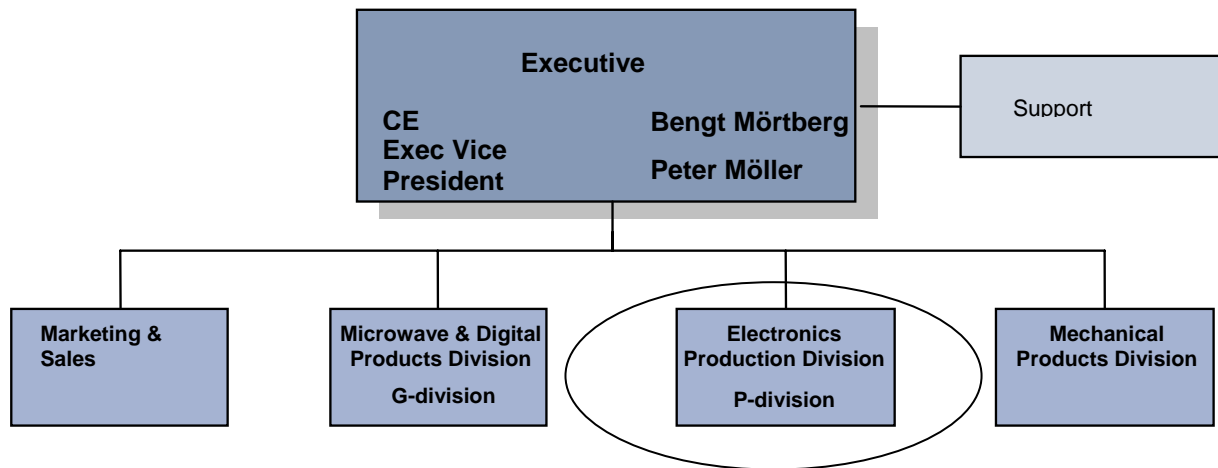


Figure 1. Saab Space organisational structure in Sweden (Source: Nordfeldt, 2006, online).

The company works with a processoriented Management System called SEMS, Saab Space Management System. The management system ensures effectiveness in the operations and is based on a customer oriented process approach with clear interaction between their management, core, and support processes.

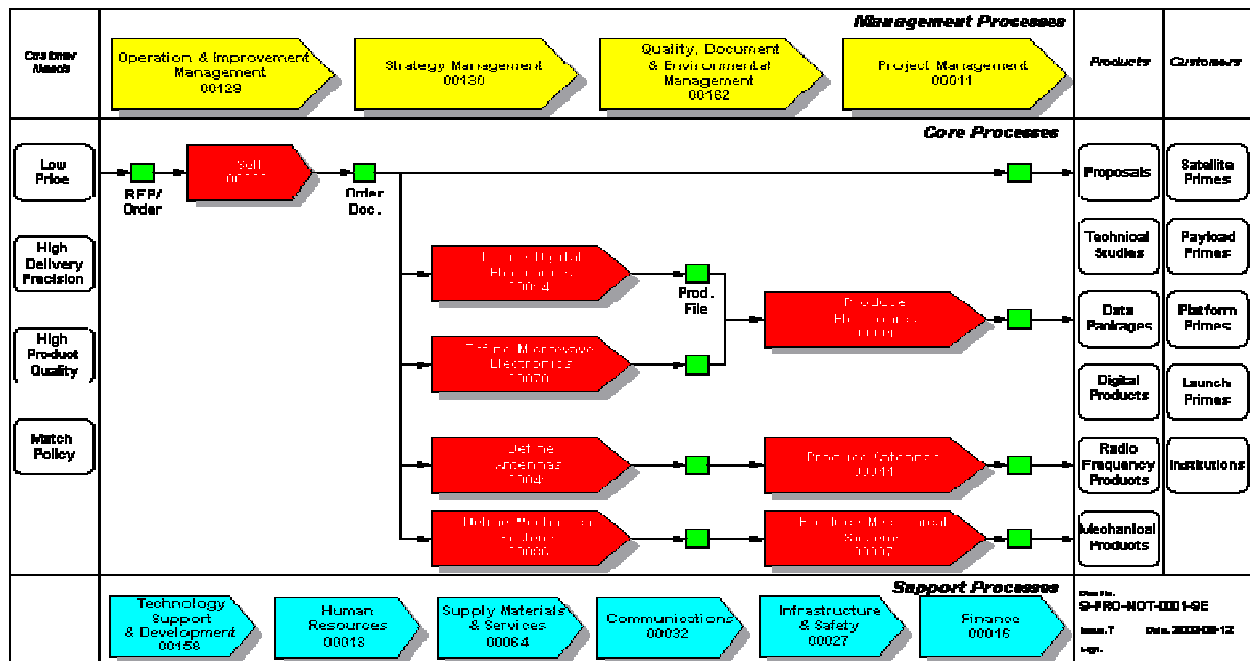


Figure 2. Saab Space Management System (Source: Nordfeldt, 2006, online).

SE's hierarchical structure is shown in Figure 3. In addition to the process orientated working approach, the company is organised with line managers and staff divided up to different sections.

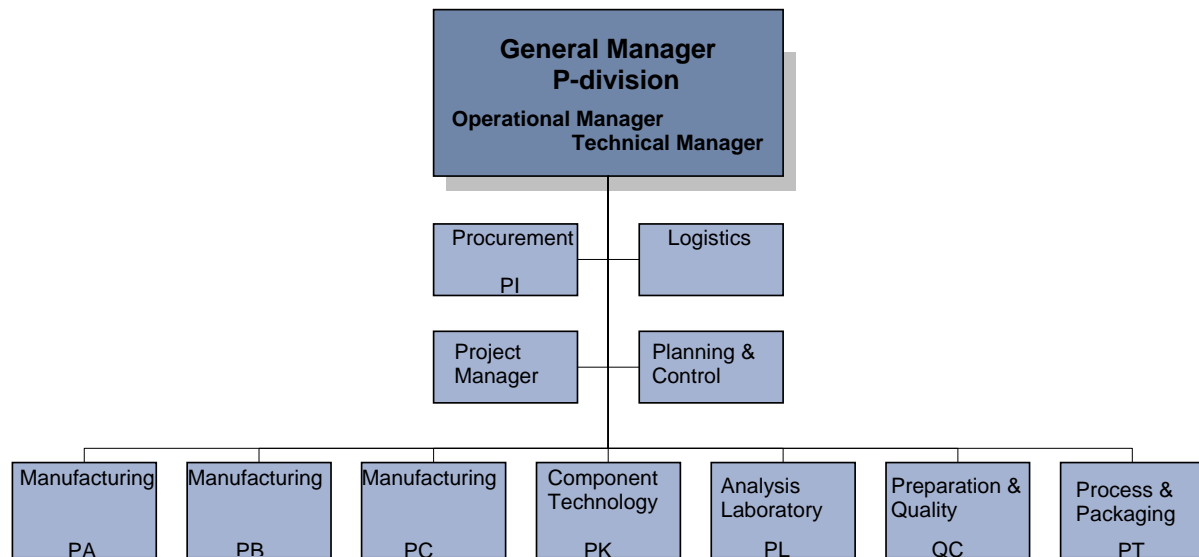


Figure 3. The organisational structure of the P-division with related sections (Source: Nordfeldt, 2006, online).

### 3. Theoretical Framework

This part of the master's dissertation will create a foundation for the present empirical study, since the interviews and questionnaires will be based upon this Theoretical Framework:

The Theoretical Framework aims to answer four questions:

1. What is lean and where did it appear from?
2. Why should an organisation use the philosophy?
3. How to work with Lean and what tools can be used?
4. Which barriers and facilitators are available for implementing Lean?

Lean is a broad concept developed to make production more efficient and effective by reducing waste, which makes Lean mostly known as 'Lean Production'. However, this dissertation will not focus on Lean Production, rather 'Lean Thinking' or just 'Lean'.

The theoretical framework might appear to be focused on Lean production since Lean thinking originates from production and has so far been adapted on the production sites of companies. However, whether it is focused on production or not, Lean thinking can be applied on every single unit of an organisation even though many examples are linked with production.

### 3.1 History

After World War II, mass production manufacturing methods shifted to be result-orientated or output-focused. Today, production systems control most of the manufacturing businesses. Efficiency strategies that helped to reduce costs, improve output, establish competitive position and increase market share were also adopted early by those production manufacturers (MAMTC, no date).

Japan was facing crises and lacked resources after the World War II. Inspired by Ford and his way of thinking, Shigeo Shingo, in the 1970's, adapted Ford's functional system of mass production. Shingo later became the father of the Toyota Production System. However, the major difference being, Shingo challenged the batch-way-of-thinking and allowed the production flow to be determined by customer needs. Consequently, lead-time was reduced, productivity increased, work-in-progress was reduced, quality improved and the utilization of space was more efficient (Dviric, 2006, online).

The heart of Shingo's Flow Manufacturing included:

- Workplace organizations & visual controls
- Change management
- Value stream mapping
- Set-up and lot-size reduction
- Pull/Kanban material replenishment system
- Cellular manufacturing

Shigeo Shingo developed, together with Taiichi Ohno and Eiji Toyoda, a discipline known as the "Toyota Production System" (TPS) or Lean. The objective of this system was to minimize the consumption of resources that added no value to the product (Dviric, 2006, online; MAMTC, no date, online).

Lean has become a widely adopted manufacturing concept, which came to be known as 'Lean Production'. The concept was developed and Lean production was spread to logistics, military, construction and to the service industry, which further developed the 'Lean Production' concept to 'Lean Thinking' (Poppedieck, 2002, online).

### 3.2 Lean

*"The key thought processes within Lean are identifying 'waste' from the customer perspective and then determining how to eliminate it. Waste is defined as the activity or activities that a customer would not want to pay for and/or that add no value to the product or service from the customer's perspective. Once waste has been identified in the Current State, a plan is formulated to reach the Future State in an effective manner that encompasses the entire system"* (LEAD, 2004, online).

Many organisations in western industrial countries are forced to move their production to “low salary countries” in order to survive due to customer and market demands (Johansson, Broman & Alsterman, 2005). Customers become more and more powerful and have plenty of choices, excellent access to information and demand excellent quality at a reasonable price, which puts the organisation under pressure.

The only way to improve profit is to reduce costs without destroying the team and its members, and weakening the organisation in the long term (Dennis, 2002).

Lean thinking means doing more during less time, using less space, less human effort, less machinery, less materials, while continuing to meet customer needs (Dennis, 2002, *p.* 13). To achieve this, the company is required to focus on processes and facilities. The Lean approach combines various practices so as to simultaneously improve efficiency, quality and responsiveness to customers (Parker, 2003, *p.* 620). Lean is built upon full participation from staff in a safe working climate and environment (Lean forum, no date). Lean forum (no date) also claims that Lean is rather more than a technical device; it’s an attitude and a way of thinking and acting. Lean must be driven from the top management and be well considered, since it’s not a piecemeal philosophy; it’s a complete way of being (Careira, 2005, online).

Many people think that lean is about cost cutting. Further to this, Womack and Jones (2003) claim that lean does not only cut costs but also shortens production lead times and time-to-market, improving quality, and providing customer with just what they want exactly when they want it. This makes it possible to order, design, produce, and deliver goods at smaller production scales by means of committed product teams, without paying a scale or investment-cost penalty. As a result, lean shortens the time it takes to convert customer orders into quality deliveries at a low cost (Kremer & Fabrizio, 2005, online). Furthermore, Lean thinking empowers workers to become independent goal seekers, who influence deeper problem solving skills and critical thinking abilities in service to customers. Teams everywhere strive towards, and are rewarded for, innovations. Processes such as lean are associated with creative outcomes in manufacturing as well as other areas. Hence, creativity is an important area to understand providing the company with a competitive advantage and a key to long-term success of manufacturing and service organisation (May, 2005, online; Pipinich, 2006).

Lean is a universal concept and has been applied successfully across many disciplines proving its success as a universal tool (Poppedieck, 2002, *p.* 1). Five primary statements describe the goals of Lean (International Institute for Learning, 2006, online; Kremer & Fabrizio, 2005, online):

1. On-time deliveries.
2. Quality products, understanding customer value and establish the best time in the project to provide value at all levels.
3. Lowest possible cost (and lowest price) to the customer.
4. Secured employment and staff involvement.
5. Develop a culture where everyone participates toward continues improvement.

The value of Lean is interpreted in many different ways as each supplier and manufacturer have their own way to interpret the added value of Lean (thinking). The final product or service often flows through many firms; each one tends to define value in their own way relative to its own needs meaning the different definitions of added value of Lean are not defined in the same way. Implementing Lean demands a change in the whole value stream from supplier, through manufactures to end customer (Johansson et al., 2005). Each product or service demanded from customers has their own “Takt time”. The “Takt time” is the relationship between the capacities, customers demand and production time; it makes sure that the products are made after the demand no more or less. As a result, large machinery producing large amounts within a short period of time may not be the most efficient. As an alternative, small machinery may be more suitable according to customers’ demands. A flow is to be created within the organisation in order to limit and reduce batch-and-queue systems, which is identified with mass production (Womack & Jones, 2003).

“Lean Office” is basically the same as Lean for the factory floor; it focuses on reducing total cycle time of administrative function to streamline information flow, the gathering, improvement, movement, and storage of information. In the office, Lean addresses the time between orders being placed and when payments are received. MEPoL (2006, online) claims that over 40% of total cycle time occurs at the front end of a project. Tasks such as taking orders, confirming credit, designing parts and ordering material are approximately 42% of a typical company’s total cycle time. Manufacturing and shipping only use 8% of the cycle time, while the remaining 50% is spent on waiting for customer payment, as outlined in Figure 4, the distribution of a products Cycle time (MEPoL, 2006, online).

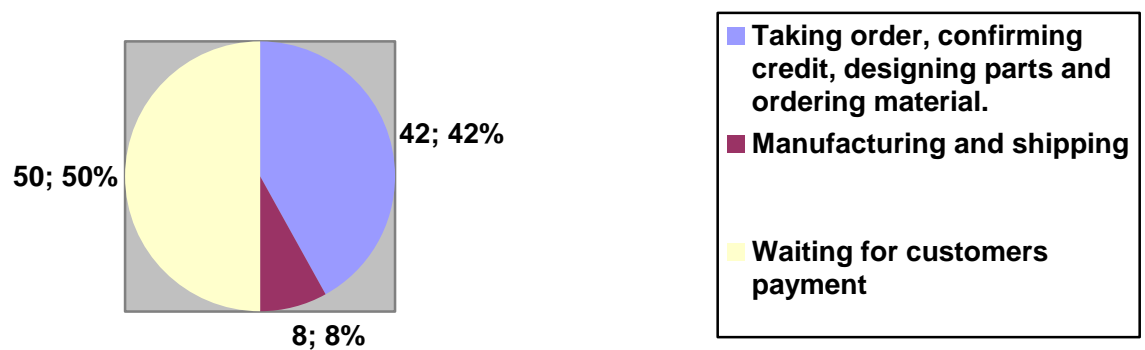


Figure 4. The distribution of a products cycle time (Source: MEPoL, 2006, online).

Lean is based on reducing costs rather than increasing prices (Trapping, 2005). Companies are constantly under pressure from customers to reduce price and lead time and maintain the highest quality and there is always a competitor in the market ready to offer a lower price. Normally, the company set sales prices by calculating costs and adding a margin of profit: **Cost + Profit = Sales price**. Lean sets the prices a bit differently in order to reach cost reduction and the price customers are willing to pay: **Market price – Cost = Profit**. Consequently, the customers decide the price and they get what’s needed, when it is needed, no more and no less, since anything that does not add value to a product is seen as waste and should be eliminated (Johansson et al., 2005, p. 63; Kremer & Fabrizio, 2005, online).

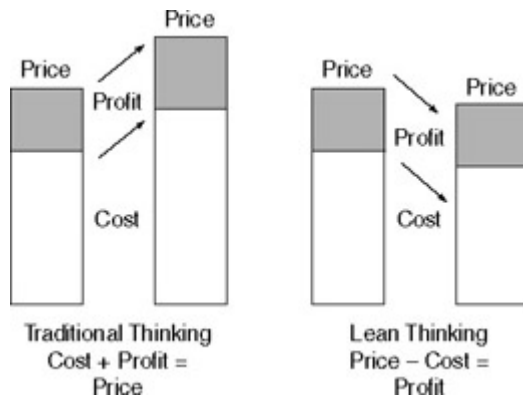


Figure 5. A lean perspective (Source: Trapping, 2005, online).

### 3.2.1 Muda / Waste

Muda/Waste is “Anything that does not add value to the final product or service, in the eyes of the customer. An activity the customer wouldn't want to pay for if they knew it was happening” (LEAD, 2004, online).

Muda is not a nice word to use in Japan, Muda means Waste and is the opposite of value, which is simply what customer is willing to pay for. Most of our day to day activity is Muda (Dennis, 2002, p. 20). Toyota focuses on reducing change time in the production, since they consider it to be waste. By reducing waste, Toyota could focus on producing more cars with fewer resources (Johansson et al., 2005). Most companies comment that only about 5% of their activities are value-added, the rest are non value-added or wasted activities. Multinational organisations operate at a level of above 40% value-added activity. Waste elimination can be applied to every process within an organisation. By eliminating waste, step-by-step, in many small ways, costs can be drastically reduced. The result is a remarkable savings and an increase in capacity (Kremer, & Fabrizio, 2005, online).

By identifying value in the processes Muda/waste can be eliminated; and by creating a value stream, every action required to be identified is mapped. The order process and how to make a specific product' is identified and the activities are sorted out in three categories (Womack & Jones, 2003, p. 131):

**VA = Value Adding; i.e.,** those processes, which actually create value as perceived by the customer.

**NVN = Non Value Adding but Necessary; i.e.,** those processes, which create no value but are currently required by the product development, order filling, or production systems and so on, can not be eliminated just yet.

**NVA = Non Value Adding, i.e.,** those actions, which don't relate to value as perceived by the customer and so can be eliminated immediately.

Seven basic types of waste have been identified by Toyota Production System (Burton & Boeder, 2003, *p.* 2):

1. Overproduction—producing more than what is demanded by the customer.
2. Waiting—waiting for the next process step.
3. Transport—the unnecessary movement of material.
4. Over-processing—due to poor tool or product design.
5. Inventory—storing more than the absolute minimum need.
6. Motion—unnecessary reaching, walking, or looking for parts, tools, prints, information, and so on.
7. Defects—scrap and rework.

These seven types of waste will be further discussed at 3.3.3.3. Reduce waste.

### 3.3 The House of Lean

Lean consists of many different methods, theories and tools and it has proven difficult to grasp as a whole. The House of Lean is a visualisation of Lean and its components in order to clarify the different parts of Lean (Dennis, 2005, *p.* 18). The house should express the strategies of an organisation to reduce waste. Each organisation must create its own house with individual strategies. Different theoretical resources claim different setups of the Lean house however; the overall information and conclusion of the resources are the same. The house must be built up on a solid foundation, which can be created by education and knowledge. The foundation includes vision, mission and goals. When a solid base has been laid, the two pillars can be completed, which consist of JIT and Jidoka. The left pillar, JIT, signifies of on time delivery and to eliminate waste, which is the most vital part of Lean. The right pillar, Jidoka, is focused on automation, which can be translated to the transformation of human intelligence concerning the processes. The roof consists of Kaizen, or continuous improvement and customer focus (Johansson et al., 2005, *pp.* 7, 8).

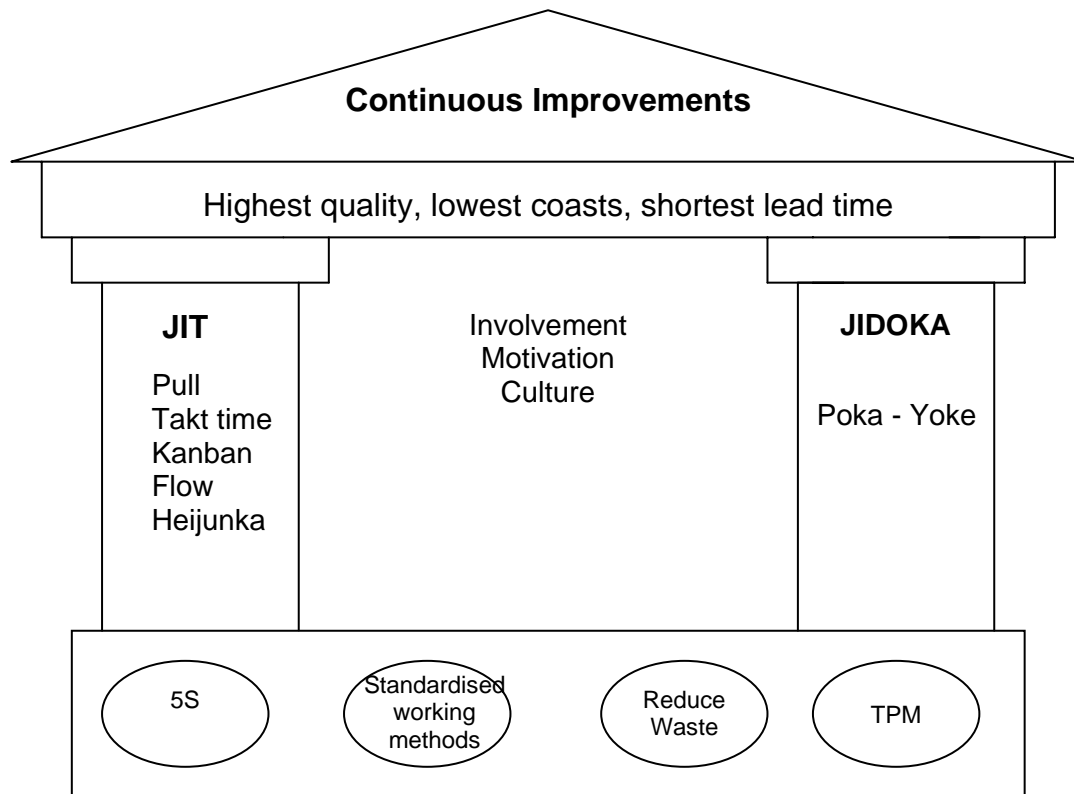


Figure 6. The House of Lean (Source: Johansson et al., 2005, p. 9).

### 3.3.1 The Roof of The Lean House

The roof or Kaizen intends to give signals that Lean is a never ending process and should be continuously improved (Johansson et al., 2005, pp. 7, 8).

#### 3.3.1.1 Kaizen

*” Kaizen -continuous improvement -the small, gradual, incremental changes applied over a long period that add up to a major impact on business results” (Burton & Boeder, 2003, p. 2).*

To strive for Lean is not a project with an end; it's a continued improvement process without an end. Kaizen is one of several processes or tools of Lean. Kaizen is a Japanese term and is translated as continuous improvement; 'Kai' meaning continuous and 'zen' meaning improvement. 'Kai' is also sometimes translated as change and 'zen' to good, for the better (Tomo, 2006). Kaizen is not limited to certain areas such as production or design; instead it is based on making changes anywhere in the organisation where improvement can be made on regular basis in order to reduce waste. In addition, its success depends on the total commitment of the workforce (Burton & Boeder, 2003, online; Graphic Products Inc., 2005, online; Productivity Press Development Team, 2002, online). Kaizen plays a major role of the foundation of Lean and the primary purpose of Kaizen and Lean production is to eliminate the seven types of waste, discussed at 3.3.3.3, throughout the entire organisation, not only production (Productivity Press Development Team, 2002, online).



Productivity Press Development Team (2002, online) recommend ten principles of improvement describing the spirit the staff needs to have in order to be successful in their Kaizen activities. The ten basic principles are:

1. Throw out all of your fixed ideas about how to do things.
2. Think of how the new method will work—not how it won't.
3. Don't accept excuses. Totally deny the status quo.
4. Don't seek perfection. A 50-percent implementation rate is fine as long as it's done on the spot.
5. Correct mistakes the moment they're found.
6. Don't spend a lot of money on improvements.
7. Problems give you a chance to use your brain.
8. Ask "Why?" at least five times until you find the ultimate cause.
9. Ten people's ideas are better than one person's.
10. Improvement knows no limits.

It is important to know that Kaizen is not a tool; it's a process and, as a process, it can be applied to various activities within any organisation. Kaizen in itself should not be considered as Lean, as it is only one of several processes and a state of mind for continued improvement that supports waste elimination (Productivity Press Development Team, 2002, online). The Kaizen philosophies, together with the Lean tools, are efficient and important involvement channels. Furthermore, involvement is an important part when it comes to changing the organisation culture and minds of staff. In addition, the goals of involvement are to solve specific problems, reduce hassle (e.g., simplify work and working methods), reducing risks by eliminating ergonomic burdens and to improve team-members capabilities to deal with new problems (Dennis, 2002).

***Implementation of Kaizen.*** Kaizen is a term for philosophical and culture change. There are many ways of how to adapt and implement Kaizen in the organisational culture (Trapping, 2005). A well-used activity is the Kaizen blitz (or Kaizen event); it's a short-term project to improve a process.

Kaizen events provide great benefits; it strengthens team members' ability to work as part of a team, lead a team, think clearly and logically, solve problems, build team-members confident and attack critical problems with many different points of views from staff members. In addition, it involves the staff in their daily work and help to support them with the right resources and skills in order to sustain involvement; consequently it can be used as a guide for managers. A Kaizen event can take from 1 day to 4 months to complete depending on whether it is simple or complex (Dennis, 2002, *p.* 104; Strategos, no date). The aim of a Kaizen event is to improve processes within the organisation and eliminate waste and non-value-added work by involving and teaching the owners and operators of a process to make improvements to that process (MCS Media, 2003, online; Six Sigma, 2003, online). Kaizen events consist of three phases; planning, workshop, and follow-up phases; it is vital that all three are equally considered. The events can be focused on one area or process or multiple areas and it is essential that the management is cooperative with the workforce in order to succeed (Trapping, 2005, online). However, there are also risks with Kaizen events; the workforce may believe that all improvement activities should be connected to a Kaizen event and therefore wait to make improvements until the event. Improvements should be done continuously (Johansson et al., 2005).



Figure 7. The three phases of a Kaizen event (Source: MCS Media, 2003, p. 51).

**Planning of a Kaizen event.** A target improvement area should be selected and a core implementation team should be assembled. A team charter, Figure 8, should be completed and approved by management, with the core implementation team and a project champion for the workshop available. An essential part is to communicate to all workers who will be affected and make sure they understand what will happen, when it will happen and what is expected from them, Figure 9 (MCS Media, 2003, online).

Team Charter		
<b>Mission</b> What the team is to do. How will the team complete its mission.	<b>Deliverables</b> What specific outcomes can be expected. Defining the metrics that will be used.	
<b>Expected Scope/Approach/Activities</b>		
<b>Team Resources</b>		
<b>Role</b>	<b>Name(s)</b>	<b>Participation Level</b>
Team Leader		
Core Team Members		
Extended Team Members		
Facilitator		
Scribe		
Team Champion		
Steering Body Members		
<b>Team Process</b>		
<b>Process Item</b>	<b>Frequency</b>	<b>Audience/Distribution (Day(s)/Time(s))</b>
Information Distribution	After meetings	Team members, team champion
Team Meetings		
Status Reporting		
<b>External Issues</b>		
Outside risks or events that may impact team mission should be listed.		
<b>Internal Issues</b>		
Internal restraints or events that may impact team mission should be listed.		

Figure 8. Team Charter (Source: Kremer, 2005, online.)

Kaizen Milestone Worksheet																			
Value Stream: <u>Customer A</u>		Date: <u>2/20/02</u>		Page <u>1</u> of <u>2</u>															
Value Stream Focus: <u>DEMAND</u>																			
Specific Event	Task	Duration	Person	Weekly Schedule															
				1	2	3	4	5	6	7	8	9	10	11	12				
<i>5S</i>	<i>Sort</i>	<i>1 month</i>	<i>D.T.</i>	△	▲														

Figure 9. Kaizen Milestone Worksheet used to communicate to workers (Source: MCS Media, 2003, online).

**Workshop of a Kaizen event.** The team needs about a day of training in Lean in order to apply Lean tools to the work area. The area or process should be observed and current methods should be recorded and analysed. The team should then be broken down in smaller groups to brainstorm and to discuss ways to eliminate waste in the work unit, and then test the ideas on the unit and observe their effects. The improvement should be implemented and followed up, after about 30 days, by measuring the result. The results should be reported and presented and be followed up again after about 30 days (MCS Media, 2003, online).

**Follow up of a Kaizen event.** Ideas should continue to be implemented and its results should be monitored and measured. From the improvements, standards should be created. The champion should submit Status reports on a regular basis in order to communicate the status of the project. When the Team Charter has been completed a final report, also called Sunset Report, should be made containing the knowledge gained by the team to share with others. The Sunset Report should be filled out by the team leader (MCS Media, 2003).

### 3.3.2 The Pillars of The Lean House

In order to be able to improve the company activities and process, actions needs to be taken. To identify waste from customer perspective is a thought process, but knowledge, inspiration and innovation might be limited.

The lean concept contains different tools, which includes theory and techniques designed to help during the Lean process. This chapter will discuss the best known tools. These are the basic tools and are seen as vital in the start up of a lean thinking project (Carter, no date).

The essential Lean tools aim to (Trapping, 2005, online):

- Identify and eliminate waste quickly and efficiently.
- Increase communication at all levels of the organisation.
- Reduce cost; improve quality and delivery in a safe environment.
- Begin improvements immediately and empower workers to make improvements themselves.

### 3.3.2.1 Just-In-Time

The first pillar of the Lean Manufacturing System is Just-In-Time (JIT) production. JIT provides customers with the quality product or service they ordered just when they are wanted and in the exact amount needed (Kremer, & Fabrizio, 2005). JIT supplies the right parts in the place at the right time with the intention of eliminate waste in forms of unnecessary moving of material. JIT consists of several supplementary parts when implementing JIT. These parts are important to consider reaching success with JIT. The different parts are; *Pull system, Takt-time, Kanban, Flow and Heijunka*, all of which will be further discussed in this chapter. JIT aims to improve profits and return on investment by reducing inventory levels, reducing variability, improving product quality, reducing production, keep delivery lead times and reducing other costs. To accomplish this, an attempt is made to reach the goals of driving all inventory buffers toward zero and achieving the ideal lot size of one unit (Chase, Jacobs, & Aquilano, 2006).

Dennis (2002, p. 66) presents four simple rules of JIT;

1. Don't produce something unless the customer has ordered it.
2. Level demand so that work may proceed smoothly throughout the plant.
3. Link all processes to customer demand through simple visual tools (Kanban).
4. Maximize the flexibility of people and machinery.

***Pull systems.*** Pull means that no-one upstream should produce goods or service until the customer downstream asks for it, internally or externally. The purpose with the pull system is to limit the storage in the organisation and minimise high costs. "Don't make anything until it is needed; then make it very quickly (Womack & Jones, 2003, pp. 67-89). The opposite to Pull is Push and means that products are produced after a prediction of an expected customer demand.

***Takt time.*** The Takt time states the direct customer demand or how often a customer intends to buy a product or service. The Takt time is vital for lean since the production time is adjusted to this time. The aim is to have a longer Takt time than cycle time; consequently, the company will be able to deliver on time and reduce working tempo resulting in reduced stress. The Takt time can be calculated as follows:

**Takt = Daily operating time / required quantity per day.**

For example, if our daily order is 890 units and we operate two 445-minute shifts, our Takt time would be:  $(445+445) / 890$  units = 1 minute, one product per minute should be produced (Dennis, 2002, p. 51).

**Kanban.** Kanban can be translated to “signboard” or “visible record” and identifies and provides information of a product and is used to provide an easily understood, visual signal that a specific activity is required. The provided information can consist of supplier, customer, where to store it and how to transport it. Kanban can signal the need to produce more parts as well as signal the need to withdraw parts from one work centre and deliver them to the next work centre (Kremer & Fabrizio, 2005, online.). Kanban is a tool to achieve a pull system and limits the amount of inventory in the process by acting as an authorisation to produce more inventories (MEPoL, 2006; Olsson, 1996). Usually, it is a card in a rectangular vinyl envelope (Dennis, 2002, p. 70). In order to gain advantage of a Kanban system it requires that the elements of short setup times and small lot size are adapted because each station in the process must be able to respond quickly to requests for more material (Chase, Jacobs, & Aquilano, 2006, online; Kremer & Fabrizio, 2005, online).

**Flow.** Flow is the progressive achievement of tasks along the value stream so that a product proceeds from design to launch, order to delivery, and raw material to the customers with no stoppages, major stoppages, problems and backflow (Womack & Jones, 2003, p. 348).

**Heijunka.** Heijunka, or levelling, aims to support standardised work and Kaizen, and its goal is to produce at the same time-pace every day so as to minimize the peaks and valleys in the workload (Dennis, 2002, p. 80). Once continued flow has been achieved, this system ties all the work and processes together. According to Trapping (2005, online) Heijunka accomplishes the following goals:

- Balanced work loads.
- Provides a visual system for identifying if work is behind schedule.
- Reduced queue times.
- Achieved continued work flow.
- A sophisticated paced withdrawal system.

In order to apply Heijunka, a Heijunka box is used as a tool. The box is a production-scheduling tool that tells us visually when, what and how many to build. The box is often loaded with withdrawal Kanbans based on that day’s order and corresponds to the numbers of products, the plant or section makes, and Takt time or pitch (Dennis, 2002, p. 81).

### 3.3.2.2 JIDOKA

Jidoka is defined by Toyota as “automation with a human mind” and involves intelligent workers and machines identifying errors and taking quick countermeasures. Since most errors are caused by humans’ Jidoka was developed with the aim of eliminating human errors causing defects (Dennis, 2002, pp. 80, 90). The goal of Jidoka is “zero defects”, to never pass a defect product downstream and to eliminate the risk that an undetected defect will end up in the hands of the customers. In addition, Jidoka should be done in a way, which promotes JIT and continued flow.

According to Kremer and Fabrizio (2005, online), Jidoka has three functions:

- Separate human work from machine work.
- Develop defect-prevention devices.
- Apply Jidoka to assembly operations.

In addition, Jidoka ensures that machines don't just move parts and products; instead machines in a Jidoka system do only "value-added" work, reduce cycle time, and prevent such waste as waiting, moving things, inspection and defects. Furthermore, Jidoka allows for stopping the production to find out the roots causes of defects. There are tools and methods developed in order to reach "zero defect" and reach "automating with a human mind", these will be *Poka Yoke*, *Six Sigma*, and *7QC*. *Poka-Yoke* is the most common and useful tool.

***Poka-Yoke***. *Poka* means unplanned error, and *Yoke* means prevention. *Poka-Yoke* means implementing simple low-cost devices that either detects abnormal situations before they occur, or once they occur and stop line to prevent defects; *Poka-Yoke* can also be translated to "mistake proofing". The aim of *Poka-Yoke* is to reduce a worker's physical and mental burden by eliminating the need to constantly check for the common errors that lead to defects (Dennis, 2002, p. 91; Johansson et al., 2005, p. 54). Each team leader, supervisor, plant manager and every successive management level should be encouraged to think "zero defect" in terms of his or her zone; for example within his or her work area. In order to detect errors which might lead to defects and to provide feedback to the source there are inspection methods designed. Those methods can consist of sensor stop, a machine won't state if a work piece is incorrectly positioned, and warning system alerting workers when abnormalities occur by activating a buzzer or a light. The Andon board alerts the group leader to identify problems by lighting the process numbers, playing a piece of music or both; it is engaged when a team member pulls the cord that runs along the line to announce an error. The Andon board aims greatly to reduce the potential for defects created by stopping the line in mid-cycle (Dennis, 2002, p. 94).

### 3.3.3 The Ground of The Lean House

This part of the Lean House is a linked and continued from the Pillars of the house.

#### 3.3.3.1 5S

5S is a tool that aims to reduce waste and optimise productivity through maintaining a neat workplace and using visual cues to achieve more reliable operational results. This method "cleans up" and organises the workplace mainly in its existing configuration. 5S provides a methodology for organizing, cleaning, developing and sustaining a productive work environment, which encourages the employee to be efficient in their daily work. This tool should be used by every single member in the organisation and on everything throughout the organisation, on large or small tasks, or on products and activities (Dennis, 2002, p. 29). The 5S stands for *sort*, *set in order*, *shine*, *standardise* and *sustain*. This tool often provides a foundation on which other Lean methods are developed out of, such as TPM and JIT (U.S. Environmental Protection Agency, 2006). Many organisations often think they have a good order amongst their tools, documents and other work related material; however this order might not be as neat as it appears. Waste-time can be limited by increased order on the workplace. By making a draft plan of the workplace, deviations can be detected and replaced (Johansson, Broman & Alsterman, 2005, p. 9). The 5S is a team activity and process, but it also involves the individual worker to commit to the process within its own area.

The benefits of 5S are (Trapper, 2005, online):

- Allows everyone to be involved in a simple Lean tool.
- Provides the foundation for the Lean Office.
- Assists in the elimination of waste.
- Smoother work flow.
- Reduced employee stress.
- Provides a systematic process for continued improvement.
- Focuses on the process and not the person.

Furthermore, 5S also communicates a common message to every employee that involves the top management immediately and creates the foundation for change. In order to implement 5S a cross-functional team should be assembled and a target area chosen; the workers and their involvement is the key in order to make the project a success (Trapping, 2005, online).

### ***1. Sort.***

“Sort through and sort out. When in doubt, move it out”

This is needed to identify unnecessary objects and/or processes and remove them (parts, equipment, files, documents, etc). Furthermore, there is need for a separation of the unnecessary from the necessary actions by going through everything on a work place. The concepts “unnecessary” and “necessary” need to be defined in relation to what purpose the objects and/or processes are supposed to be related to (MEPoL, 2006; SIFU, 2006). According to Trapping, (2005, online) the team and workers should follow the following steps:

- a. Define the staging area for unnecessary items.
- b. Create guidelines for items not essential to the area (it is recommended that if an item has not been touched in 3 months, remove it from of the area).
- c. Identify items not necessary in the area and red tag them.



*Figure 10.* Red Tag (Source: Trapping, 2005, online).

- d. Locate tagged items to a staging area.
- e. Managers/Team Leaders determine disposition of tagged items. This may include: return to area, create common area, dispose of, or donate to charity.

### ***2. Set in order***

“Set in order set limits. To ensure everything has a place and everything is in its place”.

Set in order establishes the location where items belong, by either labelling or visual markings. Everything in the organisation should have its own place to eliminate time looking for things to make the process as efficient as possible. The organisation should make decisions on where everything should be placed and stored; indicators should be painted to clarify the particular places for each device. The organisation should ask themselves how long it takes to get the needed device and how fast they can replace it (MEPoL, 2006, online; SIFU, 2006, online).

Trapping, (2005, online) recommends a way how the team should accomplish this by:

- a. Marking off common areas, labelling drawers and identifying everything within the area.
- b. Create a standard for the target area, something to refer to if an item is out of place or not returned. It should be obvious something is missing and each item should be labelled to identify where it belongs.
- c. Monitoring of the area to ensure this S is being completed.

### **3. Shine**

“Shine and inspect through cleaning. To be Lean you must be clean!”

The organisation should continuously clean their facilities and create routines for the cleaning. The cleaning works also as an inspection to locate problems and uncertainties (MEPoL, 2006; SIFU, 2006). Moreover, the team should create a cleaning plan, which aims to identify what needs to be cleaned, how it should be kept clean and by whom. A visual chart helps to ensure the process is followed. The team should accomplish this cleaning plan by:

- a. Setting time aside for cleaning activities.
- b. Creating the 5S cleaning plan for the area, this may be daily, weekly, yearly etcetera.

### **4. Standardise**

“Create and set standards for cleanliness. Standardise to improve”.

The first three S's should be standardised by implementing visual displays and controls. It is important that the standardising is maintained and continues to be improved (MEPoL, 2006; SIFU, 2006). The improvement should be done with help of created guidelines for keeping an area organised, orderly and clean. In addition, these guidelines should be made visual and obvious for everyone. According to Trapping, (2005, online) it is accomplished in five steps:

- a. Identify the target area.
- b. Decide what the specific tasks are and where they should happen (location). List them on a sheet of paper.
- c. Decide who will perform the tasks. List in column.
- d. Decide frequency and supplies required. List in column.
- e. Post in target area.

### **5. Sustain**

“Sustain all gains through self-discipline. Sustain for success!”

The gains from 5S must be sustained through self-discipline, training, communication and total staff involvement. The procedure must be a habit amongst the staff; in order to meet sustainability the staff must have received proper training, accepted the routines and be motivated (MEPoL, 2006, online; SIFU, 2006, online). MCS Media (2003) recommends a checklist, which can be useful for self inspections; this checklist is shown in Figure 11.



Moreover, to maintain the 5S Trapping (2005, online) recommends regular audits. One example of a 5S audit is shown in Figure 12.

### **Standard Inspection Sheet**

---

Have you removed dust, dirt, oil, etc. from tools?  
Have you put all tools back into their storage place?  
Have you put inventory back into where it belongs?  
Have you removed dust, dirt, oil, etc. from jigs, dies, etc.?  
Have you restored jigs, dies, etc. in proper place?  
Have you wiped the machines down and checked for leaks?  
Did you check for any loose nuts or bolts?  
Did you check for needed bulbs or tubes?  
Have you cleaned the bench?  
Did you remove items that are not needed?  
Is the area generally clean?  
Have you swept and mopped the floor?

*Figure 11. 5S Standard Inspection Sheet (Source: MCS Media, 2003, online).*

<b>5S Office Audit</b>				
<b>Name</b>		<b>5 or more problems, enter 0.</b> <b>3 or 4 problems, enter 1.</b> <b>2 problems, enter 2.</b> <b>1 problem, enter 3.</b> <b>0 problems, enter 4.</b>		
<b>Work Area</b>				
<b>Category</b>	<b>Activity</b>	<b>Date</b>	<b>Date</b>	<b>Date</b>
Sort	1. Unneeded books, supplies, etc			
	2. Unneeded reference materials, etc.			
	3. Items present in aisles, hallways, etc.			
	4. Safety concerns.			
Set In Order	5. Correct places for items			
	6. Items are not put away.			
	7. Work areas properly defined.			
	8. Office equipment locations defined.			
Shine	9. Desk surfaces, cabinets free of dust.			
	10. Computer terminal screens clean.			
	11. Cleaning materials easily accessible.			
	12. Common areas looking clean.			
	13. Labels, signs, etc. are clear to see.			
Standardize	14. Work information is visible			
	15. 5S Standards are posted			
	16. Everyone trained to standards			
	17. Checklists exist for all areas.			
	18. Items in areas can be located quickly.			
Sustain	19. An audit sheet has been created			
	20. Audits are conducted regularly.			
	21. Improvement ideas for 5S are used.			

Figure 12. 5S Office Audit (Source: Trapping, 2005, online).

Along with 5S, visualisation is often used. The visualisation aims to communicate important information about the work environment, safety, operations, storage, quality, equipment, tools, improvement activities and other work standards. Additional aims of a visualised workplace are to display, control and to gain conformity with standards; not just standard operating procedures. A good visualisation provides clear information on whether a workplace has faults or lacks order with the help of indicators instead of words, "One picture is worth a thousand words." The ideal visualisation is that it is so completely integrated with action that no deviation from the standards exists. The visualisation can be created in different ways. Kremer and Fabrizio (2005, online) mention a number of different types of visualisation:

*Storyboard* aims to share information about projects or improvements and to educate and motivate. It is a graphic representation that communicates the progress and key information on a project as it unfolds. It is essential that the storyboard is engaging by including colours and data understood by everyone.

*Signboards* aim to address location of equipment, resources and anything else which might be required to efficiently work in the workplace.

*Maps* are showing information about actual processes, standard operating procedures and direction etc.

*Checklists* aim to provide an operational tool that facilitates compliance with standards and procedures.

*Indicators*, such as colour codes, show correct location, item type's amount, or direction of flow.

*Andons* and alarms provide a sign or signal where there is an abnormality or action to be taken (e-mail, alert, pager code, and so on.)

Furthermore, the visual workplace should also include a plant-wide system for lines, labels and colour-coding. This creates a visual language of lines, labels and colours known and understood by everyone (Kremer & Fabrizio, 2005, online).

### 3.3.3.2 Standardised working methods

In order to work with improvements, standardised working methods are vital. It concerns how to find the best method, for the time being, to achieve the required quality, cost and so forth. The goal with standardised working methods is to identify Muda so that the work can continually be improved through team members' involvement and Kaizen. The workers should design the standards in order to provide a basis for improvements. The difficulties with standardised work is not how to set the standard, it is how to adapt to the constant change (Dennis, 2002, pp. 47, 61, 63; Johansson et al., 2005, p. 25). Standardised working methods are a tool for developing, confirming, and improving the processes, methods and to support other Lean tools as JIT, Jidoka etc. This provides benefits as a machine operator, for example, is able to move from machine to machine following the demand of the production line. To facilitate standardisation, it is important that the supporting processes and methods are working in a continued flow. When there are continuous stoppages and slowdowns from problems with quality, tools and parts shortages, bottlenecks or poor ergonomics, the standardised work is impossible to maintain.

### 3.3.3.3 Reduce waste

As mentioned earlier (chapter 1.3.1) the majority of day to day activities are waste or Muda (Dennis, 2002, p. 20), which do not add value to customers. Most companies locate that only 5% of their activities are value-added. The result is remarkable savings and an increase in capacity. In fact, waste elimination is one of the most effective ways to increase the profit of any business. Lean has identified seven categories of waste that cover the volume of unnecessary costs in manufacturing. In order to eliminate waste, it is important to understand exactly what waste is and where it exists. It is essential to be customer focused and be able to identify the customer's value, knowing what is and what is not waste. (Kremer & Fabrizio, 2005, online; McBride, 2006, online).

The seven types of waste are:

**Overproduction.** Overproduction is to produce more than is required to meet the demand or at a faster rate than necessary. In contrast to Just-In-Time, overproduction can be referred to Just-In-Case and is probably the worst of the seven different wastes. Consequently, it increases costs for the company as it eliminates the flow of materials, creates excessive lead times, results in high storage costs, and makes it difficult to detect defects. The concept to remove overproduction is to schedule and produce only what can be immediately sold and shipped and improve machine changeovers (Kremer & Fabrizio, 2005, online; McBride, 2006, online).

Kremer and Fabrizio (2005, online) recommend several questions of how to detect this kind of waste:

- Is production faster or slower than Takt time?
- Is there inventory in queue waiting for processing?
- Is material presentation able to be improved?
- Is scheduling based on production quotas?
- Is there a lack of a pull system?
- Is Takt time incorrect?
- Is the customer demand forecast incorrect?

**Waiting.** It is not unusual that products spend more than 99% of their production life waiting in queues for next operation, known as bottlenecking, which might have been caused by poor material flow, long production runs and great distances between work centres, (Kremer, & Fabrizio, 2005, online; McBride, 2006, online).

Kremer and Fabrizio (2005, online) recommend several questions of how to detect bottlenecks:

- Am I always watching the same operation and not adding value?
- Can something else be completing during any wait time?
- Is standardised work being followed?
- Is there a pull system in place?
- Are there buffers between processes? Are they the right quantity?
- Are Kanbans being used?

**Transportation.** Transportation is another process not adding value to the outcome. In addition, unnecessary handling can cause damage resulting in reduced quality. However, transportation is a difficult area to reduce as it can be hard to determine, which processes should be moved alongside each other. It is important to bear in mind that transporting goods further than necessary, restacking and moving them is waste (Kremer, & Fabrizio, 2005, online; McBride, 2006, online). Kremer and Fabrizio (2005, online) recommend several questions of how to reduce transportation:

- Are parts/supplies moved and stored in inventory?
- Is plant layout optimized?
- Is transfer of parts fully automated?
- Is there a pull system?
- Is production machinery flexible?
- Are set-up time reduction methods being utilized to the fullest?

**Over-processing.** Often organisations use high precision equipment where simple tools would be sufficient. Consequently, high asset utilisation is encouraged to recover the high cost of the equipment. In addition, putting more effort into a task than is required results in waste, adding no value to the customer. The ideal would be to invest in smaller, more flexible equipment (Kremer & Fabrizio, 2005, online; McBride, 2006, online).

Kremer and Fabrizio (2005, online) recommend several questions of how to avoid over-processing:

- What is the basic function of this procedure and part?
- Is the process design poor?
- Are there incorrect machine or process capability specifications?
- Is there a clear understanding of customer requirements?
- Do part specifications match customer requirements exactly?

**Inventory.** Unnecessary inventory is a waste. It takes up space requiring people for movement and maintenance. Furthermore, the inventory tends to hide problems and can be the cause of increased lead time, and delay the identification of problems. A seamless flow between work processes might improve customer service and cut inventories and their related costs (Kremer & Fabrizio, 2005, online; McBride, 2006, online).

Kremer and Fabrizio (2005, online) recommend several questions of how to reduce inventory:

- Are there queues everywhere?
- Are parts purchased or machined in larger quantities than customer demand?
- What is the amount of obsolete inventory?
- Is process capability poor?
- Is there a lack of properly sized and placed buffers?
- Is there standardized work and is it being followed?
- Is there too much variation in the manufacturing processes, machines, tools or systems?
- Are setup-time reduction methods being utilized to the fullest?

**Motion.** Many movements performed by staff in a work place each day are unnecessary. The movements are mostly related to ergonomics such as bending, waking, stretching, lifting and reaching and are also seen as health and safety issues. In addition, waiting or searching for anything, tools, people, paper, machines, or information is a waste and included in this category (Kremer & Fabrizio, 2005, online; McBride, 2006, online).

Kremer and Fabrizio (2005, online) recommend several questions of how to reduce motion:

- Can walking be reduced?
- Can body movement at any tasks be reduced?
- Can items be moved closer at the value added location?
- Can the workstation or area benefit from cellular layout?
- Are proper Kaizen techniques in use?
- Is there a thorough 5S program?
- Is standard work being performed?

**Defects.** If all processes were initially performed correctly the first time, the organisation would save a large amount of money in terms of eliminated scrap as well as unnecessary time, material, energy, equipment, and labour, which includes inspection and re-inspection, (Kremer & Fabrizio, 2005, online; McBride, 2006, online).

Kremer and Fabrizio (2005, online) recommend several questions of how to eliminate waste and perform correctly the first time:

- What is the defect rate?
- Are there common reasons for defects?
- Are master parts available?
- Is inventory hiding defects?
- Is there a lack of process capability of machines, tools, or techniques?
- Is standardized work being followed?
- Are defects accurately being determined by specifications or by perceptions?

McBride (2006, online) claims that the first step to become a world class lean organisation is to identify and attack those seven areas of waste, since customers are willing to pay for value added work, not waste.

McBride (2006, online) mentions the keys to waste elimination:

- Development of current and future state value stream maps.
- Reduction in move for parts, paper and people.
- Reduction in inventories (raw material, finished goods).
- Don't forget to consider the people and communication.

### 3.3.3.4 TPM

Total Productive Maintenance is a systematic working method, which aims to create uninterrupted processes to the lowest cost through every workers commitment by engaging every operator in the maintenance process. It focuses on eliminating the waste associated with the equipment used to produce a product.

Some of the major gains from applying TPM are; gained productivity by eliminated unplanned stops, improved quality since the machinery is improved, decreased costs through reduction of waste-time, increased delivery precision once the planning of production is simplified, improved working environment through reduction of noise and danger and increased motivation for workers once responsibility is delegated, (Johansson et al., 2005, *p.* 32; Kremer & Fabrizio, 2005, online; Venkatesh, 2005, online

There are six big wastes, which TPM aims to eliminate (WMEP, 2005, online):

- Setup and adjustment.
- Breakdowns.
- Idling and minor stoppages.
- Reduced speed.
- Start-up.
- Defects.

TPM starts by measuring and analysing the Overall Equipment Effectiveness (OEE) to help diagnose problems and to use measuring to determine how successful the TPM efforts are. Autonomous Maintenance is applied to every process. Autonomous Maintenance means that the machine operators are key members of the maintenance team. Normally, dedicated, highly skilled staff would be responsible for maintenance; they are not machine operators. But since they know their machines better than anyone and have the ability to alert maintenance people and provide excellent information they should become "process owners", and more dedicated to their own work. Furthermore, TPM shows how equipment can be modified and preventative and predictive tools can be applied to make daily maintenance quick and easy, without tools or hierarchy (WMEP, 2005). TPM operators perform daily checks and simple maintenance to prevent equipment failures. When the process owners understand their true role in production, they can begin to change things and control the equipment and decide what tasks should be performed. When implementing TPM it is important to bear in mind that the implementation should be systematic and sequential, measurement should be used at all levels, and deployment should be performed by cross-functional teams. Five further development steps are vital for TPM implementation (Kremer & Fabrizio, 2005, online).

These five steps are:

1. Improve individual equipment efficiency.
2. Implement autonomous maintenance.
3. Implement planned maintenance.
4. Improve operator maintenance skills.
5. Apply early equipment maintenance.

### 3.3.4 The Middle of the House

The middle of the house signifies the staff, how to motivate, engage and involve them in the Lean process and its activities in order to succeed and maintain Lean.

#### 3.3.4.1 Involvement

All the outlined tools, methods and techniques, Kaizen, JIT, Jidoka, 5S, standardised working methods, Reduce waste, and TPM, should encourage and bring out involvement throughout the organisation. These methods are all important involvement channels; there are several activities related to the method or tool in order to gain staff involvement. The aim and goal of staff involvement is to improve productivity, quality, cost, delivery time, safety and environment, and moral. This can be reached by solving specific problems in reducing walk time by altering layout or reducing disruptions by applying 5S. Reduced risk can be achieved through reduced ergonomic burden, the major aim being to improve team-member capability strengthening staff in order to become more confident (Dennis, 2002, *p.* 103).

#### 3.3.4.2 Motivation

Even though Lean is characterized by team work and process ownership, the standardization of processes reduces work autonomy almost completely. Consequently, this makes the jobs less motivating (De Treville & Anatonakis, 2003, online). In a modern organisation staff look to make a contribution and, as a result, they are a major source of the company's ideas and the holders of the company's reputation. Moreover, staff design and produce the products and services the company sells. Profit and the success of the company depend upon motivated staff. There are many aims and goals associated with having motivated staff, some of them are listed here:

- Committed staff that are interested in the results and take responsibility for actions.
- Increased communication in the workplace having open communication between both managers and staff where feedback is provided and listening is encouraged.
- Low staff turnover from increased loyalty and satisfaction.
- Improved creativity and initiative as staff are involved in solving problems and encouraged to experiment with their own solutions.
- Collaborating to provide an excellent customer service, both internally and externally (Messmer, 2001, online).



There are two ways to motivate staff: Extrinsic, which includes cash and gifts while intrinsic motivation includes work loads, people and managers behaviours, along with self-fulfilment and a sense of achievement. The Intrinsic motivation factor claims to be the most powerful motivation factor. In addition, there are many psychological theories of how people are motivated. The most discussed theories are: Maslow's hierarchy of needs, which is built upon the human needs. Each personal need is the development of what is motivating the person, and the Herzberg's two-factor-theory which is built upon two factors: (a) Hygiene-factors, which are natural things that are not motivating people but can cause dissatisfaction. (b) Motivational factors are things the person find vital and have a strong wish to achieve. Motivational factors can be challenges, achieved results and responsibilities (Söderqvist, 2004, *pp.*151-153).

Motivation forms a foundation of how the working culture should be structured. Dennis (2002, *p.* 111) addresses five important factors which should be considered when motivating staff: Openness, Mutual trust, Teamwork, Customer focus and Training. These should then be part of the culture in the company.

When implementing Lean, the organisation must go through a change. The management will most likely experience a resistance to the change. Since Lean is a process related to efficiency improvements, the staff will almost certainly be scared of losing their jobs. It is then vital to continue to assure that Lean provides job security; to convince the staff and gain trust the staff must be motivated to work with Lean. Trapping (2005, online) suggests five ways of how to motivate staff to believe in the change.

1. Continually look for ways to involve staff in the change process.
2. Find informal, day-to-day champions and use them wisely.
3. Ensure the use of rewards and recognition for team and individual contributions.
4. Create visual aids about the changes well in advance.
5. Communicate to everyone involved with the proposed changes ahead of time.

### 3.3.4.3 Culture

The culture of an organisation or workplace is as vital as the air it breathes. It arises from experience and can therefore be seen as a result of the management system. The culture should not be a target; the target is the things which can be seen, such as leaders' behaviour, expectations, tools, and routine practices (Mann, 2005, online). An organisation's culture has an extraordinarily powerful impact on organisational performance. It determines whether things are right or wrong, legitimate or illegitimate and acceptable or unacceptable (De Feo & Barnard, 2004, *p.* 266).

The Lean system is full of paradox and therefore, endlessly engaging. As a result, the system should be approached as an overview, realizing that it may take a lifetime to grasp. It is essential to have a Lean culture when working with Lean. In order to maintain a Lean Culture, the management has to be involved. Not only can the 5S system be visualised, the management can also be visualised. The visualisation means more pictures and fewer words. The Visual Management Triangle, Figure 13, is one way to do it (2002, *p.* 136).

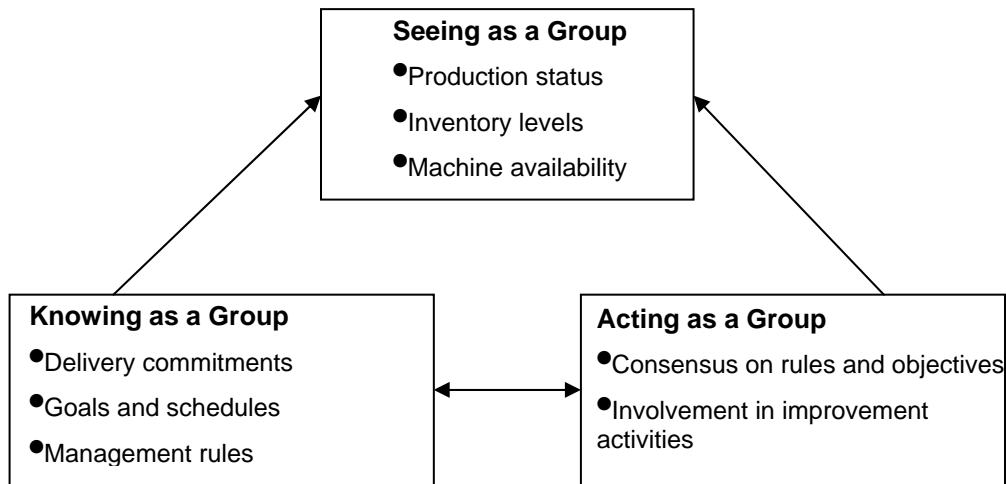


Figure 13. The Visual Management Triangle (Source: Dennis, 2002, p. 29).

### 3.4 Why Lean? Why not Lean?

As presented in this paper, Lean is a useful concept with endless efficient improvement activities. Lean has helped many organisations to recover from bad times and to become market leaders. However, it is important to be aware of the risk with Lean if not fully implemented, understood and maintained.

#### 3.4.1 Why Lean?

As presented in this theoretical framework, there are many advantages with implementing Lean into the organisation. The major advantages can be summarised as: gained flexibility through shorter lead time, decreased fixed assets through significant smaller storage, a strengthening of the staff and co-workers driving force and motivation by:

- Decreased stress.
- Increased competence.
- Decreased frustration.
- Improved communication.
- Gained understanding of the whole site.
- Broadened and more developed responsibilities.
- A more safe and secure workplace.
- A more safe and secure employment.

May (2005, online) presents benefits the Lean concept provides the organisation with in five particular areas besides manufacturing; those areas are:

1. Cultural change, value and people are in focus, which lifts up the human spirit.
2. Strategy focus, the organisational purpose and strategy for customer's requirements.
3. Process design, the business process supports the strategy; as a result they become more efficient and effective.
4. Problem solving; a problem solving ethic pervades the organisation, creating purposeful and high energy interaction.
5. People development, staff see themselves as central to the organisation's success, which make it easier to subordinate individual gain to the overall good of the organisation.

The benefits of Lean are not only seen and appreciated within the organisation; the external actors are also strongly influenced. Lean can be used as an excellent marketing tool, simplifying the process when choosing suppliers and customers. It is always an advantage if a company has implemented Lean in their organisation. Both the customer and supplier are aware that the organisation is constantly questioning and evaluating their value stream and developing. Lean strengthens the organisational competition on the market, which provides the end customers with good prices (Johansson et al., 2005, pp. 14, 15, 63, 64).

### 3.4.2 Why not Lean?

Even though there are many advantages and benefits with Lean, it is essential for the organisations, which are about to and have implemented Lean, to be aware of the negative consequences that might occur. If the entire site does not see the effect of Lean, the opposite of what is intended may arise. It is therefore vital to have a well developed, maintained and agreed plan over how Lean is implemented. This plan ensures that Lean will be implemented over an entire site perspective in order to not waste resources on unnecessary projects (Olsson, 2006, online).

The most common risk companies come across with the implementation of Lean is that the proposed changes are not completely carried out. Because of an impatient organisation they are left in an early stage. The company has to be aware of the fact that the implementation can be a long process; creating a foundation for Lean may take more than a year. The organisation has to create the right conditions for the whole value stream in order to succeed (Johansson et al., 2005, p. 15). Another problem with implementing Lean is the passing on of waste from activity to activity. Consequently, the waste is not reduced, just moved from one place to another (Liker, 1998). Equally important for the company is to be patient and not throw themselves into the improvement work, which can cause the opposite effect, the product in process and value stream might increase (Johansson et al., 2005, p. 14).

Liker (1998, online) claims that after studying a case of seven small automotive parts plants that launched continuous improvement programs at the same time, only three had any degree of success after two years; the other four gained little from their effort. By the time he finished the study he noticed that the most advanced plant still had a long way to go to implement continuous flow, a pull system, standardization work, and the other technical features of Lean. They were, however, heading in the right direction. The study certainly showed that the company needed to get people on board to become active in continuous improvement, the critical aspect of long term success. Without a total commitment Lean is most likely to fail.

### 3.5 A successful implementation

Lean goes through different stages when developing within the company. The implementation and Lean development within the company can be divided up to three stages; Stabilize, Flow and Sustain.

**Stabilize.** To start the implementation, the managers must make sure every member of the staff understand customers' value and why they must serve that demand. Furthermore, each value must be specified for each target from the point of view of the customer. The target can concern anything that can be improved in the company. In order to do so, the costumers and their needs must be identified to add value. To gain understanding for what the customer considers as value or not, two questions can be asked; does the customer wants to pay for it? And does the activity change the products or service shape, usability or function? However, SIFU claims that most things that are done are waste. At this time workplace barriers will also begin to be removed through the 5S System (Johansson et al., 2005, p. 15; Kremer & Fabrizio, 2005, online; SIFU, 2006, online).

**Flow.** This is the core of Lean implementation. The value stream should be identified by value stream mapping, which identifies the value and waste in the processes in order to provide internal and external customers with the right product, at the right time, and in the right quantity. It also ensures that value is constantly being added to the value stream process. During this stage many Lean tools are useful, for instance TPM, 5S and Jidoka can be used (Kremer & Fabrizio, 2005, online; SIFU, 2006, online).

**Sustain.** System and routines should be established in order to maintain and provide understanding for the value adding new developed value stream. The work should also, at this stage, be distributed evenly by volume and variety to allow smaller orders, reduction in process variation and the elimination of mistakes. Total employee involvement and continuous improvement is essential (Kremer & Fabrizio, 2005, online; SIFU, 2006, online).

Besides the implementation process and its three stages, a lot of other essential issues need to be considered throughout the implementation and the future of Lean. By applying Lean and its techniques on an organisation, the company is most likely to be able to reduce human effort by three quarters with little or no capital investment. It is therefore very important to guarantee that no one will lose their employment in the future due to the introduction of Lean. In order to avoid reduction of staff, the company needs a strategy of how to handle their resources gained from improvement. Even though the organisation is expecting a bright future from having implemented Lean, in most organisations less then 10% are anchor-draggers, who have difficulties to accept and adapt to new ideas.

This minority can be troublesome when moving the process forward as they can jeopardize the success by sending negative messages and identifying all the mistakes as Lean is implemented.

Gaining the commitment of staff is a vital issue when implementing and working with Lean. Lean should not only be implemented in the daily work, but rather it should be part of the organisational culture and infiltrate the entire organisation. Every staff member should have the opportunity to pass on and increase their knowledge. The continuous improvement, Kaizen, work is therefore the heart in the Lean concept (Shinkle, Gooding, & Smith, 2004, online). It is critical to get the staff to understand at the outset that no level of performance is ever good enough, and improvements can always be made. A cycle should develop whereby every machine can be moved, every job changed and the root of variances eliminated, (Womack & Jones, 2003). It is not uncommon for organisations to think they work with continuous improvement but many of them do not understand the significant differences or possible improvement to a full implementation. A lack of structure, how to transform ideas into practise and achieve improvement are the most common reasons for failure. Moreover, the improvements done must be standardised to be part of the daily work and knowledge by every member of staff (Shinkle, Gooding & Smith, 2004, online).

### 3.6 Lean and the staff

The key to successful Lean is through the staff. Lean is all about people meaning it can be adopted by the majority of organisations. Veech (2004) claims that what makes the difference between a Lean organisation and a usual organisation is the way it treats its people. A Lean organisation's primary focus is on improving people, recognising that a workforce with a higher skill set will accelerate any program of continues process improvement. Consequently, the company must create a favourable environment for growth. A favourable work environment is desired and often obvious. They often include such common characteristics as: no blame attitude, clear leadership and direction, participation from everyone, creative ideas, trust and respect, training, learning and communication are high priorities, and many types of teams, managers are always involved in positive ways. Total Employee Involvement (TEI) is vital in order to sustain Lean. TEI taps into all levels of knowledge and experience in the organisation and links specific knowledge into a cross section of best practices and management support.

Positive recognition and visual measurements help to keep people involved (Womack & Jones, 2003, *p.* 264). The co-workers and management must have mutual respect, which also shows employment security. Workers must have confidence that improvement will not result in job losses. It is vital to inform staff of the consequences of over production and a lack of efficiency, (Dennis, 2002, *p.* 103). Kremer and Fabrizio (2005, online) claim that people learn and function better and are more satisfied with their work and more motivated when in groups than when they work alone. Teamwork should encourage learning, growth, and involvement. Consequently, TEI is the key to Lean and should appear at all levels of the organisation (Börnfeldt, 2006, *p.* 24).

When implementing Lean in an organisation or in the production it is always equally important to implement Lean on the staff. Typical Lean events focus all their energy on improving a particular process. During this process the team members have to be treated with dignity and respect and focus on employee improvement activities on other processes. This is a fundamental shift in attitude for leaders. This further requires us to rethink our definition of success and how we evaluate managers (Veech, 2004, pp. 162-165).

Toyota is an excellent example of how Lean should be implemented. They clearly express that the team members who make small improvements every day, or who solve countless minor problems during their work day, make the Lean system work on a sustainable basis (Toyota Motor Sales, 2006). This also proves that Lean is adoptable in many kinds of organisations. Lean is all about people and therefore no one can argue that Lean would not apply to their business, as long as they have people (Veech, 2004, p. 160).

The organisation must have stability between processes and people in order to be flexible and meet the demands from the customers. Veech (2004, p. 162) mentions four elements of stability that that organisations must put in place and maintain:

- *Trust* between the management and the workforce, between the different departments within the company and between members of the teams.
- *Commitment* from leaders with a strong vision throughout the organisation. In addition, the culture should communicate servant leadership and loyalty, and citizenship behaviours from employees including the discipline required to hold on to standardised work practices.
- *Situational awareness*; have complete understanding of what's going on in the organisation and the process environment.
- *Trained and empowered workforce*; it is the leader's responsibility to equip the workers in order to accomplish tasks.

A thorough explanation of the importance of trust commitment and motivation is given in Figure 14. Without the motivated staff the rest of the Lean implementation is most likely to fail.

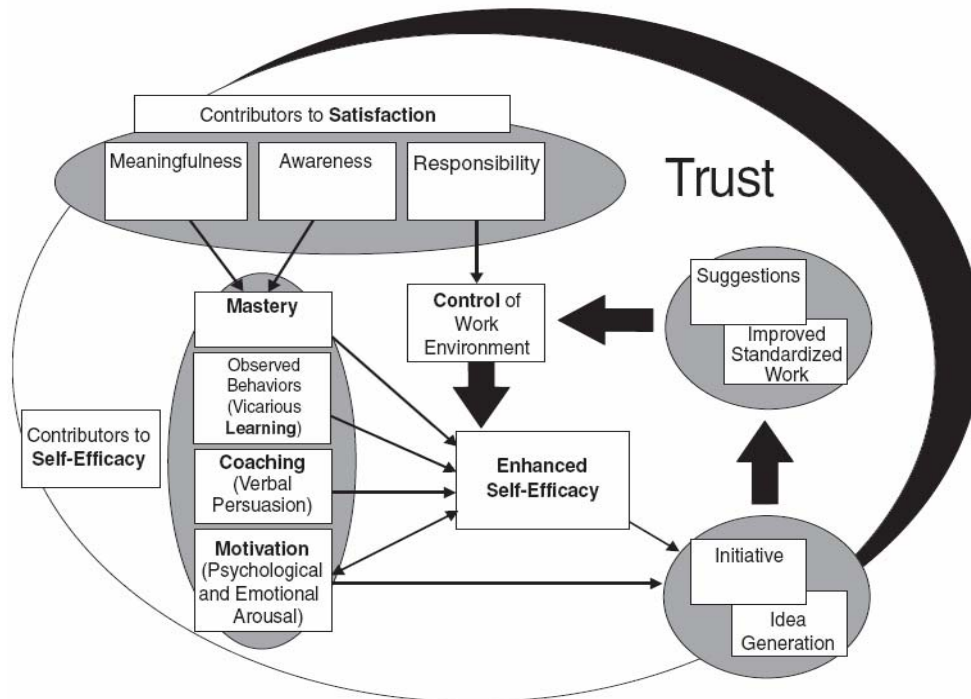


Figure 14. Job design for Self-Efficiency (Source: Veech, 2004, p. 166).

In order to achieve these elements the leaders need to understand a little more about people in the work place in order to obtain a work environment that satisfies and motivates its team members. The leader should be able to identify the factors of motivation necessary for each worker to become more confident and productive. The people with high self-efficacy are the ones most likely to master the motivation to attempt the work and then to try and improve the work being willing to try new things.

#### 4. Methodology

This part of the dissertation will describe the methods used to conduct data to meet the goal of the study. The aim of the research is to gather enough information to gain an understanding to draw a conclusion as appropriate for the company's current state as possible.

The data collection consists of two parts, primary and secondary data collection. The secondary data collection is mainly based on research articles collected from e-journals, databases, libraries and internet. The secondary data creates the framework, direction and limitations for the primary data.

The primary data collection aims to answer two questions.

*How should SE take their first step to become a Lean organisation:*

- *with the considerations of their staffs' attitude towards a change in relations to Lean?*
- *with the considerations of their current working- and Lean-activities?*

*Question one* is answered by a quantitative and a qualitative study consisting of a number of interviews and a questionnaire.

*Question two* is answered by the author having gained extensive knowledge from various resources as a Lean conference held outside SE, three external visits to other organisations currently performing Lean, a pre-interview with a Lean consultancy and gained further knowledge of the company's Lean activities by spending time at different departments, with staff and managers from different part of the sections at SE.

The result from the gained knowledge aims to answer question two, and is presented as short summaries of the experiences, further discussed and then contributes to the conclusion as suggestion of how to continue the Lean implementation at SE with the consideration of question one, the staffs' attitude toward changes.

## 4.1 Participants

The participants of the research were either part of the organisation, SE, or had a strong relation to the subject, Lean.

The interviews were held at SE with their staff and managers participating. The numbers of participants were six and had different areas of employment at SE. The participants were selected by the help of the authors' supervisor at SE, and primarily consisted of staff and managers showing a particular interest in the improvement activities at SE, in order to provide the author with good information and statues regarding current work at the company. To facilitate a broad view of knowledge from the interviews, the participants belonged to five different sections at SE; Production staff from PA, PC, PB, a manager from PB and construction staff from GCM.

In addition, a pre-interview was complete to broaden the authors' view of knowledge. The participant of the pre-interview was a consultancy, Ola Johansson, with a great competence of Lean. The consultant is working for PART development, which business is to supervise companies in Sweden with their implementation, maintenance and development of Lean.

The target audience for the quantitative research consists of staff and managers associated with production belonging to the P-division. The number of people included in the audience was approximately 110 people. There was a high rate of participants of the questionnaire 76 individuals, 70%.

## 4.2 Instruments

The instrument varies depending on the type of method and participants of the resource.

### 4.2.1 Pre-interview with Lean consultancy

The pre-interview was a non structured interview, with a focus on the implementation phase of Lean. The aim of the pre-interview was to collect data which could develop the authors' understanding of Lean to facilitate as appropriate an answer to question two as possible. The pre-interviews main focus was: how to maintain an implementation of a Lean organisation, how to structure a Lean organisation, how to continue the Lean work at SE with the concerns for the current state, and PART developments' role as external partners.



### 4.2.2 Interview guide

The qualitative research consists of a number of structured interviews. The aim of the interviews was to achieve a depth in the questions posed in the questionnaire. The interviews were divided up to five different categories: Suggestions for improvement, Waste elimination and understanding for work process, Standardised working methods, Maintenance of Equipment, Team climate, Orderliness and routines at work. The five different categories are based up on the structure of the Lean house (chapter 3.3), and signifies the foundation of a Lean organisation. In Appendix A, the outline of the interviews can be studied further.

### 4.2.3 Questionnaire

The quantitative study took the form of a web-questionnaire. The questions in the questionnaire were used to measure attitudes toward changes and the staffs opinion and current state of an overall change and the foundation of Lean. The questionnaire was divided up to five categories, Improvements, Waste elimination, Teamwork, Routines and Orderliness and Attitudes toward organisational changes. The question categories were outlined to investigate the current state of the organisation in relation to the foundation of the Lean house (Chapter 3.3) Each category of questions consists of between three and 10 questions. The questionnaire can be further studied in Appendix B. It was formed with multiple-choice questions where the participants had the option to rate their strength of their opinion between 0-5, where zero is related to negativism and five is related to positivism. The data was further summarised and conduct with the help of SPSS. A number of answers to questions were outlined in a reversed manner in order to be summarised in a consequent way.

### 4.2.4 Educational visit to external organisations

The author made three external visits to other organisations that have implemented Lean and are working towards a Lean culture. The aims of the visits were to gain an understanding on how to implement and maintain a Lean organisation, learn from the other organisations' experiences and take advantage of their practice. The external visits were made by the author and a number of production managers from SE. The visits were mainly focused on the organisations' production sites and how they were handling issues concerning Lean.

### 4.2.5 Lean conference

The author participated in a two day Lean conference, which brought up various examples and experiences of the implementation of Lean in a number of companies. Furthermore, an experienced Lean manager from Toyota shared and educated his experience by engaging the participants in a workshop.

The topics brought up during the first day of the Lean conference were:

- Manufacturing Coast through Lean Product Development.
- New patterns within the building industry.
- Lessons learned of Lean in health care.
- The Supply Excellence Project at Ericsson and Solectron.
- A travel agencies group-journey towards Lean.
- Lean within the produce industry.
- Lean and 6 Sigma, a successful combination.
- 1000 products through 7 product flows, is that possible?
- Disappointment with Lean: Are we missing a Key Piece?

The second day of the conference consisted of a workshop, with the topic: To Lead through changes. The purpose of this session was to introduce three Toyota management practices that are not Lean techniques themselves but are keys to Toyota's development of the Toyota Production System and its continued success refining it.

#### 4.2.6 Spending time at different departments

The author took advantage of the opportunity to spend time with managers and staff at SE to gain knowledge of the company, the organisational structure, the organisational culture, their way of working in processes and how far Lean activities have been preceded. The author spent approximately half a day/a day at each section. The time spend on different sections did not only provide the author with background knowledge of the company; the involvement gave the author an opportunity to take advantage of the manager's opinions, experiences and impressions of the implementation of Lean. The author particularly spent a lot of time with Thomas Lundström who also supplied the author with Figures for the dissertation.

### 4.3 Procedure

The procedures of the different researches were differently outlined depending on the aim of each individual research.

#### 4.3.1 Pre-interview with Lean consultancy

The pre-interview was held at SE, the Lean consultant showed examples of PART developments work done with other companies implementing Lean. Before and after pictures of examples of PARTS experiences were showed as well as other models from real Lean implementations. The pre-interview lasted approximately three hours and the result from the pre-interview is outlined as a summary of the consultancies experiences and advises.

#### 4.3.2 Interview guide

The interviews were tape recorded and transcribed. The interviews were approximately an hour long, depending on each individual being interviewed. The interviewees were also given the opportunity to express their own thoughts about Lean and its implementation.

### 4.3.3 Questionnaire

The questionnaire was outlined to be a web-questionnaire; the author's supervisor at SE and the author emailed the underlying assumption of the research together with the questionnaire as an attachment. The targeted staff for the questionnaire also had the opportunity to find supplementary information about Lean on the company's internal network.

### 4.3.4 Educational visit to external organisations

The visits were made as a group; production managers and the author, with the visits lasting from four to six hours. The visitors were given a summary of the organisation and a more thorough outline of the Lean work at the organisation. Every hosting company gave the visitors a tour around, primarily, the production site where Lean was mainly implemented.

### 4.3.5 Spending time at different departments

The author was provided with a supervisor for each section visited. The supervisor for the day gave the author an input of how the processes are accomplished and the routines of everyday work are processed at the particular visited section. The author particularly spent a lot of time with Thomas Lundström who also supplied the author with Figures to dissertation

### 4.3.6 Lean conference

The Lean conference was arranged by an external organisation serving as a Lean network between companies in Sweden working, or having a certain interest, in the Lean concept. The conference was held at the University of Chalmers in Gothenburg.

## 4.4 Data analysis

The data analysis is presented individually in the result chapter of the dissertation. The result is then discussed and used as a foundation for the drawn conclusion.

### 4.4.1 Pre-interview with Lean consultancy

The information gathered from the pre-interview with a Lean consultancy was summarised and presented as part of the result. Furthermore, the data was discussed and served as a major source of information supporting the outline of the conclusion.

### 4.4.2 Interview guide

The result from the interviews was summarised and presented separately from the other results, as one of the major parts of the result. When summarising the interviews, the author paid particular attention to the sources answering the question of the dissertation. Since the purpose of the interviews was, for the author clear, the unimportant information provided by the interviews could easily be eliminated. Moreover, the results from the interviews were discussed and integrated jointly with the other results, which contributed to the conclusion.

### 4.4.3 Questionnaire

The results from the questionnaire were outlined in a number of different ways. The questionnaire consisted of two questions providing the answerer the opportunity to comment on different issues. These comments from the two questions were summarised and presented as a part of the result from the questionnaire. The remaining questions were analysed statistically with the help of SPSS (Statistical Package for the Social Sciences). SPSS enabled different varieties of analyses of the data, which was analysed with the weight on the relationships and comparison between the different opinions of the sections and question-categories. Furthermore, the construction of the questionnaire made it possible to get diagrams of the number of answers at each question; this data was also used in the result section. Moreover, the result from the SPSS was presented and further discussed jointly with the other data. The result also plays a major part in the conclusion and answer of question one.

### 4.4.4 Educational visit to external organisations

The most vital data gathered from the number of external visits were summarised and presented as a separate part of the result. It was further discussed and played a major role of the foundation of the conclusion in terms of how the company should carry out a sustainable Lean implementation.

### 4.4.5 Spending time at different departments

The information gained from spending time at different sections with staff and managers provided the author with significant information useful in order to adjust the additional result to the organisations' current working processes. The information, which is related to and could have an impact on the dissertation, was summarised and presented as a part of the result as: Visualisation boards, Lean Workshop, Value Stream Analysis, Improvement groups, 5S, and Measurements. It is further discussed and had impact on the conclusion of the dissertation.

### 4.4.6 Lean conference

The knowledge gained from the Lean conference was summarised and presented as a part of the result. The data was considered in the discussion and then supporting the outline of the conclusion.

## 5 Result

The result from the different research resources will be outlined individually but divided into two different sections depending on which one of the two questions posed it answers.

### 5.1 Question one: staffs' attitude towards a change in relations to Lean?

At this chapter will the result answering question one be presented. It is divided up into different sections depending on resource.

#### 5.1.1 Descriptive analysis of questionnaire data

The mean value indicates the average answer on each question, question-category or section; each question has five possible answer alternatives 0-5, where 0 low and 5 high. In some cases the alternative answers are reversed, which will be notified at each case.

The first statistical analysis has been done by analysing each category of question separately; the questions within each category have also been analysed to examine the reliability (homogeneous answers or not) between the questions with the help of Cronbach's alpha (limit for acceptable level = .70, see Bobko, 2001). An analysis of the correlations between different question-categories was conducted.

***Suggestions of improvement.*** The category concerning Suggestions for improvements had three questions posed about improvements of the work and work processes. One of them asked about the management's concern about supporting implementations of their co-workers' suggestions of improvements of work related issues and processes. The correlation between the answers to this question and the two other improvement questions were of low magnitude but statistically significant. It seems that implementation isn't that much related to support from the manager. There was about the same variation in giving suggestions to improvements at work and implementing their ideas and suggestions to improvements (see Table 15). Twelve percent of the participants answered that they often suggest improvements of the work and work processes.

In addition, the Table 15 shows that the staff belonging to the P-division gives more suggestions to improvements in their work and are supported by their manager in comparison to how commonly they actual implement their ideas and suggestions how to improve their work.

According to Bobko (2001), Cronbach's alpha is acceptable when  $\alpha = .70$ , which means that an index could not be created out of the three suggestions to improvement variables. However, Bobko (2001) also claims that at this type of explorative study the acceptable level is  $\alpha = .65$ . Since the Cronbach's alpha for these three variables was  $\alpha = .64$  and very near to the acceptable level an index was created,  $index\ mean = 3.08$ ,  $SD = .957$ , which will be used in further analyses.

**Table 15.** Means, standard deviations and correlations: Suggestions to improvement

	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>r</i>	
				1	2
1. How often do you give suggestions to improvements in your work?	75	3.16	1.115		
2. How common is it that you implement your ideas and suggestions how to improve your work?	75	2.91	1.141	.53***	
3. To what extent do you find that your manager supports you to implement your suggestions to improvements?	70	3.30	1.232	.25*	.44***

Note 1. The scales ranged from 0 to 5, 0 = Never, and 5 = Often. Don't know = missing data.

Note 2. *r* = Pearson Product-moment correlation.

\*  $p < .05$ , \*\*\*  $p < .001$ .

**Waste elimination.** Two questions were posed about reasons for work and in what way work contribute to customers', internals' and externals'; answers to these two questions showed a significant correlation of a greater magnitude, i.e., reasons for the work and how the work contributes to internals' and externals' demands were strongly related (see Table 16). The *mean* for these two questions was fairly high and did not show significant large standard deviations, which means that the staff has a good understanding for the purpose with their work and what their tasks contribute to internal and external customers.

Only this question, the third one, was posed about waste elimination; i.e., to what extent work consists of unnecessary work issues. However, there was a substantial variation in answering this question (see Table 16). The *mean* was 2.96 but a substantial variation was shown in the answers to this question. As a result this shows that staff's opinion about unnecessary work in their work processes is very spread from person to person with a middling *mean*.

Before computing an index of this group of questions, a Cronbach's alpha analysis was conducted, and since the alpha was acceptable (.71), an index of these three variables was computed; *index mean* = 3.89, *SD* = .762.

**Table 16.** Means, standard deviations and correlations: Waste elimination

	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>r</i>	
				1	2
1. To what extent do you know the reason why your work has to be done? <sup>a</sup>	75	4.39	.787		
2. To what extent do you know what your work task contributes to internal and external customers? <sup>a</sup>	74	4.35	.883	.70***	
3. To what extent do you find your work consists of unnecessary work issues and work processes? <sup>b</sup>	75	2.96	1.257	.33**	.29**

<sup>a</sup> The scales ranged from 0 to 5, 0 = Not at all, 5 = Very good. Don't know = missing data.

<sup>b</sup> The scale ranged from 0 to 5, 0 = High, 5 = Low. Don't know = missing data.

Note. *r* = Pearson Product-moment correlation.

\*\*\*  $p < .001$ , \*\*  $p < .01$ .

**Teamwork.** Three questions were posed about team climate. The answers to all three questions were strongly correlated (see Table 17). Table 17 shows that the staff feels good with their co-workers and considers them to work well in a functional team work. However, the question about wish for better working team climate has a lower mean value, which means that some staff wish for better team climate, and the high standard deviation number should be taken into consideration which shows that the opinion about this question is shared.

Cronbach's alpha was high (.86), which enables computing an index of these three variables; *index mean* = 3.86, *SD* = 1.05.

*Table 17.* Means, standard deviations and correlations: Team climate

	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>r</i>	
				1	2
1. To what extent do you feel good together with your co-workers? <sup>a</sup>	75	4.44	.809		
2. Do you function as a team? <sup>a</sup>	73	4.14	.933	.80***	
3. To what extent do you wish that the team climate was better in your work site? <sup>b</sup>	71	3.03	1.502	.62***	.61***

<sup>a</sup> The scales ranged from 0 to 5, 0 = Not at all, 5 = Very good. Don't know = missing data.

<sup>b</sup> The scale ranged from 0 to 5, 0 = Very much, 5 = Little. Don't know = missing data.

Note. *r* = Pearson Product-moment correlation.

\*\*\* *p* < .001.

**Orderliness and routines at work.** Most of the respondents feel a need for searching for information and tools to some large extent (see Table 18). However, there was a great variation among the respondents in answering this question. Question one (see Table 18) shows that many people do waste a lot of their time to look for tools and information, and even the variation was high this answer is noticeable. There was fairly strong relationship between question two and three, both results indicate that staff are slightly more than satisfied with the orderliness at work, while the *mean* for question three indicates that equally many staff would like better orderliness at work. The strong relationship between questions three and four tell us that staffs wishing for better orderliness also wish for routines to be better kept in control.

There were also rather high variations in the answers about the respondents' opinions about orderliness at their work site, wish that the orderliness was better, and wish that the routines for order were better kept in control (see Table 18). The two questions about a wish of better orderliness and routines for order kept in control were posed in reversed order compared to the other two variables in this group of questions, why they needed to be reversed before analysing them any further. These two variables were strongly correlated (see Table x). As a result, Cronbach's alpha was acceptable (.69), which enabled computing an index of the four variables; *index mean* = 2.36, *SD* = .904.

*Table 18. Means, standard deviations and correlations: Orderliness and routines at work*

	<i>N</i>	<i>Mean</i>	<i>SD</i>	<i>r</i>		
				1	2	3
1. How often do you waste your daily time searching for information and tools? <sup>a</sup>	75	2.35	1.370			
2. How do you consider the orderliness at your work site? <sup>b</sup>	75	3.13	1.082	.27*		
3. To what extent do you wish that the orderliness was better? <sup>c</sup>	74	3.08	1.290	-.01	-.66***	
4. To what extent do you wish that the routines for order were better kept in control? <sup>c</sup>	74	3.04	1.265	.08	-.55**	.79***

<sup>a</sup> The scale ranged from 0 to 5, 0 = Often, 5 = Never. Don't know = missing data.

<sup>b</sup> The scale ranged from 0 to 5, 0 = Bad, 5 = Very good. Don't know = missing data.

<sup>c</sup> The scales ranged from 0 to 5, 0 = Not at all, 5 = Much better. Don't know = missing data. *Reversed*.

Note. *r* = Pearson Product-moment correlation.

\*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$ .

***Attitudes toward organisational changes at work.*** Ten questions were posed about attitudes towards organisational changes at work. All correlations were statistically significant related, although some showed a low magnitude (see Table 19). Question nine; “to some extent I am resistant to changes that concern my work” were posed in reversed order compared to the other variables in this group, and low values are positive values and vice versa. The mean value indicates that staff attitudes toward organisational changes are generally good. The two questions with the most positive *mean* were the questions concerning “if I consider myself as open toward changes” (question one) and “to some extent I am resistant to changes that concerns my work” (question nine). This information shows that the staff is generally open toward changes and show little resistance towards changes concerning their own work and since there is a significant correlation between those two question and question ten “staff rather believes that great changes develops the company at the end”. However, the fairly high variation should be taken in to account, which indicates that the opinion is shared amongst the staff. Question number two shows that a large number of staff believes that they deal with changes better than most co-workers.

Cronbach's alpha was very good (.82), and an index was computed for attitudes towards organisational changes at work; *index mean* = 3.61, *SD* = .711.



Table 19. Means, standard deviations and correlations: Attitudes toward organisational changes at work

	N	Mean	SD	r										
				1	2	3	4	5	6	7	8	9		
1. I consider my self as open towards changes?	76	4.20	.833											
2. I deal with changes better than most co-workers?	62	3.45	.862	.51***										
3. When great changes occur in this company I can handle them very good?	75	3.65	1.020	.46***	.57***									
4. Changes give me possibilities?	74	3.59	1.033	.38***	.44***	.53***								
5. Rapid changes are something I can handle.	74	3.51	.925	.40***	.46***	.52***	.61***							
6. Facing changes I try to react rationally and not by affect.	73	3.96	.920	.32***	.51***	.45***	.29*	.30**						
7. I welcome changes instead of complaining.	74	3.64	.945	.57***	.60***	.52***	.73***	.63***	.39***					
8. I welcome changes in this company even though I don't know what they will mean to me.	67	3.19	1.048	.51***	.48***	.48***	.31**	.57***	.37**	.48***				
9. To some extent I am resistant to changes that concern my work	73	1.60	1.24	-.54***	-.25*	-.29*	-.38***	-.36**	-.24*	-.54***	-.36**			
10. Great changes develop the company at the end.	63	3.41	1.02	.31**	.27*	.39**	.59***	.40***	.31*	.52***	.44***	-.45***		

Note 1. The scales ranged from 0 to 5, 0 = Almost never, 5 = Almost always. Don't know = missing data.

Note 2. r = Pearson Product-moment correlation.

\*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$ .

### 5.1.2 Correlation of index variables

To investigate a more over-arching view of the relationships a correlation analysis was conducted of the five resulting index variables of different categories of questions. The main finding was that waste elimination and need for better orderliness and routines at work both were asked for. The *index mean* for Waste elimination is 3.89 and the *index mean* for Orderliness and routines at work is 2.36.

Table 20 shows the correlations among the five different categories of questions. It signifies that the two categories “Waste elimination” and “Orderliness and routines at work” were strongly correlated (see Table 20).

*Table 20.* Number of respondents, mean and standard deviations, and correlations among index variables

	N	Mean	SD	1	2	3	4
1. Suggestions of improvements	76	3.08	.96				
2. Waste elimination	76	3.89	.76	.22†			
3. Team climate	76	3.86	1.05	.15	.19		
4. Orderliness and routines at work	76	2.36	.90	.12.	.40**	.18	
5. Attitudes toward organisational changes	76	3.61	.71	.30**	.09	-.08	.03

\*\* Correlation is significant at the 0.01 level (2-tailed); † = .059.

### 5.1.3 Multiple regression analysis

A multiple regression analysis where the index variable: “orderliness and routines at work” was dependent variable (i.e., criteria variable) and the rest of the index variables were independent variables (i.e., predictor variables) showed that only waste elimination could significantly explain the variance in need for orderliness and routines at work (see Table 21).

*Table 21.* Multiple regression analysis: Independent variables; suggestions to improvement, waste elimination, teamwork and attitudes toward organisational changes at work; dependent variable: to orderliness and routines at work

Index	Mean	SD	Beta	t	p
1. Suggestions of improvement	3.08	.959	.02	.16	> .76
2. Waste elimination	3.89	.763	.38	3.37**	< .001
3. Team climate	3.86	1.05	.10	.90	> .37
4. Attitudes toward organisational changes at work	3.61	.711	-.14	-.01	> .99

Not. Adjusted  $R^2 = 12.5$ . ANOVA  $F(4, 75) = 3.68$ ,  $p < .009$ .

### 5.1.4 Variance analysis (ANOVA)

A One-way ANOVA was created to be able to find out whether or not there was a significant difference between the respondents at each of the sections in answering the posed questions (in this analysis only the five index variables was used as independent variables). The participants from the various sections showed a statistically significant difference in answering variables summed in two index variables, i.e., suggestions to improvement (PT – PA) and team climate. Suggestions to improvement significance was  $p = .048$  and team climate's significance was  $p = .007$ , which makes it to a significant difference between the different sections within these two question-categories. Moreover, there was a tendency to significant difference among the various sections in attitudes toward organisational changes ( $p = .056$ ) and orderliness and routines at work ( $p = .097$ ). According to Bonferroni Post Hoc analysis, the PA section answerers related to the question-category team climate differed from the PT section's *mean*, PA showed a lower *mean* than PT at this particular category of questions (see Table 22). This indicates that PA are generally less satisfied with their working friends, their teamwork and wish for a better team climate at their section in comparison to section PT.

According to Bonferroni Post Hoc analysis, the PC section answerers related to the question-category suggestions to improvement differed from the PA, PB, PT and PL sections' *means*; PC illustrates a significant lower *mean* than PA, PB, PT and PL (see Table 22). This proves that the PC section in relation to PA, PB, PT and PL is not as good to come up with suggestions of improvements, implement them and be supported by their manager.

In addition, the test also showed a tendency to significant differences between sections PB and PS concerning the question-category "attitudes toward organisational changes". The *means* indicate that PB is slightly more open toward changes than PS is.

Table 22. Means and standard deviations: Suggestions to improvements of work and work processes and Team climate as a function of sections

Sections	Suggestions of improvements <sup>a</sup>			Team climate <sup>b</sup>		
	N	Mean	SD	N	Mean	SD
PI	8	3.25	.66	8	3.85	.60
PK	9	3.07	.66	9	3.93	.80
PC	8	2.71	.77	8	2.50	1.57
PA	13	2.35	.94	13	4.00	.93
PB	14	3.24	1.20	14	4.17	.91
PT	7	3.71	.95	7	4.43	.81
Stab.	5	3.10	1.30	5	3.83	.75
PS	7	3.24	.60	7	3.52	1.14
PL	5	3.73	.43	5	4.47	.38
Total	76	3.08	.96	76	3.86	1.05

<sup>a</sup>  $F(8, 75) = 2.10, p < .05$ .

<sup>b</sup>  $F(8, 75) = 2.94, p < .01$ .

### 5.1.5 Comparison with Swedish norm data: Attitudes toward organisational changes at work

The value for organisational change at work of the participants did not differ significantly from Swedish norm data [ $t_{(75)} = -.467, p = .64$ ]; study mean = 3.61, SD = .957; Norm data mean = 3.65 (Karlsson & Archer, 2005).

### 5.1.6 Personal comments expressed in questionnaire

Out of approximately 110 people who were asked to answer the questionnaire, 76 answered. The last question consisted of an open space left for the target staff to fill in their own comments and thoughts. Twenty-six out of 76 (34%) persons responded with comments. The comments were showing that the staff has a generally positive attitude toward the Lean work they have experienced so far. However, there was a tendency that the staff working with administrative tasks felt left out from the Lean activities going on at SE and had difficulties to relate and adapt the Lean activities they had experienced.

It was clearly expressed that staff think that an implementation of Lean activities will help to improve orderliness, routines and increase knowledge of individual goals, which will improve the precision of reached schedule. Since the space industry declares a lot of specific space-demands and qualifications in order to make sustainable products, the work can often be experienced as non value-added work but necessary to perform due to the space demands, e.g., a required higher quality standard. According to the comments this has created a mentality in the company signifying a belief that every thing being processed might not be value-added to customer, but is necessary to conduct to meet the strict space demands. However, it is claimed that the demand is not in every case of significance importance and could be eliminated and thereby eliminate a lot of waste in the company. In order to do so the commentator claims that there is a need of change within the organisation.

Many comments indicate that the Lean change is positive for the company; the positive aspects are that it's a planned change and will solve current problems on long term basis but not only with the focus on the Lean tools but also has a focus on the people. The changes should be small and supplementary instead of fewer and large changes, which are better for both the staff and the management to handle, even though larger changes are sometimes necessary in order to achieve a goal. When larger changes are required the importance of communication and support from management is then vital, claimed commentators.

When it comes to attitude toward changes, it is claimed that the changes needs to have gained approval from management before being processed, since there is a belief that changes, which has been forced on to staff is often difficult to gain trust in. In addition, the staff should be well informed and knowledge about the change before it takes place. A person claimed that the changes being processed in the company at this time is often related to the avoidance of problem rather than try to improve the processes in order to mend the problems.

There has also been expressed the importance to consider the staffs' suggestions for improvements. The suggestion must be taken care of by a responsible person, the response from the suggestion of improvement will, according to a commentator, encourage other people to want to improve their own workplace. Moreover, another commentator claimed the importance to follow up the changes, which has been implemented. The comments indicate a positive attitude toward changes; however it is possible to outline a general feeling of reservation towards changes concerning changes with not a visible and understandable reason to the change.

### 5.1.7 Motivation to take initiative to improve work

The question posed about motivation was: *What do you think encourage and stimulate people and yourself to take initiative to improve?* The answer consisted of five different alternatives to chose between; Help internal and external customers to succeed, Improvement groups, Increased response from manger, Reward, Increased own responsibility, Improvement boards, and Other, see commentary. In addition they were left room to make their own comments. These comments will be summarised here.

It is agreed that there are many things encouraging to improve, often one of them is not enough, several of them are mutual important in order to encourage people to improve. According to the comments; increased own responsible and increased feedback from managers together with personal development are highly motivating criterions for people to be encourage to improve their work. Furthermore, the importance of involvement was addressed to be vital, to share and take part of other people's improvements is claimed to be motivating. The improvement solution should not come from someone else; they should be developed by staff. Improvement groups was also claimed to be a good tool for involvement. To some extent a kind of laziness encourage people to simplify their own work in order to faster reach goals by eliminating unnecessary work, which contribute to development of improvements. However, it was claimed that at current state there is a lock of time to work with improvements, it is not prioritised in many projects.

The comments also indicates that some kind of reward is encouraging, however the reward could consist of someone taking note of the improvement, implemented or not, at least the improvement suggestion is considered. In addition, it was also mentioned that outlined guiding principles of how to implement a suggested improvement could help people to encourage improving.

The satisfaction of reaching success is stated to be encouraging; reward of different kinds can be a proof for the success.

There were a substantial number of times that showed agreement that the managements' support is significant, since they have the mandate to provide resources needed for improvements. In addition, their general support is also encouraging. Furthermore, it is argued that someone needs to be positioned to be responsible for the improvements, to investigate whether the improvement is of value of not.

It was also mentioned that visits to other organisations in order to learn from others is encouraged to improve their own work place. Furthermore, different people are encouraged by different ways. Another example mentioned in the questionnaire was the importance of a stimulating coaching leadership, where the leader should improve their ability to ask questions, which aims to stimulate constructive thinking and create security by asking “open” questions. The staff should feel stimulated so that the person gives a possibility to take responsibility in order to influence, which creates motivation, security and flexibility. Furthermore, the leadership should create a culture with values as: openness, mutual trust, teamwork, customer focus, no prestige and development and training. Table 23 presents, in percent, the results of motivation to improve work.

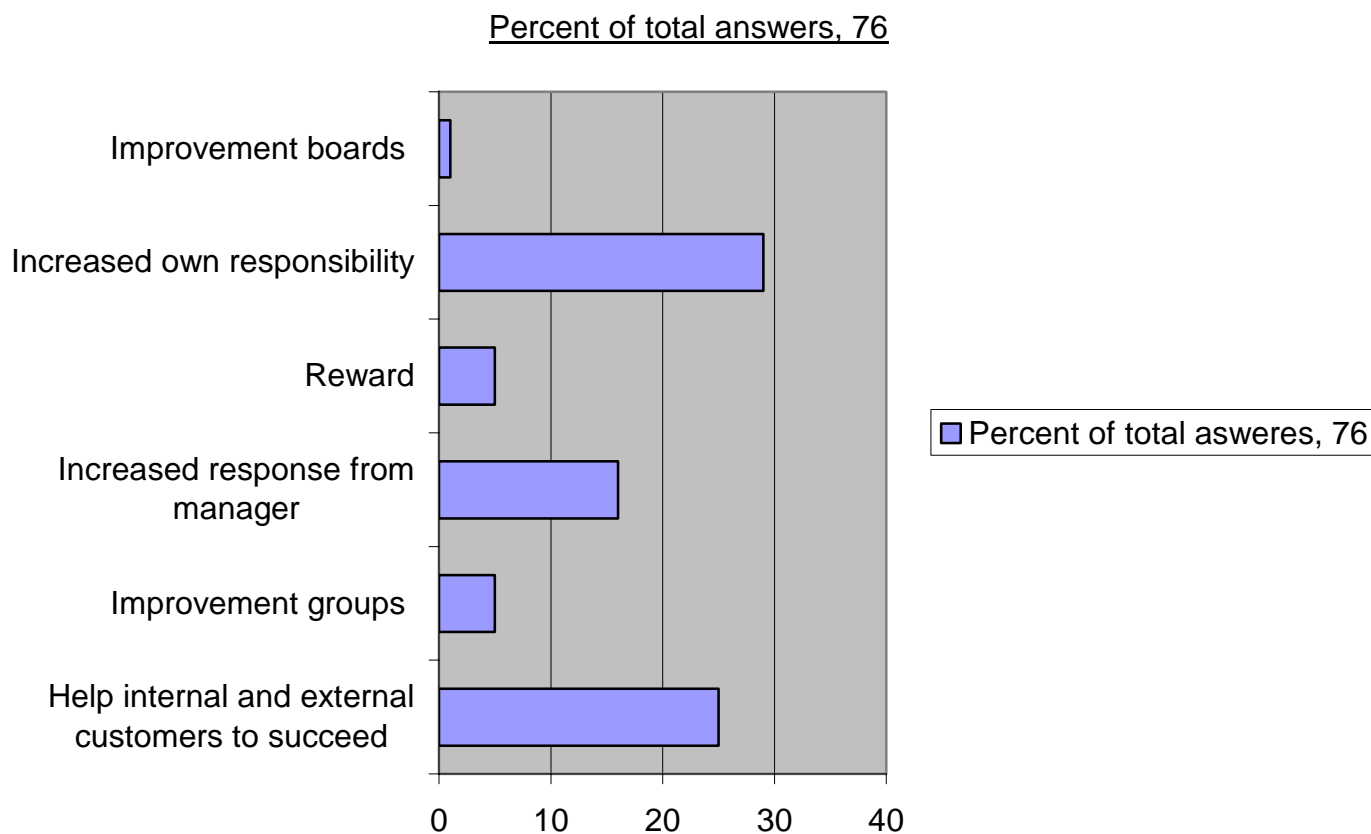


Figure 23. Motivation to take initiative to improve work.

### 5.1.8 Result from interviews

The interviews were divided into six different categories: Suggestions for improvement, Waste elimination and understanding for work process, Standardised working methods, Maintenance of equipment, Team climate and Orderliness and routines at work.

#### ***Suggestions of improvement***

The interviewees expressed different views of how to work with improvements on the P-division. One site of the P-division, PC, indicated that they are working continuously with improvements. Weekly improvement meetings take place, which are lead by the staff working in the processes with limited interference from managers. This continuity of working with improvement encourages the staff to think for themselves and develop their own improvement processes.

On another site of the P-division, the majority of the interviewees agreed that they are supported by their manager when they have, and want, to implement suggestions of improvements. Although, it was mentioned that there exists a lack of knowledge of whom to turn to when they have a suggestion of improvement that needs approval from the level above their manager. There are often problems to find some interested individual willing to take responsibility for the improvement because the managers can have difficulties to take responsibility for the improvements. The informants explained a wish to have a specific person responsible of the suggested improvements. They also meant that such an improvement officer should be able to support the person who suggested the improvement to implement it, both with time and money.

Once a year, new targets for improvements are developed and set by top management. It is, according to interviewees, argued that this target formation for improvements should be done continuously and be developed by the staff, since they are the ones having the correct knowledge to improve their own activities and processes. Moreover, it is claimed that the management should encourage their staff to work with individual improvements and share them between co-workers together with support from the management. According to one interviewee, overarching improvements within the company are too large and difficult to relate to; smaller adjustments concerning the individual work is easier to relate to and should be given more focus when it comes to improvements at SE.

Another issue that was brought up is that many problems are discovered during periods where time is short and often too short to be able to fix them at that time and are later forgotten. When it comes to more extensive suggestions they also often tend to fade away without being implemented or considered. An interviewee deals with improvements when a particular annoying problem comes up, either on its own or if necessary, with the help from the manager.

According to many of the interviewees, rewards such as movie tickets or a raise in salary for implemented improvements, are to a certain extent, encouraging the continuation of the implementation of improvements but is not a good tool in the long run to encourage improvements. It was agreed among several interviewees that responsibility under freedom is the best way to encourage staff to improve their own processes parallel to having a manager listening and showing respect for the improvement a co-worker presents, together with clear goals and purpose of why the company needs to improve. The result of the improvement being accepted and made visible is important in order to create a sustainable continuous improvement climate within the company.

An interviewee pointed out that when everyone's individual work is to be improved, the personal integrity boarder might be crossed. Consequently, people might feel intimidated by changes of their daily work and routines. This should be considered by management when encouraging improvements. Furthermore, the informant also claimed that it is therefore vital that the staff is well aware of the purpose of the changes and improvements. Opinions such as the following were agreed upon by many of the respondents. "There is often a risk by "think new", but by having understanding for the products and processes the risk of resistance should be minimised and eliminated. It is therefore vital that the management support all communication concerning improvements. This would lead to an organisational culture open toward changes, where the employees automatically think ahead."

***Waste elimination and understanding for work process***

It was clear that the most visible waste is transportation. Transportation directly related to the product as walking to the arrival, kitting and washing swallows up a lot of time. However, during the assembly it was mentioned that there is not that much of waste. It was also mentioned that there are well outlined routines for how to reduce waste in processes as how to search for information in an efficient way as how to avoid unnecessary “walks” around the work place in order to find information and tools.

It was also stated that some of the production work includes a lot of controls, which can be considered as not value adding for customer. Instead it was recommended that gained knowledge for the process should decrease numbers of making and consequently there would be less or no job needed to be redone.

Several interviewees claimed that they were often called for meetings, although not every meeting or parts of the meeting was claimed to be useful for their work. However, they agreed to have the right knowledge to know whether the meeting could provide them anything in advance and they also sometimes left the meeting when their information was done.

The majority of the interviewees consider themselves to have enough information to be able to perform their work. If some information is missing or questions occur, the communication amongst the staff is generally good. Also, the understanding for internal and external customers and suppliers is often good depending on person to person. In contrast, a minority argued that there is a gap in the information flow from internal suppliers and more details from the suppliers would simplify the work. It was argued that this gap depends on the lack of knowledge for what the internal customer wants and needs from their supplier. It was highlighted that the supplier in this case was from the G-division. In addition, information about the internal customer and knowledge of their processes was also almost non-existent. In order to improve this issue, the informant suggested that better outlined information should follow the product through the value chain to avoid unnecessary searching for information and to avoid guessing instead of time-consuming searching for information.

The information required to perform a task was mainly agreed to be enough. However, people having the eagerness to find additional information to expand their knowledge, is not encouraged at every section. Most people know that their tasks are vital but don't know why it is vital and why it should be performed. It was suggested that an introduction course for every new member of the staff should be held, particularly for the production staff. Such a course should aim to teach the new staff member why each process and activity should be performed, its goals and purpose. Consequently, an ownership for each task should be developed and improved responsibility for the work to be done.



### ***Standardised working methods***

According to the interviewees, when it comes to standardised working methods the company has created well structured routines concerning the processes and actions in the company presented in the management system SEMS. Parallel to these standards are working orders outlined concerning processes included in each individual project; these working orders are developed by the staff. Furthermore, the interviewees also stated that the branch demands a lot of standardisations, to which the company has added their own standards. An interviewee suggested that the company should, instead of creating their own standards, take advantage of standardisations outlined by a global organisation, which in some cases can reduce the amount of standards/routines and help to keep them updated. In relation to this statement it was added that by adapting Lean many of the standards could be restructured and eliminated.

### ***Maintenance of equipment***

This part of the interview mainly concerned interviewees working on the production site.

It was agreed among the interviewees that not much maintenance is done. The production at SE does not include a large amount of heavy machinery but more likely equipment as microscopes, test equipment and tools. Often, the staff fixes smaller problems themselves but generally little maintenance of the equipment is made. Furthermore, if the reparation of equipment is time consuming, it is often handed over to technicians. The information confirmed a mixed opinion to the encouragement from management and someone claimed that the staff tries to rotate amongst colleagues from the same section in order to gain understanding for the processes and the equipment included. In contrast, someone else claimed the lack of encouragement for maintenance from management also contributes to little average knowledge for the maintenance of the equipment. Lack of time was also mentioned to hinder the staff from working with maintenance. Moreover, it was also stated that an increased ownership of every once process would create an improved interest to gain knowledge for the equipment and its maintenance.

When it comes to the product, bureaucracy was claimed to be a major obstacle, which was argued as not enabling complete process ownership, e.g., if a fault is discovered on a product it has to be documented, registered and go through an investigation. Consequently, someone else, other than the person working with the product, will be dealing with the problem and the ownership is then taken away from that particular individual.

### ***Team climate***

The interviewees presented an overall satisfaction concerning the team climate at the company. Some of the interviewees are working close to their co-workers and had therefore developed a good team spirit where team members helped each other in the daily work. While some are working more independently and had therefore not developed as good team spirit, the team spirit was never considered to be bad.

The communication between co-workers was claimed to be generally good, although someone wished there was more time to communicate with co-workers. The communication between co-workers and their managers was also stated to be good. Due to the fact that staff are placed near to each other, may be a strong aspect to the developed good team climate and good communication. The majority, except one person, agreed that their good team spirit influenced the work positively, and the person claiming the opposite does not work closely in a team but don't think it has any negative impact on the job.

Concerning the communication, it is, as mentioned previously, good between co-workers but when it comes to the communication between the staff at the different divisions within the company, the interviewees indicated clearly that there is a lack of good communication between the two divisions. In order to improve the communication, concerning one cross-division-project, a 15 minutes meeting is held three times a week with the involved parties. The meeting provides good and direct feed back to the right person at the right time and as a result the understanding for each others work and the communication has increased.

In addition, according to an interviewee, there is a strong negative “we and them” feeling between the sections working on each side of the “corridor” in the production site. There is little understanding of each other and limited co-operation, which depends on a modest understanding for each other. Furthermore, this does not only concern the co-workers, it also regards the managers, which could be the root of the problem, according to the interviewee.

### ***Orderliness and routines at work***

Routines of how to perform tasks are generally good and visible in the management system SEMS. Routines concerning tidying up was agreed to be improvable, especially on the desks and work places. The staff not belonging to the production site is otherwise satisfied with the orderliness and routines at work. The routines of orderliness concerning tools and work place are not as good as they would be and a lot of time it is wasted time to search for tools and shared equipment. Many tools and materials have their own places but seldom are they there; people lend from each other without handing back. A person claimed the reason to be lack of visible routines. An interviewee claimed that there are at the moment little or no routines for orderliness concerning consumption material and a lot of time is wasted because of a need to search for this kind of material. Moreover, at several times it was mentioned that there is a lack of culture in which people wants to keep order in the common spaces, “people don’t think it is part of their job to keep the place tidy”.

## **5.2. Question two: Current work with Lean-activities**

Although SE has not started their major implementation of Lean in their organisation, they have done a number of Lean activities and their mental grounding for the Lean implementation has, at its current state, proceeded well. This part of the result will present what the author gained from spending time at different departments and with staff and managers from different parts of the organisation in order to acknowledge what has been done concerning Lean implementation at SE. In order to answer question two, the result from the pre-interview with the Lean consultancy, a Lean conference and external visits to organisations currently performing Lean will be presented at this point. The result is presented as short summaries of each experience.

### 5.2.1 Spending time at different departments

**Visualisation boards.** From spending time at the different departments at SE, it was SE started their Lean implementation by meeting a demand in the production. A number of consultancies working in the production had previous experiences with visualisation boards showing which products where in production and where in the production line it was being processed or stored. A board was developed and adjusted to the production at SE. And a first attempt to introduce a visualisation planning board was made and it helped the staff to easily recognise where the products were and what job was waiting in line to be processed. In addition, they are able to identify the priorities the products have by red and green marks, e.g., red for high priority and green for normal. The current visualisation board can be seen in Figure 24. The implementation was successful and is now implemented in two parts of the production site. The current visualisation board is constantly being developed and adjusted, they are alive. Between five and three times a week, 15 minutes a time is a meeting held. The meetings have been implemented primary with success although people find them occasionally time consuming.

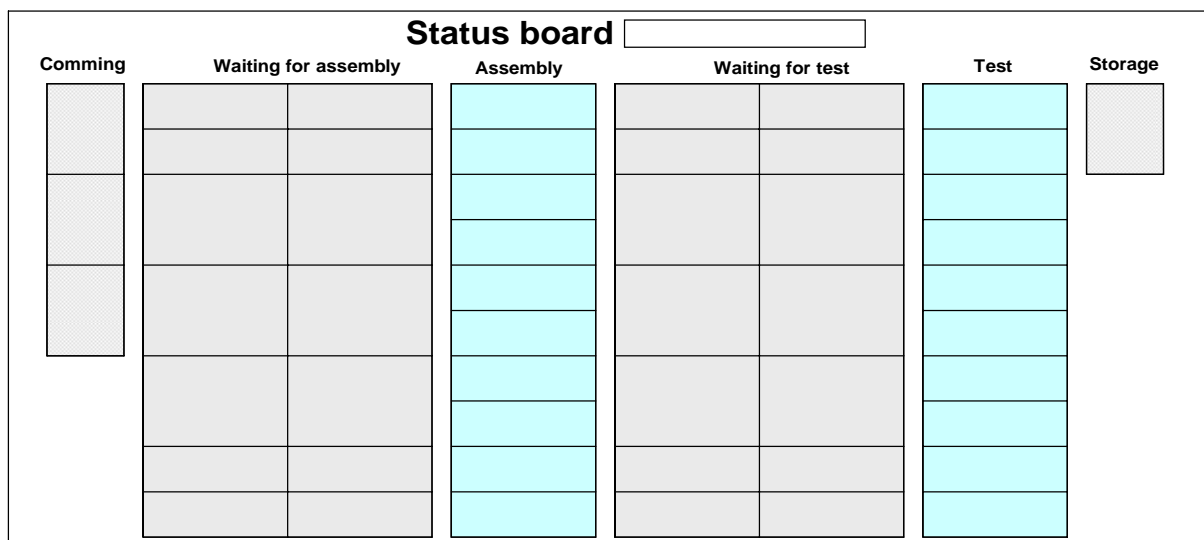


Figure 24. Status board (Source: Lundström, 2006)

***Lean workshop***

In order to prepare the staff and give them knowledge, every member of the staff belonging to the P-division had, during the autumn 2006, the opportunity, to participate in the one-day Lean workshop. It was held by a consultancy and aimed to create an understanding and holistic view the basic principles of Lean Production. During the workshop day a production game was played, where a production based organisation was simulated. During the game, the participants had to makes decisions of how to influence the business to increase profit. The aim of the game was to, in an educational and fast way; show the importance of co-operation and communication in a production and changeable work. During this workshop the participants were also encourage to discover the advantage with Lean tools. In addition, the participants were given an introduction of Lean and its philosophy.

***Value stream analysis***

In order to become strong competitors on the market and increase profit in the projects at SE a shared project between the P- and G-division has been started. The purpose with the project is to introduce working routines with an increased personal responsibility in order to carry out every working activity in a correct way at the very first instead of trusting that the possible mistakes will be discovered and repaired later in the value chain. The working method will increase the amount of handovers and the need of waiting for inspections and controls. This concerns both divisions, P and G-division (Mortberg, 2006).

The working method will be introduced initially in the converter project HOTBIRD-9 and EUTELSAT W2M and will further be applied on the Ariane-5 and Galileo project. If the working method proves to be successful, it will become part of the future ordinary working methods at SE. The project aims to not only shorten the lead time and decreased costs but also contributes to discover mistakes at an earlier stage without having to go through tests (Mortberg, 2006).

During a conversation, Roine Lundstöm (2006) claimed that during this process the value stream analysis concerning the production of some of these projects was outlined and analysed. It showed that 12 of 44 (27%) handovers consisted of value adding activities. Twenty-two of them were necessary but not paid by customer; two weeks of lead time consisted of 13 handovers.

***Improvement groups***

The first introduction of improvement groups was made on the test included in the PA section. The introduction started with a meeting aiming to fill a Pick Chart (Figure 25) with suggestion of improvements. The suggestions were evaluated to see the relationship between the benefit and the cost of the suggestion. The result indicates the priority of the suggestion, large benefit with small costs (implement) is prioritised before large cost and small benefit (kill).

## Pick Chart

Cost vs. consequence of ideas

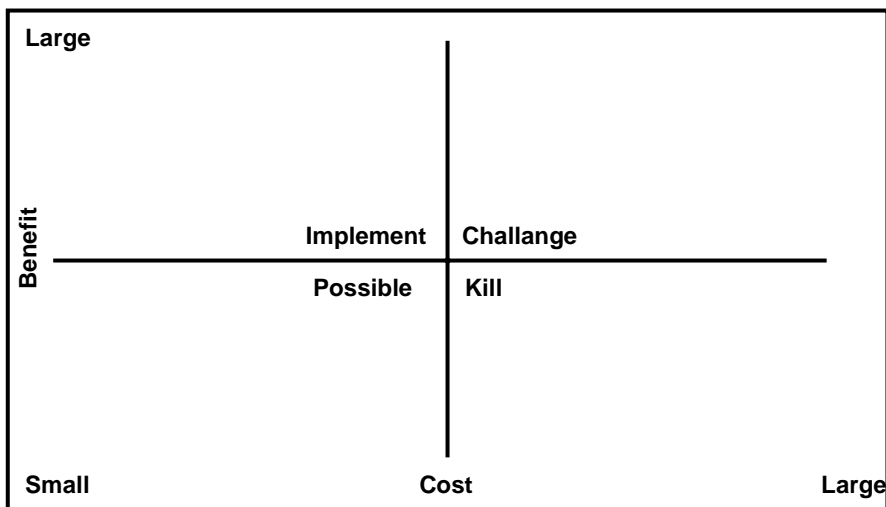


Figure 25. Pick Chart evaluates the improvement suggestion (Source: Lundström, 2006)

The initial meeting was followed up by another meeting, thus creating the first regular morning meeting, twice a week, where the prioritised suggestions were summarised on an improvement board (see Figure 26). This improvement board was further developed to be used during the regular morning meetings.

Improvement Board					
Improvements under progress					
Prio	Description	Owner	Status	Performed by	End date
1					
2					
3					
4					
5					

WAITING LIST		MERITS	
1		1	
2		2	
3		3	
4		4	
5		5	
6		6	
7		7	
8		8	
9		9	
10		10	
11		11	
12		12	

Figure 26. Improvement Board (Source: Lundström, 2006)

The participating staff were delegated to be responsible of the implementation of the prioritised suggestions depending on their relation to the suggestion and considering how much time they had to put in to the improvement. After the introduction of the improvement boards, the staffs are meeting twice a week in order to discuss the improvements and its implementation.

## 5S

The suggestions, that arose during the first improvement meeting (see pervious paragraph), indicated that there was lack of space and orderliness in their working area. Due to the problem and request for improvement concerning this area, a 5S workshop (see 2.3.3.1) was set up. The workshop aimed to release space by cleaning up a storage room. To facilitate the workshop, three different colour post-it papers were used to indicate the status of the equipment being cleaned out. Red is indicating waste, yellow is indicating doubtful, and green indicating keep. Furthermore, a system for how to store equipment in the storage room was developed and implemented. During this phase, there were also stickers developed to visualise where to place what kind of equipment and tools, see Figure 27.

# Standardize

Visualisation to keep orderliness

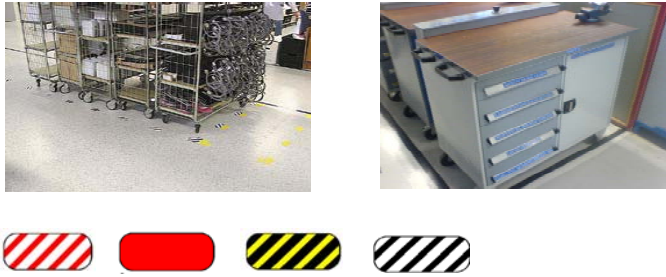


Figure 27. Standardized visualisation (Source: Johansson et al., 2005, pp. 23, 24).

## Measurement

In order to measure whether the implemented suggestions of improvements will show an improvement or not in the future, the same group of people as in the 5S workshop has started to measure how many days they waste time on searching for things every month. To simplify the measuring and to make it visual, they took use of a cross consisting of squares; each square had one date of the month in it, see Figure 28. Each person was given an own cross and every day they were searching for things as tools, information or equipment they had to put a dot in the square at that particular day with a read marker and if they had not been searching for anything they put a green dot in the square of that day.

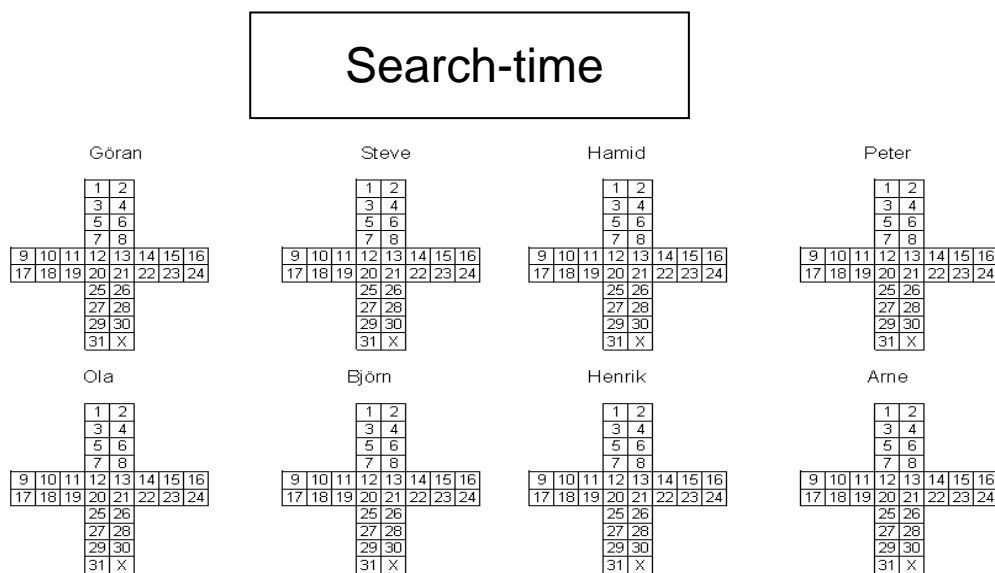


Figure 28. Search-time (Source: Lundström, 2006)

To further measure the status of the improvements accomplished from the Improvement groups and the 5S workshop, a reference group was assembled. The aim of the reference group was by judging the group engagement, atmosphere, orderliness, response on ideas and whether there was a sense of being able to succeed the project or not. The reference group presented their opinion at the end of November 2006.

The activities concerning test belonging to the PA section were carried out as a part of a B.Sc. dissertation (Larsson, 2006) where further reading can be done.

### 5.2.2 Educational visits to external organisations

In order to gain additional knowledge both for the author of this dissertation and for some of the staff at SE, external visits to other companies working with Lean were made. Three external visits were made to, Autoliv, Ericsson AB, and to Parker Hannifin.

Autoliv in Vargarda proved to have come far in their Lean implementation and had a lot to teach. Their foundational spirit is to always do right at once and therefore has eliminated a lot of their inspections. Every member of the staff, no matter position, is working with Visual Planning. Visual Planning means that everyone is planned their working day together with other workers at a large board on the wall where everyone met from the same working team to discuss their day. At this meeting it is also appropriate to comment on work tasks and other work related issues. The meeting is held at the same time and place every day, which gives the managers the opportunity to participate and gain a quick insight of the status.

The company also communicated that they live as they learn, from CEO to customers; everyone has a strong discipline to maintain a Lean organisation. They have also adopted the concept train the trainer and when new Lean activities to be implemented the staff trains each other. Before the implementation of a new Lean activity a workshop is held in order for each team to be educated in the new activity and prepare for an implementation. In order to maintain a Lean organisation the different parts of the organisation audit each other and the result of the audit is presented as a score. There are no hierarchal boundaries during the audits.

To further develop the organisation, they have continuous improvement groups, every suggestion of improvement is dealt with within 24 hours. The improvement is then recognized and implemented.

In order to eliminate waste, they have reorganised the management office. There is one large table for them all to share. The table has built in computers and it is only allowed to have one small shelf per person to store material. Consequently, no unnecessary work is done.

During sudden stops in the production site, the staff are always delegated to work with maintenance of machinery and continue improvements.



Ericsson in Boras proved to have a management 100% dedicated to Lean and the Lean activities within the company. The company decided to work with Lean autumn 2005, but before that they had been practising the improvement tools: Six Sigma, 5S and Visualisation board for a few years but it was not practised with a holistic site of it. Ericsson, as Autoliv, is also practising “train the trainer” in order to provide everyone with the same frame of goal and directions of the Lean work. They started their Lean work with two pilot-projects aiming to do an implementation test of various activities such as: Improvement groups, Housekeeping (5S), Competence and training, Measurements and Visual planning.

Every member of the staff is belonging to an improvement group. For ten minutes every week, the group is assembled in order to work through the status of the improvements. Every member is prepared for the meeting and each group is working with maximum three improvements at a time. In order to visualise the improvements white boards are used. Every improvement which is carried out is gathered on a Merit list attach to the board.

Every day includes a ten/fifteen minute’s status report in a group. Each group has a responsible person who brings the statuses of the meeting to another meeting with the other responsible persons to bring overall statuses of the daily work concerning the production.

Ericsson takes advantage of the time released when sudden stops occur. The first obligation is to help other staff with their problems or if a need isn’t required, the staff is expected to work with maintenance or improvements.

At Ericsson, the staff’s daily work includes improvements and contribution to the development of the company, which is not an option. Furthermore, the company has a philosophy to always be prepared for visitors; no additional cleaning should be required, since the work place is expected to always be tidy and orderliness. The factory shows clear marks aiming to visualise every tool and equipments place.

Parker Hannifin in Boras, has key managers responsible for the Lean work. The key managers are most commonly working as managers at different parts of the organisation or belong to the top management. Parker works a great deal with Kaizen events, which starts as a request from the staff. Parker has their major focus on product family orientation and value stream flow. Four times a year a value stream mapping on each part of the organisation is done. The aim of the mapping is to investigate where the problems are aroused. Further, a future plan developed is concentrating on measures of how to solve the issues and a follow-up plan is stated. The result is then used to Takt the production. The result from the value stream mapping is proved to pay off, their lead time has been reduced from one month to one week and their storage could also be reduced significantly.

Parker is also working with improvements; when the staff comes up with suggestions of improvements they are notified on a board and in order to implement it successfully a PDCA-sheet should be filled in. The sheet consisted of five parts: Problem descriptions, temporary measure, measure plan, root of the problem analysis and follow up and evaluation. Parker is, as Autoliv and Ericsson working with visual planning, weekly and daily planning.

### 5.2.3 Pre-interview with consultancy

The pre-interview with the consultant, Ola Johansson from PART development, discussed important issues to consider and gave strategic suggestions of how to start the implementation of Lean at SE. He recommended that during the start up of a Lean implementation and an organisational change, a chosen person should be responsible for the process, since the process is demanding for the co-workers and managers it is central to find someone able to drive the change forward and gain extensive knowledge of the subject and the company. The selected Lean Manager should find an area which is in need of improvement. Value Stream Analysis was recommended to be a useful tool to improve an area, but Johansson (2006) pointed out the importance of an action plan showing:

- What to do?
- Who is responsible?
- When it should be completed?

When the analysis is completed the actual work should take off. Staff and managers should be trained Lean internally and externally. Thereafter, Johansson (2006) recommended reorganising the structure of the company, which should be planned to take approximately one and a half year. The reorganising process of the company structure must handle the production as a heart of the company; the other functions are supporting function to production. Therefore, should the company organise functions based upon the product families' value stream. Furthermore, Johansson (2006) claimed that a Lean team must be united in order to engage every member of the staff and management in the company. A vital issue for the team to early point out is the importance of what to do about the overcapacity created from improvements, since the overcapacity always needs to take advantage of, not dismiss.

Johansson (2006) also presented some tips of how to implement Lean tools. He pointed out the significance of the involvement and commitment of management at every phase of the implementation jointly which clear goals in order to increase staff's understanding and interest of the Lean implementation.

### 5.2.4 Lean conference

Two managers at SE and the author of the dissertation participated in a two day Lean conference. The aim of the conference was to listen to other companies' Lean success, failure and to share other Lean experiences with other Swedish based companies. **The First day** consisted of several lectures held by Lean managers from different companies from different branches of business based in Sweden. Three of the lectures discussed their collaboration between each other as suppliers and customers. By helping suppliers to decrease costs, the customers receive products they have paid for, not more or not less. In addition, both companies could develop a Takt time (see 2.3.2.1) in the production with a more even production flow and decrease storage. The result from the mutual relationship showed that *Solectron* could decrease their delivery from six weeks to two weeks and decreased the production time from 300 hours to 60 hours. In addition, they gained from 70 to 99 % delivery precision. Furthermore, *Fixturelaser* who produces and sells laser measurements, also shortened their time spent on looking for tools and information substantially by applying the Lean tool 5S (see 2.3.3.1). In a month they had reduced their working area by 40 % by a new layout. The electronics' company *Note* also pointed out the importance of orderliness and routines. Furthermore, they highlighted the importance of collaboration with customers and a supplier, the entire value chain has to be engaged in the Lean work. Note also presented their action plan of how they had implemented Lean in their organisation.

**The second day** of the conference consisted of a workshop held by David Verble. He has many years' experience of Lean from working at Toyota in the USA. The workshop was a mix of lecturing and participation. David stressed the importance of how to work with changes and management. A short summary of his theory is outlined to express his concerns about Lean and management.

Verble (2006) explained three ways of how Leaders in Toyota gain commitment and support for the countermeasures and improvements they propose to staff. These three ways are universal and could be adopted by the Lean Managers at every Lean organisation not only Toyota. The three ways are:

- ***The Plan-Do-Check-Act Management Cycle***

Verble (2006) claimed that when management is working with Lean activities and methods, the PDCA cycle is an excellent way to lead the situation toward a sustainable Lean improvement and implementation.

- ***Changes proposed and managed as experiments***

According to Verble (2006), with the PDCA cycle management, Toyota approaches changes as an experiment and uses it as a learning process. The purpose of framing proposed improvement as an experiment is to describe the observation, reason and theorize about the situation and convince and to engage staff.

- ***The Nemawashi agreement-seeking process***

The word "Nemawashi" is Japanese and means "Preparing the Ground for Planting". Verbal (2006) explained that Nemawashi is an important element in any major changes. Before the changes takes place a successful Nemawashi will enable the changes to be carried out successfully. By talking to the people concerning the change and to gather support and feedback, the information process is laying the foundation for the proposed changes.

## **6 Discussion**

When it comes to the staff's attitudes toward changes, the result from the questionnaire indicates clearly that the attitudes toward changes are generally good.

The high rate of participants of the questionnaire (70%) is a sign, which tells that the staff is dedicated and is willing to take part in the company's activities. Out of the 70 % respondents 34% persons responded with comments, which presented a positive response indicating that people are interested of giving their opinion, good or bad.

Referring to the result (Table 19), it is proved that the P-division is open towards changes, showed a limited resistance towards them and thought the changes develop the company at the end. The staff stated they are fairly well informed about the aim of a Lean implementation, which might influence their attitude towards Lean implementation. The knowledge of what the result will bring does probably have a major impact on the reason for being positive towards the change. This could also be argued to be the same reason for the resistance toward the change; the lack of knowledge of the outcome of the change might make people more reserved towards it. Although, the staff was generally positive toward changes, the test showed a large variation between the answers meaning; there also exist people who are more resistant toward a change. Furthermore, according to the interviews, it was mentioned that the staff might feel intimidated when it comes to improvements of their daily work, since their integrity boarder might be passed. However, due to this inconvenience this people might at first be resistant toward the Lean work and become an “anchor dragger”. According to Johansson et al. (2005, p. 7), the anchor draggers could consist of managers as well as of staff, which the result of the interviews indicated.

Although, some indications of resistance toward a change, the preparation and start-up of the Lean activities at SE has been a good foundation of inspiration for the staff to be motivated to work with Lean. The start-up activities indicate that there is a demand for improvements in the production site. The request for visualisation boards indicates that the staff are interested in participating in order to improve their work. Concerning attitudes toward changes, the one-way ANOVA proved that people working at the PA section are generally less satisfied with their working colleagues, their teamwork and wish a better team climate in comparison to people working at section PT. Furthermore, PA also had a lower result concerning suggestions of improvements than the other sections. This result can be discussed to be reasonable; because of the different ways of working, tasks and obligations at the two sections. What might have influenced the result of the team climate could be that PA’s working obligations might require a more independent performance than PT’s working obligations and PA’s working environment might limit their team climate.

However, the result from the questionnaire did show signs of diverse attitudes toward the change according to what section of the company the staff was belonging to. The author argues that the diversities between the different sections could be depending on the attitude and encouragement provided by manager and the type of tasks performed by the section. Different tasks demand different working methods, which contributes to the staff’s attitude towards the work, positively and/or negatively. The way of performing tasks also influences the ability to adapt Lean activities on the work place and processes.

The implementation of Improvement groups and a Visualisation board could help the section to increase their improvement work. The Visualisation and Improvement boards are discussed during meetings with the team aiming at gaining understanding for each others work and also for improvements of their team climate. However, the managements’ engagement must be visible to every member of the staff to fulfil success with the improvement boards and to improve the team climate.

The same test also showed that PC in relation to PA, PB, PT and PL is not as good to come up with suggestions of improvements, implement them and be supported by their manager. The reasons for such answers could be numerous, but this result expresses a need for an improvement group and board. The outcome of the implementation of such boards will presumably be stronger at PC in relation to the introduction of improvement groups and boards at PA, PB, PT and PL. However, it is vital to stress the importance of prioritising the meetings and maintain discipline, without the managers' support and being a raw model the outcome of the boards might fail or be less successful. As Verble (2006) mentioned, the PDCA cycle theory should be adopted by managers in order to lead into sustainability of Lean.

The result from the questionnaire indicated that PB is slightly more open toward changes than PS is. The reason for such a result could depend on the experience PB has gained from the already implemented Lean activities, since PB belongs to the production site and have to some extent experienced limited implementation of visualisation boards.

To further analyze the result from the suggestions of improvements; the results from the questionnaire indicates that staff generally have quite a lot of suggestions for improvements and are supported by their manager to implement it, but the majority does not implement the suggestion of their improvements. The reason for staff not to implement the suggestion could depends on lack of encouragement from the surrounding, e.g., the existing working culture. The staff might lack of knowledge of what to do and where to gain resources of how to implement the suggestions. Referring to the theoretical framework, it seems to be important for management to actually consider the staff's suggestions. Consequently, the company should be working more to get the staff to actually implement their own improvement suggestions and to acknowledge the improvements in order to encourage the continuance of incoming suggestions of improvements. Improvements visualisation boards and groups are successful tools to use to involve managers and the staff to actually implement their suggestions to improvements with a support from management. These tools will also help to provide responsibility and increased feedback from managers. If the discipline of maintaining the improvement groups fails, the suggestion of improvements will fall back to the old pattern quite soon. These tools and ways of working clearly show the staff that improvements are part of their daily work. The action of implementing suggestions of improvements should not be taken only if they have time, but rather they should be given the time for improvements.

The three companies, Autoliv, Ericsson AB and Parker Hannifin, which were visited by the author, all agree that without the managements' commitment every Lean activity is likely to fail. However, the managers' commitment is not the only success factor; the staff needs to be engaged in the processes as well. The staff's ability to engage in the processes by the Visualisation board, 5S workshop and the improvement groups is considered as a contribution to the openness toward the implementation of Lean.

In order to prove the result of the improvements; understandable measurements should be established, as the Search-Time cross used to measure the improvements of searching for tools and information. It is important that the measures stay understandable and easy for everyone to relate to and to enabling the staff to increase their understanding for the importance of every process, while managers gain a quick insight of the current status, as applied by Autoliv.

A comment made in the questionnaire claimed that to some extent laziness encourage people to simplify their own work in order to faster reach goals by eliminating unnecessary work. This statement is very important when it comes to the individual improvements, which should be clearly stressed when working with Lean. The aim of Lean is to simplify the process for the individuals, not to make their work more stressful, but rather easier to perform. As shown in the result, the most encouraging reward for implemented suggestions is response from management and co-workers. As mentioned in the result section, in order to provide satisfying responses the leadership must be stimulating coaching. The result signifies a general request for many of the Lean tools providing as an improved system for the implementation of improvements in order to simplify the daily work. Such request is good for the Lean implementation at the company.

The results from the questionnaire showed a positive result concerning the staff's understanding for their work and the contribution of it. This information should be found as a good base for the eliminating waste in the company, since the understanding makes people aware of their processes and what is value adding for customers or waste.

Furthermore, in order to acknowledge staff of what is value adding within the processes the visualisation boards and a clear vision of the goal should help with the processes to engage staff to participate and gain knowledge, not only for their own processes but it provides the staff with a holistic view of the value stream in which their own processes are included. In a combination with improvement groups, the staff would probably also be able to contribute with the development of value stream analysis. The staff's contribution is vital in order to take advantage of the knowledge the staff enclose.

The team climate was proved through the questionnaire to generally be satisfying; however there were indications on a wish for better team climate at work site. Obviously, a team climate might always be improved; however the expressed wish could vary depending on what section the individuals work at. The different tasks could demand more or less teamwork with co-workers, which could affect the team climate, also the size of the section could influence the team climate. The author argues that having a satisfied staff influences the workplace and peoples' willingness to accomplish a task with concern for the company's best. By eliminating waste the stress amongst staff could be decreased and staff could feel more satisfied with their working climate. This type of stress caused by waste can to a certain degree be related to orderliness and routines at work, which might possibly be eliminated by a 5S workshop, but the maintenance of the result from the 5S workshop might be equally important.

The results concerning orderliness and routines at work confirm that the majority of the respondents' waste a lot of their time to look for tools and information, however there is a significant variation of this answer, the reason for the variation could depend on what section the staff comes from. The author believes that the sections directly related to production are using more tools and equipment than other sections, consequently they have a stronger reason to search for equipment. The author claims the need of an implementation of 5S and visualisation boards which strongly encourage waste elimination in terms of searching and walking. In addition, the tools help to improve knowledge for each individual process and action where a lot of waste could be hidden. The answer also indicates that there is a big need and request amongst the staff to improve the orderliness and routines for such; however this primarily concerns the production site.

Since Lean encourage people in a company to increase responsibility by participating in the development of their processes it is vital that the management pay attention to what the staff is willing to do for their environment and duties. Not every person is interested of taking responsibilities and gain engagement in their work; they just want to complete their daily task without paying to much attention to it. However, the author argues that Lean assessments, methods and tools are part of every once daily work; it's not besides their daily work its part of it, witch needs to bee taught and proved by management to every member of the staff.

The study shows that SE has well prepared their staff for a Lean implementation, especially by the Lean workshop held by a consultancy. The workshop was as far as the author concern an interesting and fruitful experience where every member of the staff and manages hade the opportunity to develop and particpate, however, the author believes that the workshop could be difficult to related to since the game was structure to suit a completely different type of production branch than SE's branch. If the game was adjusted to the target audience, they might have been able to gain additional understanding and knowledge of Lean. However, the management has to consider that not every one bought the concept, staff may feel intimidated by it as well, they are afraid that their improvement work they have done previously is not longer worth anything.

As far as the author concern, the visits made to the three external companies working with Lean were a fruitful experience for the production managers at SE. The visits proved the importance of the management commitment and the engagement from staff. But, it is important to consider the business branch of the company when adapting other companies' Lean strategies. Since Lean origins from the car industry (Toyota) many Lean methods and tools are adjusted to that particular business, which might not be successful on the type of business SE is performing.

Thus, the visits were profitable the author has an opinion of Parker Hannifin's way of manage Lean in the organisation. The company did not have one or several fulltime Lean managers; the Lean development was managed by key managers who were working with Lean additionally to their ordinary works as e.g., production managers. It is important to have an organisation with every managers working with the maintenance and development of Lean; nevertheless the author believes that a company at such size as SE should have at least one fulltime Lean Manager only focusing on Lean. In addition, there should be key people, in the company working more or less with the Lean questions. Whether the key Lean persons consist of section managers or not can be argued. If the key persons are part of the management they have the mandate to provide necessary resources in order to implement improvements, but if the key person belongs to the staff, the person will represent the staff's voice, which is argued by the author to be vital when it comes to the encouragement and engagement of the staff.

A further reflection made by the author while doing the research was that an enormous Lean interest grew amongst managers belonging to the P-division, which is an excellent advantage. But as far as author concerned is it important to keep the Lean work structured and well planned to gain a consistent and sustainable Lean implementation and development by clear and shared goals at SE.

## 6.1 Limitations of the study

Regarding the questionnaire, some of the participants expressed their difficulties to know how to interpret some of the questions, in particular: changes and workplace. They found it difficult to know whether the change was meant to be interpreted as positive or negative, since they believe it is both. It was also argued that the questions were too long and that not every one had participated in the Lean course held at SE, which the author of the questionnaire assumed. In contrast, some commentators thought the questionnaire was of high-quality. In addition, the Lean information, which had been claimed by the author to be found on the division's home page, had not been found by one of the commentators.

Furthermore, question 8 and 14 could be particularly difficult to answer since these questions were asked in a diverse manner, see Appendix A. The answers to these questions should be analysed with deliberation.

The studied topic, Lean production, is a broad issue and concerns many important parts of an organisation. Therefore, the dissertation work could have left out parts, which might be considered to be vital parts of Lean Production but maybe not as important for the purpose of this dissertation, i.e., to find out barriers and facilitators for implementation of Lean at the company.

## 6.2 Future research

The dissertation has not made any deeper research concerning what Lean tools and methods are suitable for the organisation to implement and which are not. The author provides a suggestion of how to adjust Lean tools to the organisation. There should also be a continued research of how to develop the Lean work within the company with the concerns of the staff development and adoption to a Leaner organisation.

## 7 Conclusions

The conclusion will consist of a recommendation of how to implement Lean at SE with the current state as starting point, concerning the staff's attitude towards a change and the company's current working-methods and Lean activities.

In order to success the implementation and maintenance of Lean; the staff and the management have to be committed. The management and their commitment is the most critical issue. Without their support it is according to Ericsson AB (2006, external visit) difficult to gain trust from the staff. The quantitative study indicates that the staff at SE seems to have a fairly open attitude toward changes and should, with support from management, not have any major difficulties to adapt to a Lean thinking culture. Nevertheless, it was in the interviews claimed that there have previously been attempts to improve the organisations. In some cases, the improvement have been poorly followed through, which might have caused a lack of interest among the staff when the management suggesting new improvement projects. Consequently, the staff might not be likely to adapt to the new changing culture if the management haven't already changed and are dedicated.

According to Johansson et al. (2005, p. 7), a long term basis plan with short, clear and shared goals creates a secure climate amongst staff and a willingness to improve SE further. The plan should include clear and visible goals showing the strategy of how to manage the resources gained from the improvement in order to show that the staff will not eliminate their own employment by improvement.



Before stating to implementing major changes concerning Lean it is vital to have planned everything thoroughly. A solid plan will provide trust amongst staff and makes it easier for management to follow through the change. There are three important steps that the planning has to work through. The three steps consist of implementing, usage and maintenance. These three steps, purpose, goals, and strategy have to be clear before the implementation. The plan will also secure resources and agreement to the managements' commitment. A strategic action plan will also make the implementation mutual for every part of the section, no parts will be left out or experienced weak and unsupported Lean attempts.

When the current Lean activities in the organisation have reached a fist target of implementation it is time for the SE to structure their Lean work. Furthermore, the Lean management structures also have to be developed. This structure should be set and planned during the current start up of Lean activities, not after. The structure of the Lean work will provide every section at SE with structured Lean goals and well developed methods with a management demanding Lean consideration which will provide trust amongst staff. If the current implemented Lean activities at SE are successfully implemented a basic understanding and believe should have been developed amongst the staff working on the P-division.

According to Johansson (2006, pre-interview) the reconstruction of the company will most likely take some time, approximately a one and a half year, which means that in a year there should have grown a new organisational structure within the company.

To secure the success of the Lean implementation an action plan should be created. Johansson (2006, pre-interview) suggests that the action plan should be on a six month basis and consist of goals a half a year onwards. This action plan and its goals should be planned together with the overall company and its Lean goal.

When working with Lean it is essential for the company to have a Lean goal to strive for. In order to reach the goal one important question has to be answered: Why Lean?

SE's Lean goals are to:

- reach 100 % delivery precision
- reach 100 % calculation precision
- no mistakes to customers
- decrease cost to gain a advantage on the market by competing with good prices.
- increase order intakes

These goals has to be broken down and analyzed, answered and translated so that every individual can relate to the goal and apply on their activity, process and daily routines included in their daily and ordinary work.

When the goals are broken down to part-goals three questions should be possible to answer due to the fact that the goal is understood and can be related to, by everyone.

The three questions are:

WHAT should I do?

HOW do I do it?

WHY should I do it?

Figure 31 shows how the goal ought to be broken down within the organisation.

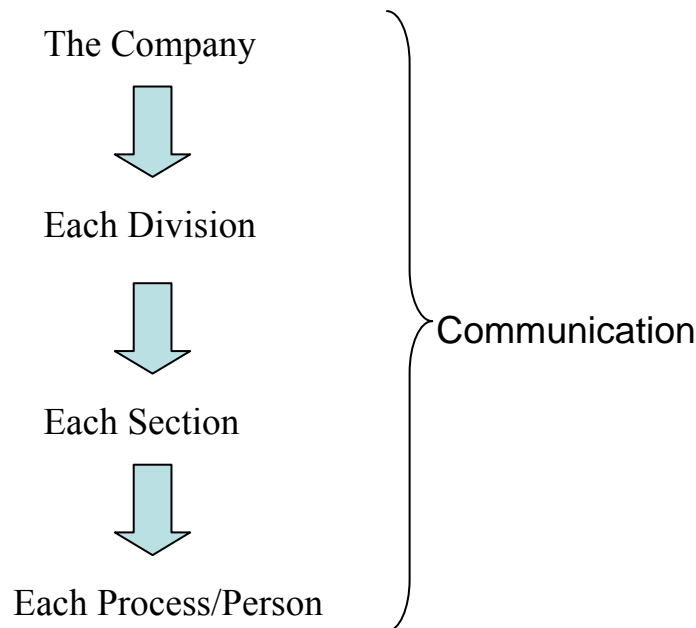


Figure 31. How to break down the goal.

## 7.1 Action plan

The action plan outlines the primary implementation action, what to do and when to finish. Johansson et al., (2005, p. 16) claims the importance to follow set dates and to actually prioritise the dates, many activities are dependent on each other and therefore could delays disturb the entire plan. It will most likely show up unexpected concerns not considered in the action plan, it is therefore important that the action plan is flexible and adjustments can be made continuously. The plan will be carried out by the management and key Lean people. It is of major advantage if these people have a good knowledge of Lean and its tools. The involvement of an external partner at this stage is highly recommended by the author, the external partners will work as Lean support and supervisor.

A suggestion of an appropriate action plan has been outlined, it has been influenced by an action plan form a company with a similar production and Lean implementation (Johansson et al., 2005, p. 17). The different parts of the plan will be further developed in the dissertation.

During the realization of the Action plan the Lean Managers together with key managers should continue to work on the next phase. This planned should according to Johansson (2006, pre-interview) be more detailed and include more production technical efforts.

### Action Plan Phase 1

	Start	Complete
<b>Develop a Lean philosophy</b>	08 January	
<b>Develop a Lean Team</b>		
Define roller, tasks, competence	08 January	21 January
Allocate resources	08 January	31 January
<b>Develop and implement Lean activities</b>		
5S	08 January	28 January
Visualisation boards	08 January	28 January
Improvement groups	08 January	28 January
<b>Value Stream Analysis (VSM) Workshop</b>		
Identify and map value streams in production	15 January	24 February
Map a future value stream		27 February
Implement new value stream		28 February
<b>Revision of Measurements</b>		
Define measurements relevant for the change	15 January	01 March
Implement methods for measurement	02 March	30 April
<b>Structure Audits</b>		
Analyse audit areas	02 April	01 May
Set up an organisational Lean audit	02 May	02 July
<b>Value Stream Analysis (VSM) Workshop</b>		
Identify and map value streams in production	01 February	24 February
Map a future value stream		27 February
Implement new value stream		28 February

#### 7.1.1 Develop a Lean philosophy

During this initial state of Lean at SE the philosophy is under development at SE. When the action plan sets in action the philosophy is to be outlined. At current state the philosophy concerns: do right at first, delegate responsibility and staff's willingness to participate.

#### 7.1.2 Develop a Lean Team

A Lean team should be build up, the suggestions of the structure of the Lean team is strongly influenced by Autoliv's organisational Lean structure. The team should consist of a few dedicated people only concentrating on Lean. The Lean team should be constantly trained Lean and be responsible for every Lean activity in the company. This team should work closely together and constantly develop and maintain Lean at the company.

The Lean organisation should be signifying the model of Train the Trainer. Train the Trainer means that the knowledge should be used inside the "house. The staff at different levels teaches each other.

The idea of the Lean team is to get every Lean activity thoroughly planned by the selected Lean team members within the company; no other Lean practice should take place before consulting the Lean team. Consequently, Lean will be controlled and managed by staff having the right knowledge, activities not healthy for the organisations will as a result be avoided, e.g., the implementation will be maintained and activities not thoroughly planned will not be rushed into and failure can be avoided. The author suggests model of a Lean team, the model is based upon a similar model Autoliv use in their organisation to maintain and develop Lean and there is an aim to adjust the model in order to fit the management system (SEMS) at SE. The model consists of Lean Mangers, Lean Champions and Lean Mentors.

#### *Lean Mangers, Directors*

The Lean Managers also called directors are managing SE's Lean development and maintenance on fulltime basis. The Managers should constantly be trained in Lean to constantly bring the company forward with new Lean challenges. They are responsible for the development, implementation and maintenance of new Lean activities concerning the entire company. Furthermore, the Lean Managers act as supervisor during Kaizen events and other Lean tools. They have the obligation to train the Champions in order to make them knowledge to become owner of a Lean tool. According to the gained experience from Autoliv, SE should have Lean Managers working parallel and cooperatively from the P- and G-division in order to implement Lean evenly throughout the entire organisation, since both of them plays an equally important part of the products and projects value stream. Furthermore, a long with the implementation of Lean and the restructure of the organisation the numbers of Lean Managers might have to be increased.

#### *Lean Champions, Drivers*

The Lean Champions also called Drivers are key Lean staff and should be part of the management Lean team but still remain its ordinary work, while on the side be the owner of a Lean activity or tool. The Champions should also receive regular training, but primarily from the Lean Managers. They should have a major responsible for the training of the Mentors and are also part of the adjustment of the implementation of new Lean tools and methods.

The Lean Champions could possibly consist of current sate managers given extra resources which enable them to work with Lean. The amount of time needed for the Lean Champions in order to challenge their tasks must be build up through the development of Lean. The Lean Champions ordinary work and tasks should decide the owner ship of the Lean activity or tool, since the burden could vary and consist of different knowledge and resources.

To integrate the Lean Champions into the SE's organisation they could, as a suggestion, be places in the processes and take form as a process manager.

*Lean Mentors, Doers*

There should be one Mentor at each section. A Mentor will be responsible for the actual implementation of Lean at each section within the company, which makes him/her and the staff to *doers*. The Mentors role is to teach and train the staff at its own section and to could possibly be responsible for each sections improvements meeting. When new Lean activities and tools are to be implemented in the organisation it's the Mentors role to be responsible for such an implementation at its own section. The Mentor should be trained by the Champion responsible for the particular activity. However, the training of the section staff should not be longer than 15-30 at time. In addition, the Mentor has the overall implementation and maintenance responsibility within the section. The Mentors should be "the people's voice" and ought to inspire and encourage each member of the sections staff to work and develop Lean by operate as inspiration sources for co-workers. Furthermore, the Mentor should also together with a Lean Champion and Lean Managers be responsible for Kaizen workshops held at the section when needed. A Mentor should also have limited mandate to provide the section with resources for their Lean and continues improvement efforts.

The work load required from a Lean Mentor should not be more than a Champions work load. However, this is due to the current sate, some months demand more Lean consideration than others, but a Mentor should always prioritise Lean but still be able to handle ordinary work besides. A Mentor should receive continues Lean training primarily from Champion.

To integrate the Lean Mentors into the SE's organisation they could be places in the linear/section structure and take form as a key Lean staff in the different sections within the company.

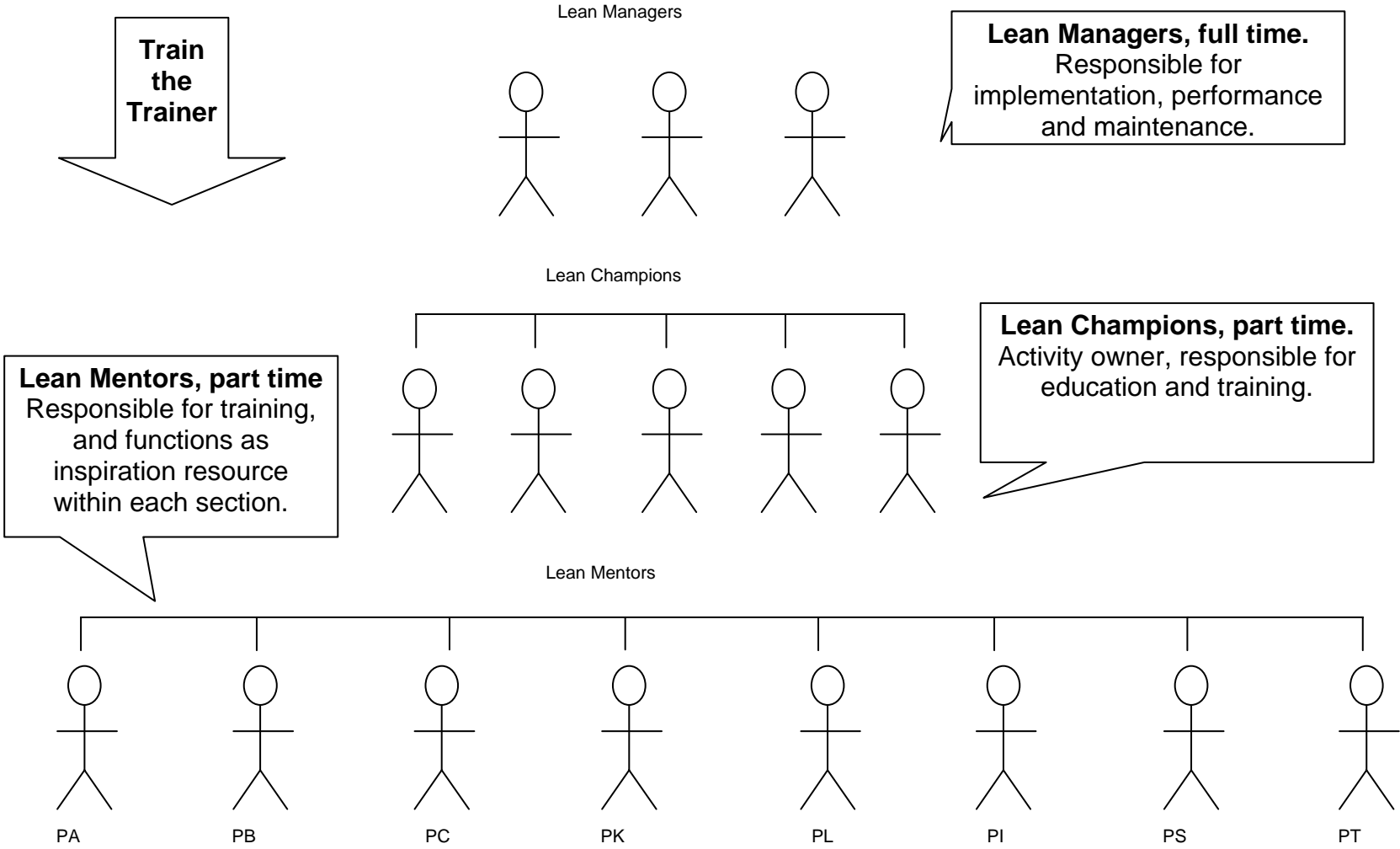


Figure 32. The structure of the Lean team

Moreover, it is important that the overcapacity is being used to develop the organisation. The extra time which is required from Lean Mentors and Champions is time which has been released from overcapacity. If the over capacity released through Lean activities is used to dismiss staff the company will most likely not have staff being willingly to work happily with improvements in the future due to their fear to loose their own employment.

It is vital that not only this particular selected key Lean people are managing Lean, the entire company should pervade Lean which means that the managers plays a major part. They should always strive to achieve the best possible Lean climate at their responsible management area. It should exist in every manager's interest to manage with a Lean spirit. Even though not ever member of the staff and the management within the company has been given a Lean title it does not mean they are not responsible for the Lean work at the company, it is part of everyone's daily work.

### 7.1.3 Develop and implement Lean activities

The 5S workshops, Visual planning and Continues improvement boards should be carried out on every section of SE in the same manner as done previously (see result) and recommended in the theoretical framework. It is suggested that the 5S workshops should be carried out during one full day and engage manages as staff at each section. Measures should be taken in order to create a visible understanding for the improvements accomplished from the workshop. The visual planning must be adjusted separately to match every part of SE.

Following is a suggestion of how to develop the continues improvement boards. Since Lean is all about improvements with the aim to reduce waste, it is essential to get the staff engage in the continues improvement work at the company. As mentioned in the result, a visualisation board could be helpful in order to visualise the improvements and engage staff.

The author is recommending that each improvement which is to be implemented should be processed through an improvement sheet. The aim with such a sheet is to make the improvement implemented successfully and sustainable. The improvement sheet is based upon the PDCA-Deming cycle and not only helps the responsible person to make a sustainable implementation it also helps to questions the improvement or the current situation. The questioning can help to investigate the improvement further and come up with the actual reason and need for an improvement. Consequently, the improvement might have a much larger positive effect and can solve problems normally difficult to find. The improvement sheet should be filled out at once a new improvement is claimed and registered on the waiting list.

The sheet should then be placed on a folder attached to the improvement board and when the improvement is prioritised the sheet should be used as an action plan for the implementation of the improvement. Everything concerning the improvement including the results should be registered on this sheet. This improvement sheet should simplify the implementation process. When the implementation has been followed up and every adjustment and standards have been made and the result has been reported during an improvement meeting the improvement sheet should be place in another folder on the improvement board or in a file near by. Alternatively, the sheet could be progressed on the Webb.

It is vital that the sheet is not too complicated due to the fact that people tend to think it is too much work to fill out the sheet.

Figure 72 shows an example of how such a sheet can be outlined. The outline of the improvement sheet has been inspired of a similar sheet used by Parker Hannifin (2006, external visit).



<b>Improvement Sheet</b>					
Improvement title:	Owner:	Status:	Performed by:	Start date:	Follow up date 1 (after one week)      Follow up date 2: (after one month)
<p><b>1. Improvement description.</b> address a problem or a need                      What does the current situation look like?</p> <p>What purpose does the improvement fill?</p> <p>What benefits does the improvement have?</p> <p><b>Finding the route of the problem</b>                      Why? _____                      Why? _____                      Why? _____                      Why? _____                      Why? _____</p>			<p><b>2. Plan.</b> agree on a practical process.                      What resources and how much time are needed?</p> <p>_____</p> <p>What activities will be required for implementation?</p> <p>_____</p> <p>How to communicate the improvement?</p> <p>_____</p> <p>How to measure and monitor?</p> <p>_____</p>		
<p><b>3. Measure and Monitor:</b>                      The measurements and monitoring showed following result:  <b>Following up 1:</b>                      _____</p> <p><b>Following up 2:</b>                      _____</p> <p style="text-align: center; border-top: 1px solid black; margin-top: 20px;"> <b>Is the improvement completely implemented?</b>  <i>If not, start from the beginning again.</i> </p>					
<p><b>4. Lessons learned:</b>                      Important information to bring forward to future improvements, <i>this information should be notified at next improvement meeting in order to take advantage of the information.</i></p>					

In addition to the daily continues improvements meetings, each section should be able to arrange a Kaizen event. If one or more section has a problem or a critical point they would like to solve or improve a Kaizen event could be a good option, see 2.3.1.1. Except the section or sections organising the event should one Lena Manager and one Lean Champion take part in a Kaizen event. Depending on how big it is and what it concerns the size of the group can be change. However, it is important that the Kaizen event is supervised by a Lean Manager. The Kaizen events could be matched to the Red Team concept applied at SE. When a problem arises at SE a Read Team is put together to only focus on the problem and its salvation. When problems arise, Read Team basically files the same purpose as Kaizen event.

#### 7.1.4 Value stream analysis (VSM) Workshop

Analyse the value stream of each product and create product families. Johansson et al (2005, *p.* 6) and Parker Hannifin (2006, external visit) have both pointed out the importance of organising the company's function with the focus on the product families value stream. The focus on division of product families is vital in the process to focus on the value stream analysis. Change the production site to a value stream oriented production layout. When the production is working comfortably with Lean the value stream analysis should be done on every section of the organisation, or every single value stream within the organisation. In order to do these analyses the products should be divided up to product families. The value streams should then be continuously analysed in order to maintain the improvements of the value stream. The value stream analysis is a continued part of a process which has already started at SE. The same process should be carried out on ever part of the production site to start of with. The intention is to in the future further develop VSM (Value Stream Mapping) on every single part of the organisation, from product development, management to the supply chain.

In a year when SE has started to become comfortable with there Lean organisation its time for SE to have a look at the entire value chain of there products. Which means that its time to start working with there suppliers. If SE have managed to shorten their lead time, it is essential that the suppliers are equally flexible to be able to match the flexibility SE hopefully has build-up.

One day every year should each member of the staff visit their internal customers and suppliers in order to gain understanding and knowledge for their work and the products value stream. If possible visits should also be made to external customers and suppliers, but these visits should be more planned.

#### 7.1.5 Revision of Measurements

Measurements are important in order to observe the changes. The organisation can be measured in many different ways. During the initial implementation and start up of Lean some basic measurements should be done. This measurement aims to make a simple measurement easy to understand and compare; before and after. Such measurements could, according to Johansson (2006, pre-interview), take form as measuring of surface, needs for tools, distance and time spent looking for things as equipment.

When every section has concurred the first implementation of Lean as 5S, visual planning and continues improvement boards the measurements should be developed into more advanced numbers. Johansson et al (2005, p. 33) claims that a number of key measures supporting Lean is an important process. Missing or incorrect key numbers can be a reason for focus on the wrong events which can hinder the development of Lean. The key numbers must support the organisation in order to focus on value adding behaviours. Value adding behaviours mean that everyone in the organisation should be able to measure report and be rewarded for their effort to reduce waste in the processes. In order to gain staff's commitment to the measurements, they must be visualised and used in a way that engage the staff with the key numbers. SE should focus on two kinds of measurements; one which is easy for the individual to relate to e.g., time spent on searching for tools and information each month, how much space is used at current state verses how much space is used after a 5S workshop, how many tools are in circulation before a 5S workshop verses how many tools are in circulation after a number of months from the 5S workshop, what distance are there to reach and fetch tools, equipment and information at current state verse the distance in a near future after a Lean assessment. The second type of measurements should be focusing on the project, the delivery precision, value chains and calculation precision. These recommendations of measurements have earlier been adapted by Note in Torsby and are strongly recommended by Johansson et al. (2005), furthermore, the long term measurements are developed to match SE's Lean goals.

### 7.1.6 Structure Audits

In order to maintain Lean, the author recommends that audits should be held on regularly basis. The audits serve two purposes; one is to maintain and improve implemented Lean activities, the second is to communicate and break boundaries between different sections and hierarchy. The audits should follow a standard for how to audit each particular section. There should also be an overall standard of how to do an audit, concerning the entire company. Different sections should do audits on other section no matter hierarchy.

Each section should have their own board visualizing their work and showing the ratings from the audits. The board will then clearly communicate how far the particular section has come with their Lean work and how well they maintain their implemented Lean tools. The audits serve several purposes, the audits have the potential to be developed into small competitions amongst the different sections, which also triggers the section to maintain and improve their implemented Lean activities. Furthermore, they break boundaries between different hierarchy levels and the management is forced to leave as they learn. The Lean Mentor should have the main responsibility to support the section to work with Lean. See 5S in the theoretical framework, example of a 5S audit. The recommendation of how to work with audits has strongly been influenced by the way Autoliv work with audits.

### 7.1.7 Further Implementation

This part of the conclusion will present a recommendation of how to work with the implementation and maintenance of new Lean tools and activities. The recommendation is based upon the authors gained knowledge from the study and has drawn a conclusion from how SE is working at current state.

### 7.1.8 Implementing new activities and tools

When a new Lean tool, activity or method is to be implemented in the organisation it is recommended by the author that they should be tested and adjusted through a workshop. The workshop will consist of the Lean Managers, organisational managers and one or several Lean Champion; one Champion will be selected to become the owner of the new activity or tool. The Lean Managers has before the workshop gained education and knowledge about the tool and should during the workshop train the other participants. The workshop should work as a test and a way to analyse a suitable adjusted implementation method in order to succeed a sustainable implementation. After the activity has been tested and adjusted it should be implemented on the different section of the organisation. Each section decides for them selves though a request, when they feel mature enough to implement the new activity.

The reason to engage managers beside Lean Managers is to make them believe in the concept and knowledge about Lean and the on going Lean activities in the organisation, consequently the managers will be capable to help to improve the organisation and encourage their own staff. However, if the management is not committed to the change the Lean efforts made will most likely fail.

When planning the workshop and implementation Briner et al (2004, p. 94) claimed three questions needs to be asked and answered:

1. *Why* are we doing this?
2. *What* our assumptions and expectations about the workshop and our roles?
3. *How* are we going to operate?

When the new Lean activity has been adjusted through a workshop and it is ready to be implemented a Lean Champion should gain ownership for the activity. The Champion has the responsibility to train every Mentor. The Mentor should get the training when its section requests the implementation of the activity. The Mentor should then give its staff 15 min training to communicate the purpose, goals and instructions of how to implement and maintain the new activity.

### 7.1.9 Problem which can arise during the implementation

The result from the interviews showed that previous improvement activities implemented in the organisation have been poorly followed up and the result has seldom been visible for the staffs who have been working with the improvement attempt. Consequently, there might be a lack of interest concerning future attempts of improvements. As Olsson (2006, online) mentions, it is important for the staff at SE to see the effect of the Lean change in order to gain trust from them. Even though, Lean is a well known successful concept it is not self-governing. The organisation must have patient and be aware of a long process ahead. By throwing themselves into the improvement work might cause the opposite effect. Extra caution must be paid to where the eliminated waste goes. Does it actual leave the company for god or is it just transformed into another form or another part or activity in the company, as Johansson et al. (2005, p.14) was warning for.

SE must provide for their own character of business, take consideration of what the result of this study actually indicated and not adapt Lean methods straight from another industry without adjusting it to SE. Johansson (2006, pre-interview) mentioned a vital issue concerning the Lean implementation; many companies do not think Lean is anything for them since they have such unique and complicated products and an uneven market demand. This issue is particular vital for SE since their branch of business is difficult to relate to the car industry which invented the concept. However, by following the action plan and continue the training of staff and management at SE the knowledge of Lean should grow and the doubts disappear.

## 8 References

- Aronsson (1994) *SPSS for Windows*. Lund: Studentlitteratur.
- Bobko, P. (2001) *Correlation and regression: principals and applications for industrial/organizational psychology and management*. 2:nd edn. Thousand Oaks, USA: Sage Publications.
- Briner, W., Hasting, C., & Geddes, M. (2004) *Project Leadership*. 2:nd edn. Hampshire: Gower Publishing Limited.
- Burton, T., & Boeder, S. (2003) *The Lean Extended Enterprise: Moving Beyond the Four Walls to Value Stream Excellence*. J. Ross Publishing [Online]. Available at: [http://library.books24x7.com.proxy.lib.chalmers.se/book/id\\_8436/viewer.asp?bookid=8436&chunkid=956365710](http://library.books24x7.com.proxy.lib.chalmers.se/book/id_8436/viewer.asp?bookid=8436&chunkid=956365710) (Accessed: 18 July 2006).
- Börnfeldt, P-O. (2006) 'Förändringskompetens på industrigolvet, Kontinuerligt förändringsarbete i gränslandet mellan lean production och socioteknisk arbetsorganisation', *Arbete och hälsa* [Online]. Available at: [http://ebib.arbetslivsinstitutet.se/ah/2006/ah2006\\_01.pdf](http://ebib.arbetslivsinstitutet.se/ah/2006/ah2006_01.pdf) (Accessed: 5 July 2006).
- Carreira, B. (2005) *Lean Manufacturing that Works: Powerful Tools for Dramatically Reducing Waste and Maximizing Profits* AMACOM [Online]. Available at: [http://library.books24x7.com.proxy.lib.chalmers.se/book/id\\_8853/viewer.asp?bookid=8853&chunkid=547311401](http://library.books24x7.com.proxy.lib.chalmers.se/book/id_8853/viewer.asp?bookid=8853&chunkid=547311401) (Accessed: 6 July 2006).
- Carter, L. (no date) *Lean tools' hammer waste, improve processes* [Online]. Available at: <http://www.af.mil/news/story.asp?id=123022313> (Accessed: 28 June 2006).
- Chase, Jacobs, & Aquilano (2006) *Just-In-Time Production* [Online]. Available at: <http://personal.ashland.edu/~rjacobs/m503jit.html> (Accessed: 17 July 2006).
- De Feo, J. A., & Barnard, W. W. (2004) *Six Sigma Breakthrough and Beyond*. United States of America: The McGraw-Hill Companies, Inc.
- De Treville, S., & Anatonakis, J. (2003) 'Could lean production job design be intrinsically motivating? Contextual, configurationally, and levels-of-analysis issues', *Journal of Operations Management*, ELSEVIER [Online]. Available at: <http://www.sciencedirect.com> (Accessed: 10 June 2006).

- Dennis, P. (2002) *Lean Production Simplified – A Plain Language Guide to the World's Most Powerful Production System*. New York: Productivity Press.
- Dvirc, (2006) *A Brief History of Lean* [Online]. Available at:  
[http://www.dvirc.org/history\\_of\\_lean.pdf](http://www.dvirc.org/history_of_lean.pdf) (Accessed: 4 July 2006).
- Graphic Products, Inc (2005) *What is Kaizen?* [Online]. Available at:  
<http://www.graphicproducts.com/tutorials/kaizen/index.php> (Accessed: 10 July 2006).
- International Institute for Learning (2006) *Lean Project Excellence* [Online]. Available at:  
[http://www.iil.com/webinars/lean\\_project\\_excellence.asp](http://www.iil.com/webinars/lean_project_excellence.asp) (Accessed: 13 June 2006).
- Johansson, O., Broman, M., & Alsterman, H. (2005) *Lean production. Ett strukturerat sunt bondförnuft*. Stockholm: PART development AB.
- Karlsson, E., & Archer, T. (2005). *Relationship between personality characteristics and affect: Gender and affective personality*. Manuscript, Department of Psychology, Göteborg University.
- Kremer, R. J. (2005) *The Lean Office Pocket Handbook* MCS Media [Online]. Available at:  
[http://library.books24x7.com.proxy.lib.chalmers.se/book/id\\_5742/viewer.asp?bookid=5742&chunkid=965513134](http://library.books24x7.com.proxy.lib.chalmers.se/book/id_5742/viewer.asp?bookid=5742&chunkid=965513134) (Accessed: 19 July 2006).
- Kremer, R. J., & Fabrizio, T. (2005) *The Lean Primer. Plant Edition* MCS Media [Online]. Available at:  
[http://library.books24x7.com.proxy.lib.chalmers.se/book/id\\_11574/viewer.asp?bookid=11574&chunkid=0491471358](http://library.books24x7.com.proxy.lib.chalmers.se/book/id_11574/viewer.asp?bookid=11574&chunkid=0491471358) (Accessed: 6 July).
- LEAD (2004) *Lean Definition* [Online] Available at:  
<http://www.leanadvisors.com/Lean/glossary/definition.cfm/Word/Lean.cfm> (Accessed: 14 July 2006).
- Lean forum *Lean thinking = Filosofin bakom de framgångsrika* [Online]. Available at:  
<http://www.leanforum.se/thinking.asp> (Accessed: 13 June 2006).
- Liker, J. K. (1998) *Becoming Lean: Inside Stories of U.S. Manufactures* Productive Press [Online] Available at:  
[http://library.books24x7.com.proxy.lib.chalmers.se/book/id\\_4421/viewer.asp?bookid=4421&chunkid=0435270347](http://library.books24x7.com.proxy.lib.chalmers.se/book/id_4421/viewer.asp?bookid=4421&chunkid=0435270347) (Accessed: 7 July 2006).
- Malloy, J. (2004) *Lean Production* [Online]. Available at:  
[http://searchcio.techtarget.com/sDefinition/0,,sid19\\_gci810519,00.html](http://searchcio.techtarget.com/sDefinition/0,,sid19_gci810519,00.html) (Accessed: 17 July 2006).
- MAMTC (no date) *A Brief History of Lean Manufacturing* [Online]. Available at:  
[http://www.mamtc.com/lean/intro\\_intro.asp](http://www.mamtc.com/lean/intro_intro.asp) (Accessed: 3 June 2006).

- Mann, D. (2005) *Creating a Lean Culture: Tools to Sustain Lean Conversions* Productivity Press [Online]. Available at:  
[http://library.books24x7.com.proxy.lib.chalmers.se/book/id\\_11437/viewer.asp?bookid=11437&chunkid=0601538432](http://library.books24x7.com.proxy.lib.chalmers.se/book/id_11437/viewer.asp?bookid=11437&chunkid=0601538432) (Accessed: 6 July 2006).
- May, M. (2005) 'Lean Thinking for Knowledge Work', *Quality Progress*; June 2006; 6, ABI/FORM Global p.g. 33 [Online]. Available at:  
[http://proquest.umi.com.proxy.lib.chalmers.se/pqdweb?RQT=305&querySyntax=PQ&searchInterface=1&moreOptState=CLOSED&TS=1150970138&h\\_pubtitle=&h\\_pmid=&clientId=19460&JSEnabled=1&SQ=Lean+Thinking](http://proquest.umi.com.proxy.lib.chalmers.se/pqdweb?RQT=305&querySyntax=PQ&searchInterface=1&moreOptState=CLOSED&TS=1150970138&h_pubtitle=&h_pmid=&clientId=19460&JSEnabled=1&SQ=Lean+Thinking) (Accessed: 24 June 2006).
- McBride, D. (2006) *The 7 Manufacturing Wastes* [Online]. Available at:  
<http://www.emsstrategies.com/dm090203article2.html> (Accessed: 17 July 2006).
- MCS Media (2003) *The Lean Pocket Guide: Tools for the Elimination of Waste!*, MCS Media [Online]. Available at:  
[http://library.books24x7.com.proxy.lib.chalmers.se/book/id\\_5740/viewer.asp?bkid=5740&image\\_src=http://images.books24x7.com.proxy.lib.chalmers.se/bookimages/id\\_5740/035a%5F0%2Ejpg&image\\_id=38&previd=IMG\\_38&title=Kaizen+Workshops](http://library.books24x7.com.proxy.lib.chalmers.se/book/id_5740/viewer.asp?bkid=5740&image_src=http://images.books24x7.com.proxy.lib.chalmers.se/bookimages/id_5740/035a%5F0%2Ejpg&image_id=38&previd=IMG_38&title=Kaizen+Workshops) (Accessed: 17 July 2006).
- MEPoL (2006) *Lean Office*. Available at: <http://www.mepol.org/site59.php> (Accessed: 3 July 2006).
- Messmer (2001) *Motivating Employees For Dummies*. New York: John Wiley & Sons [Online]. Available at: Available at:  
[http://library.books24x7.com.proxy.lib.chalmers.se/book/id\\_5332/viewer.asp?bookid=5332&chunkid=286295646](http://library.books24x7.com.proxy.lib.chalmers.se/book/id_5332/viewer.asp?bookid=5332&chunkid=286295646) (Accessed: 9 August 2006).
- Mortberg, M. (2006) 'vi blir bara bättre!', *Saab Space intranet* [Online]. Available at:  
[http://intranat/Nyheter/dokument/2006/september/vi\\_bli\\_bar\\_battre.htm](http://intranat/Nyheter/dokument/2006/september/vi_bli_bar_battre.htm) (Accessed: 29 September).
- Nordfeldt, L. (2006) *About Saab Ericsson Space* [Online]. Available at:  
<http://www.space.se/en/AboutUs/> (Accessed: 11 August 2006).
- Olsson, J. 'Så gick NOTE Torsby över till Lean production', *Elektronik i Norden*. 16 June [Online]. Available at:  
[http://www.evertiq.se/newsx/read\\_news.aspx?newsid=9606&cat=20](http://www.evertiq.se/newsx/read_news.aspx?newsid=9606&cat=20) (Accessed: 10 August 2006).
- Parker, S. (2003) 'Longitudinal Effects of Lean Production on Employee Outcomes and the Mediating Role of Work Characteristics', *Journal of Applied Psychology*, 88 (4), 620-634 (Accessed: 3 June 2006).
- Pipinich, R. E. (2006) 'High-stakes creativity Employees with perspective can turn your company into a valuable work of art', *Industrial Engineer*, 38, 6; ABI/INFORM Global pg. 30 [Online]. Available at:  
[http://proquest.umi.com.proxy.lib.chalmers.se/pqdweb?RQT=305&querySyntax=PQ&searchInterface=1&moreOptState=CLOSED&TS=1150970138&h\\_pubtitle=&h\\_pmid=&clientId=19460&JSEnabled=1&SQ=Lean+Thinking](http://proquest.umi.com.proxy.lib.chalmers.se/pqdweb?RQT=305&querySyntax=PQ&searchInterface=1&moreOptState=CLOSED&TS=1150970138&h_pubtitle=&h_pmid=&clientId=19460&JSEnabled=1&SQ=Lean+Thinking) (Accessed: 22 June 2006).

- Poppedieck, M. (2002) 'Principles of Lean Thinking' [Online]. Available at: <http://www.PsycInfo.se> (Accessed: 3 June 2006)
- Productivity Press Development Team (2002) *Kaizen for the Shop floor*. Productive Press. [Online]. Available at: <http://library.books24x7.com.proxy.lib.chalmers.se/books.asp?task=search> (Accessed: 10 July 2006).
- Shinkle, G., Gooding, L., & Smith, M. (2004) *Transforming Strategy into Success: How to Implement a Lean Management System*. Productive Press [Online]. Available at: [http://library.books24x7.com.proxy.lib.chalmers.se/book/id\\_7486/toc.asp](http://library.books24x7.com.proxy.lib.chalmers.se/book/id_7486/toc.asp) (Accessed: 3 July 2006).
- SIFU (2006) *Produktionsutveckling med Lean Production*. Denmark: Scandinavian Enterprise Management AB.
- Six Sigma. (2003) *Kaizen Event* [Online]. Available at: [http://www.isixsigma.com/dictionary/Kaizen\\_Event-411.htm](http://www.isixsigma.com/dictionary/Kaizen_Event-411.htm) (Accessed: 13 July 2006).
- Strategos (no date) *The Kaizen Blitz – Is It Right For You?* [Online]. Available at: [http://www.strategosinc.com/kaizen\\_blitz.htm](http://www.strategosinc.com/kaizen_blitz.htm) (Accessed: 30 June 2006).
- Söderqvist, L. (2004) *Ständiga förbättringar*. Lund: Studentlitteratur.
- Söderqvist, L. (2004) *Ständiga förbättringar*. Lund: Studentlitteratur.
- Tomo (2006) *Kaizen* [Online]. Available at: <http://www.isixsigma.com/dictionary/Kaizen-42.htm> (Accessed: 22 June 2006).
- Toyota Motor Sales, U.S.A., Inc. (2006) 'Overview of Toyota's North American Engineering and Manufacturing' [Online]. Available at: <http://www.toyota.com/about/operations/manufacturing/index.html> (Accessed: 5 July 2006).
- Trapping, D. (2005) *The Lean Office Pocket Guide: Tools for the Elimination of Waste in Administrative Areas!* New York MCS Media [Online]. Available at: [http://library.books24x7.com.proxy.lib.chalmers.se/book/id\\_11022/viewer.asp?bookid=11022&chunkid=726818367](http://library.books24x7.com.proxy.lib.chalmers.se/book/id_11022/viewer.asp?bookid=11022&chunkid=726818367) (Accessed: 6 July 2006).
- Veech, D. (2004) 'A person-centered approach to sustaining a lean environment –job design for self efficacy', *Defense AR Journal*, August-Novemeber 2004 [Online]. Available at: [http://www.findarticles.com/p/articles/mi\\_m0SVI/is\\_2004\\_August-Nov/ai\\_n15862594/pg\\_12](http://www.findarticles.com/p/articles/mi_m0SVI/is_2004_August-Nov/ai_n15862594/pg_12) (Accessed: 3 June 2006).
- Venkatesh, J. (2005) *An Introduction to Total Productive Maintenance (TPM)*. [Online]. Available at: [http://www.plant-maintenance.com/articles/tpm\\_intro.shtml](http://www.plant-maintenance.com/articles/tpm_intro.shtml) (Accessed: 7 July 2006).



Verble, D. (2006) *The Paradox of Toyota: Continuous Improvement through a Standardized Change Process*. [Workshop to Lean Conference]. 4 October 2006.

WMEP (2005) *Total Productive Maintenance*. [Online]. Available at: <http://www.wmep.org/tpm.html> (Accessed: 7 July 2006).

Womack, J., & Jones, J. (2003) *Lean Thinking –banish waste and create wealth in your corporation*. London: Simon & Schuster UK Ltd.

## 9 Bibliography

Boddy, D. (2002) *Managing Projects, Building and Leading the Team*. Harlow: Pearson Education Limited.

Flinchbaugh Engineering (2006) 'Lean Success Improves Line-Transfer Strategy', *Quality*; Mar 2006; 45, 3; ABI/INFORM Global pg. 52. Available at: [http://proquest.umi.com.proxy.lib.chalmers.se/pqdweb?RQT=305&querySyntax=PQ&searchInterface=1&moreOptState=CLOSED&TS=1150970138&h\\_pubtitle=&h\\_pmid=&clientId=19460&JSEnabled=1&SQ=Lean+Thinking](http://proquest.umi.com.proxy.lib.chalmers.se/pqdweb?RQT=305&querySyntax=PQ&searchInterface=1&moreOptState=CLOSED&TS=1150970138&h_pubtitle=&h_pmid=&clientId=19460&JSEnabled=1&SQ=Lean+Thinking) (Accessed: 29 June 2006).

Frater, M. (2005) 'No Time, No Money? Get Lean', *Journal of Housing and Community Development*; Nov/Dec 2005; 62, 6; ABI/INFORM Global pg. 6. Available at: [http://proquest.umi.com.proxy.lib.chalmers.se/pqdweb?RQT=305&querySyntax=PQ&searchInterface=1&moreOptState=CLOSED&TS=1150970138&h\\_pubtitle=&h\\_pmid=&clientId=19460&JSEnabled=1&SQ=Lean+Thinking](http://proquest.umi.com.proxy.lib.chalmers.se/pqdweb?RQT=305&querySyntax=PQ&searchInterface=1&moreOptState=CLOSED&TS=1150970138&h_pubtitle=&h_pmid=&clientId=19460&JSEnabled=1&SQ=Lean+Thinking) (Accessed: 29 June 2006).

Holweg, M. (2006) 'The genealogy of lean production', *Journal of Operations Management*, vol. 25 nr. 2 ELSEVIER [Online]. Available at: <http://www.sciencedirect.com> (Accessed: 10 June 2006).

Ivf (2005) 'Lean produktutveckling används utav fler och fler företag', *Underleverantören*. March [Online]. Available at: [http://www.ivf.se/upload/pdf-filer/artiklar\\_fran\\_ivf/ulev\\_3-05.pdf](http://www.ivf.se/upload/pdf-filer/artiklar_fran_ivf/ulev_3-05.pdf). (Accessed: 9 August 2006).

*Lean Tools* (2006) [Online] Available at: <http://www.mepol.org/site59.php> (Accessed: 14 June 2006).

Olsson, J (1996) *Kanban-an Integrated JIT System* [Online] Available at: <http://www.geocities.com/TimesSquare/1848/japan21.html> (Accessed: 14 June 2006).

Sowards, D. (2005) 'Waste is everywhere but isn't inevitable', *Contractor*; Dec 2005; 52, 12; ABI/INFORM Global pg. 50. Available at: [http://proquest.umi.com.proxy.lib.chalmers.se/pqdweb?RQT=305&querySyntax=PQ&searchInterface=1&moreOptState=CLOSED&TS=1150970138&h\\_pubtitle=&h\\_pmid=&clientId=19460&JSEnabled=1&SQ=Lean+Thinking](http://proquest.umi.com.proxy.lib.chalmers.se/pqdweb?RQT=305&querySyntax=PQ&searchInterface=1&moreOptState=CLOSED&TS=1150970138&h_pubtitle=&h_pmid=&clientId=19460&JSEnabled=1&SQ=Lean+Thinking) (Accessed: 29 June 2006).

U.S. Environmental Protection Agency (2006) *Lean Manufacturing and the Environment*. Available at: <http://www.epa.gov/lean/thinking/fives.htm> (Accessed: 26 June 2006).

## 10 Appendix A

### Improvements

How often do you give suggestions to improvements in your work, and how often do you implement them?

Do you feel as you are supported by your managers when you want to implement your suggestion of improvements?

What do you think encourage and stimulate people and yourself to take initiative to improve?

### Waste elimination and understanding for work

Do you understand the underlying assumption of why your working tasks should be performed?

Do you understand what your working tasks contribute to customers (internal & external)?

Do you consider your work to consist of unnecessary actions and processes?

Do you think you and your co-workers are having enough knowledge and information in order to perform the working tasks optimised?

Do you think that increased availability of information concerning your work should contribute to increased understanding for your working tasks?

Do you think that increased understanding from customer and supplier (internal & external) would simplify your work and vice versa?

### Standardised working methods

Do you work after standardised working methods?

How are the standards outlined and created?

**Maintenance of equipment**, this part of the interview mainly concerned interviewee working on the production site.

Do you call for help if problems occur concerning tools or products, or do you mend it yourself?

Do you think increased maintenance of tools and machinery would enhance the chances of discover problems at an earlier stage.

To what extent do you think increased ownership of processes would affect the personal knowledge of the equipment positively?

### **Team climate**

Do you consider the team climate to be satisfying at your work site?

Do you wish the team climate was better?

How do you think your team climate affects your work?

Do you think the communication is good

- Between you and your manager?
- Between you and your customers (if relevant)?
- Generally at your working site?

### **Orderliness and routines**

Do you consider yourself and your co-workers to spend a lot of time looking for information and tools daily?

What does the routines for orderliness and keeping the work place tidy looks like?

Do you wish the routines were better?

Do you think improved routines of how to keep the work site in order would improve the daily work?

### **Other questions and comments concerning the interview or Lean?**

## 11 Appendix B

### Saab Space's Lean questionnaire 2006

---

1. Which section do you belong to?

PA     PB     PC     PD     PK     PL     PI     PS

### *Improvements*

2. How often do you give suggestions to improvements in your work?

Never

Often

0     1     2     3     4     5     Don't know

---

3. How common is it that you implement your ideas and suggestion how to improve your work?

Never

Always

0     1     2     3     4     5     Don't know

---

4. To what extent do you find that your manager supports you to implement your suggestion to improvement?

Never

Always

0     1     2     3     4     5     Don't know

---

**5. What do you think encourage and stimulate people and yourself to take initiative to improve?**

- Improvement boards
- Increased own responsibility
- Reward
- Increased response from manager
- Improvement groups
- Help internal and external customers to succeed
- Other, comments below
- Don't know

**5b. Comments.**

## ***Waste elimination***

**6. To what extent do you know the reason why you work has to be done?**

Not at all

Very well

- 0   
  1   
  2   
  3   
  4   
  5   
  Don't know

**7. To what extent do you know what your work task contributes to internal and external customers?**

Not at all

Very well

- 0   
  1   
  2   
  3   
  4   
  5   
  Don't know

**8. To what extent do you find your work consists of unnecessary work issues and work processes?**

Not at all

Too much

0    1    2    3    4    5    Don't know

---

## ***Teamwork***

**9. To what extent do you feel good together with your co-workers?**

Not at all

Very good

0    1    2    3    4    5    Don't know

---

**10. Do you function as a team?**

Not at all

Very much

0    1    2    3    4    5    Don't know

---

**11. To what extent do you wish that the team climate was better in your work site?**

Can only be better

Can't be better

0    1    2    3    4    5    Don't know

---

## ***Orderliness and routines at work***

**12. How often do you waste your daily time searching for information and tools?**

Often

Never

0    1    2    3    4    5    Don't know

---

13. How do you consider the orderliness at your work site to be?

Bad

Very good

0    1    2    3    4    5    Don't know

---

14. To what extent do you wish that the orderliness was better?

Not at all

Much better

0    1    2    3    4    5    Don't know

---

15. To what extent do you wish that the routines for order were better kept in control?

Not at all

Much better

0    1    2    3    4    5    Don't know

---

***Attitudes toward organisational changes at work,  
Choose the answer alternative which YOU think matches your  
attitude. Fill in the answer quickly without too much thinking.***

16. I consider my self as open towards changes?.

Almost never

Almost always

0    1    2    3    4    5    Don't know

---

17. I deal with changes better than most co-workers?

Almost never

Almost always

0    1    2    3    4    5    Don't know

---

**18. When great changes occur in this company I can handle them very good?**

Almost never

Almost always

0     
  1   
  2   
  3   
  4   
  5     
  Don't know

---

**19. Changes gives me possibilities?**

Almost never

Almost always

0     
  1   
  2   
  3   
  4   
  5     
  Don't know

---

**20. Rapid changes are something I can handle?**

Almost never

Almost always

0     
  1   
  2   
  3   
  4   
  5     
  Don't know

---

**21. Facing changes I try to react rationally and not by affect?**

Almost never

Almost always

0     
  1   
  2   
  3   
  4   
  5     
  Don't know

---

**22. I welcome changes instead of complaining?**

Almost never

Almost always

0     
  1   
  2   
  3   
  4   
  5     
  Don't know

---

**23. I welcome changes in this company even though I don't know what they will mean to me?**

Almost never

Almose always

0     
  1   
  2   
  3   
  4   
  5     
  Don't know

---

**24. To some extent I am resistant to changes that concerns my work?**

Almose never

Almose always



0       1    2    3    4    5       Don't know

---

**25. Great changes develop the company at the end?**

Almoste never

Almoste always

0       1    2    3    4    5       Don't know

---

**26. Have you any personal comments concerning the survey or Lean?**