Implement Lean Production in small companies

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Abstract

This study has been carried out within the field of Lean Production. It has been aimed to investigate how a small company could implement the philosophy in own organisation. The work with this dissertation has been carried out in cooperation with Österbergs Förpackningsmaskiner AB with the goal to create recommendation for the company in how they could implement Lean Production. In order to answer the question what should a small company focus on to implement the Lean Production concept successfully, an investigation in four middle sizes companies in the south and western parts of Sweden were visited. One interview was carried out with a responsible manager at all the four companies and a questionnaire was handed out to workers, in order to compare the Lean companies with company that not are working with Lean. The aim was to see if there were any large differences between the companies in the way they are working and inform the employees. The four companies were found in different Swedish technical production magazines, they were all middle sizes companies that had been working different long with the principles.

The interview and questionnaire did show that a company should implement Lean Production if they wanted to accomplish more in the own organisation with teamwork and get more engagement from the employees. They had realised that they could not stay in the traditional Taylorism ways of working when the employees do not need to be involved in the planning and steering of the work. It is important that all co-workers know the vision and goal why a company are implementing Lean Production. The interview companies did almost follow the same pattern whit the implementation and that this had work quite well. The idea is not try not to do any different between manufacturing and administration departments with the implementation. Run the same basic training for all employees in the beginning. Go to other companies that has implement the way of working after the first course to visual the information in how it

could work and then start to change the own organisation in a clear visible area of the company so everybody could see that something is going on.

It is important to realise that Lean Production is not a successful tool that you can apply in a company and expect success straight away. It is a way of thinking; it is important to understand the concept and go the whole way in the company when implementing it and also to work with the company's suppliers and consumers. This thesis has tried to give some recommendation to a small company in what they should think about if they choose to implement Lean Production. But it is difficult to give any over gripping suggestion in how a company should do, instead be honest about the own organisation, understand that no process are fulfil, it could always be better. Do like the company that developed Lean, look at companies that are better yourself, take the best parts of if and develop them into your own organisation. A common mistake is to take on too much, pick a few boulders to work on each year, it took Toyota, the company behind lean production, more then 30 years to develop the system, and they are still improving it.

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Introduction

CHAPTER 1

Background

The concept of Lean Production arrived to Sweden in the mid 1980's from Japan and United States of America, but it was mostly the larger companies that adopted the techniques. Now, middle and small companies has started to adapted the Lean production concepts and several articles is written about the concept that has become 'extreme production makeover' (NyTeknik, 2006). After been studding Lean Production theoretical, an interest started to grow in how the concept actual works out in Swedish companies and how it could be implemented in a small 'none Lean' organisation. The questions that this dissertation investigates concern what some Swedish companies made change there way of working and how difficult it is to change over an old production strategy and change established routines into a new way of working. Which parts should a small company focus on to successfully implement Lean Production? A big part of the Lean Production philosophy is to make the leaders actually go to the place where it happens. In a factory for example, go to the workshop and understand the process, be in the process and work for the process. That is why this dissertation investigates the concepts of Lean Production in several companies, where products really are being made. The aim is to come up with conclusions for a small 'none Lean' organisation, in what they should focus on to successfully implement the Lean Production concept.

Purpose

What is Lean Production and what should a small company focus on to implement the concept successfully? This was the major question to be investigated in this work. A challenge is that the way of thinking is original Japanese and the Japanese culture are different from the Swedish culture. How is the concept working in companies in Sweden and which of the Lean Production concepts could work at a small Swedish company? The dissertation focuses on the concept of Lean Production with nine underlying questions.

Company Goal

- Why should a company start to implement Lean Production?
- Which strategically goal should the company have in that case?

Implementation

- How should a company implement Lean Production?
- What should a company focus on?
- Which time perspective should a company have?
- How should a company plan and arrange the work?

Employees

- How does a company motivate and educate its employees within lean work?
- How much time will a company have to spend on Lean Production in its daily work?

Results

- Which benefits could a company gain when changing into Lean Production?

This dissertation will just investigate one small company in the Swedish manufacturing business. It will investigate the possibility to implement this production philosophy at this company. With the focus on how four other companies have done. However, four other small companies are studied in respect of what they experienced when going though a similar change process.

Research Strategy

The work with this thesis was divided into three phases:

1. Concept phase
2. Interview phase
3. Evaluation phase

The *Concept phase* started out with participation in Lean Forum Sweden conference 2006 where the latest in Lean Production from the USA, the UK and various Swedish companies were presented their work and routines. Two weeks was then spent at the small 'none Lean' company to learn the way they are working right now. Mostly was the work in the assembly workshop that was undertaking a study of how they are working and to know the people. During this time a literature research was also been caring out in the subject to understand the concept. The experiences from the time at the company and from the literature review built a base to plan and prepare a number of interviews and to develop a questionnaire.

In the first part of the *Interview phase* a test questionnaire was handed out in the small company to be tested. Some minor changed was then made after feedback sessions. Then the questionnaire was handed out in the company. Four visits for the purposes of study were then planed and made in different companies in the south and west parts of Sweden that is working with Lean Production. The different companies were choice because three of them were often used as good examples for working with Lean in technical magazine, and had been working with the concept various times. The last company was choice because they had recently implemented the Lean way of working, in the last year, and could answer if the implementation had any child diseases. Also was three consulting agencies contacted and interview to investigate possible help with an implementation.

In the *Evaluation phase* the interviews, that had been digital recorded, was first written out and analysed into tables. The aim was to see structure in how these companies had implement and are working with Lean Production. The results of the data from the interviews were used to draw conclusions in which areas and how a small company should start working with Lean Production. The results from the questionnaire were used to compare the current status in the workshop at the company that is not Lean against them who is. So suggestion could be given in which parts an implementation should focus on first for this small company.

Literature Review

CHAPTER 2

History

To understand the concept of Lean Production, this chapter gives a short retrospect about the development of mass production, how the company that developed the philosophy behind Lean Production, Toyota Motor Corporation, invent the concept that they started to call Toyota Production System, and how the concept started to spread world wide.

Frederick Winslow Taylor, a manager from Philadelphia in the end of the 19th century, laid the foundation for mass production with his time and motion study, presented in his text "The Principles of Scientific Management" (Åhlström, 1998). It was later named as Taylorism. Taylor's system was to separating planning from production, standardized the work, identifying the best and easiest way to do the job reduce cycle time, the time it takes for a given process. In the beginning of the 20th century Henry Ford developed the ideas with the introduction of the moving assembly line and the T Ford (Dennis, 2002). Ford standardized the parts to the model so he could manufacture a large amount of the parts and transport it to the very efficient assembly line. This system made the model T become comparatively cheap to build and a product for normal people. But this also made that quality took a back seat to production and the defect rates were very high by current standards. Workers were not involved in the organization of the work, in order to reduces the action required of each worker (Dennis, 2002).

In 1950 an engineer from Toyota Motor Company, Eiji Toyoda, visited one of the Fords plant in Detroit to study the plant in an exchange program between the occupying America and Japan after the WWII. The feeling he got from the final assembly line was that everything in the line was moving along in a smooth, synchronous pace. But Eiji noticed that this was just the case along the line, virtually every other stage of the process, parts and materials were produced in discrete large

batches (Nicholas & Soni, 2006). The result was huge amounts of inventory everywhere, wasted motions, wasted materials and huge effort to organise everything. After the return to Japan, which at that time was a country in deep depression, Eiji and one production manager Taiichi Ohno concluded that Fords mass production would not work in Japan, also that there were some possibilities to improve the production system (Dennis, 2002). Japan had during this time very underprovided infrastructure, as constantly power losses, lack of good roads, etc. which demand that everything that was made really was necessary and with high quality. So Toyota developed procedures and modifications that made equipment multipurpose, movable, and easy to adapt to producing a range different parts for different products. They developed the capability to produce the parts efficiently in small batches, when they needed it, and synchronised the whole production, not just the final assembly line. The beginning of the Toyota Production System that Taiichi Ohno, explains the concept with: "All we are doing is looking at the time line from the moment the customer gives us an order to the point when we collect the cash. And we are reducing that time line by removing the non-value-added wastes." (Liker 2004). It took Ohno almost 30 years to perfect the system and drive it through Toyota Motor Company and during the 1960s and 1970s they spread the system to suppliers and later other industries in Japan.

In the beginning of the 1980s, the American televisions network CBS showed a documentary “If Japan Can, Why Can’t We?” with the aspect that the Japanese products had become so much cheaper and with higher quality than the American products (Bicheno 2004). At the same time Toyota formed a joint venture with General Motors (GM) to start up a light truck factory in Fremount, California, that had been closed by GM (Liker, 2004). The factory became called NUMMI (New United Motor Manufacturing) and against GM advice Toyota took over the management of the plant. With the old workers, and union that had a hostile attitude against the TPS that it was just a basically speed up, work harder principles. They started the work to rebuild the factory and teach the employees the new production system. For example, they sent a shop committee from Fremount to the plant in Japan for three week to teach the principles on site in a factory so they really could understand the system and they then when came back they could convince sceptical employees that the TPS was not so bad (Liker, 2004). In 1984, under the Toyotas new management, it surpassed all of GM’s plants in North America in productivity, quality, space, and inventory turns. David Verble from LEArN Enterprise Group was lecturer at the Lean Forum conference 2006. He told about his experiences from when he once visited NUMMI and spooked with workers that had been worked for GM and then been a part of the renewal under Toyota. A worker said that ‘the different is this much’ and showed it with is thumb and finger.

In 1985 Massachusetts Institute of Technology started a five year study on the future of the automobiles, the International Motor Vehicle Program, which becomes a groundbreaking analysis of the worldwide move from mass production to, as they started to call it, Lean Production. The findings were presented in the book *The Machine that Change the World* (Womack et al. 1990) and describe Lean Production that it is based on the principle that more can be produced while reducing waste. In order to give the costumers exactly what they want, when they want it with focus on flexibility. They claim in this book that Lean Production is not only the world's most efficient system for manufacturing cars. It is the best way of organizing all kinds of industrial production, featuring both dramatic increases in productivity and qualitative improvements in working conditions. Holweg (2006) writes in his articles *The genealogy of lean production* about several articles that was presented in the 1980s and claims that the by the mid 1980s considerable knowledge about the Toyota Production System were already available and the ‘Machine’ book did not present any

new facts. The book has been criticised in various ways, for example did Williams et al. (1992) criticise the measurement process and lack of secondary data in the book they say glorify the findings in the industry. Treville et al. (2006) argue in a resent article that workers in Lean Production organization are working in highly limiting and provocative conditions; ‘‘motivation’’ in the best case is external, with standardized processes reduce worker autonomy almost completely and that lean production jobs simply cannot be intrinsically motivating. One of the more controversial lean production practices attempts to increase utilization by providing employees with less time than needed to accomplish a given task. Mehri (2005) writes in his article about his three year as a working American engineer in a Japanese company in Japan and claims that it is fundamental to understand the Japanese culture with ‘what you are supposed to feel and say’ and ‘what you actually feel and say’ when to investigate the production system in Japan. Mehri writes that if someone is investigating the company a worker is supposed to fake a good-nature and not show your true feeling, and it is really easy to misperceive how the Toyota Way are working in the workplace, he claims that the reality turned out to be far from the theory.

Principles

In order to understand and answer the main question in this thesis “What is Lean Production” and to be prepared before the interviews this section describes the principles Lean Production are based on. Articles written by Schonberg (2006) and Åhlstöm (1998) claims that companies are missing out a lot if they not look at the whole picture. That is why this section also includes the 14 principle that Liker (2004) writes about the Toyotas Productions System. The different principles will later be discussed with the results from the investigations to be able to summer up what a small company should focus on to implement the concept successfully.

Lean Productions 5 Principles

In the book *The Machine that Changed the World* (Womack et al. 1990), the authors suggested five lean principles and that this literally meant life or death for a company, (at least in automotive industry). The principles were renewed in the book *Lean Thinking* (Womack & Jones, 1996), and focused more on how to add value in any manufacturing company or service not just to reduce waste. The five principles are:

1. Specify value from the point of view of the customer. This means that the customer buys results, not products, and that any company needs to identify and begin product design and manufacture by focusing on what their customers need and want. It is as simple as the old expression “give the customer what they want” and not what is convenient for the manufactures.

2. Value Stream. Value Stream techniques focus on one object or product in the company not the viewpoint or the department of process step. The principle is to focus on the whole supply chain, from customers’ orders, to the planning department, orders of raw material from different suppliers and then the value adding steps for the product, emphasising economics of time rather than economics of scale. Value is added to a product while someone is working on the piece, non value adding steps are when the product is waiting in batches or stocks, which is waste.

3. Flow. This principle tries to describe that it is important to make the product move through one value adding step to the next one and keep the product in constant one-piece flow. Companies should avoid batches and queues, or at least continuously reduce them and never delay a value adding step by a non value adding step.

4. Pull. Pull means meeting consumer's rates of demand with production but not over producing. Most organisations will have to push to a certain point and response to a final costumer from that point. The idea with Lean is to push this point as long upstream in the product making process as possible, wait for a demand and then make the product fast and with high quality. So if the delivered products have any defect, only a small batch of products will have been affected.

5. Perfection. The last principle seems more possible after the other four principles. Perfections does not only mean quality, it also means producing exactly what the costumer wants, exactly when they want it, to a fair price and with minimum waste.

Toyotas 14 Principles

Some companies have used the five principles and adapted them to fast with no real deeper philosophy behind the implementation. Åhlstöm (1998) writes that it is important to look at the whole picture and it is first necessary to change the employees' attitudes to quality in order to attain a material flow containing only value adding operations. Fujio Cho, President of Toyota Motor Company is cited in the book *The Toyota Way* (Liker 2004) that "The key to the Toyota Way and what makes Toyota stand out is not any of the individual elements… But what is important is having all the elements together as a system. It must be practiced every day in a very consistent manner – not in spurts."

1. Base Your Management Decisions on a long-Term Philosophy, Even at the Expense of Short-Term Financial Goals – This is the foundation for all other principles. All decisions should be taken to generating value to the company, its employees, the customers and the society as a whole. This principle should be the starting point, not just for product/service design efforts, but for every function in the company. All managers must all take responsibility, the job should be a mission greater then earning a pay check.

2. Create Continuous Process Flow to Bring Problems to the Surface – Flow means reducing all time a product or item is waiting for someone to work on it. Reduce all the none-value added time and make one-piece flow. Benefit of one-piece flow: Builds in quality, Creates real flexibility, Creates higher productivity, Frees up floor space, Improves safety, Improves Morale, Reduce cost of inventory. Flow is one of the keys to true continuous improvement process and to developing people. Everyone is forced to solve the problem so team members have to think and through thinking team members grow and become better people.

3. Use "Pull" System to Avoid Overproduction – The principle means that the customer pull and company replenishment. Receive items only when you demand and the retailer receives product based on actual customer demand but, try to flow where you can, pull where you must. Stock relatively small amounts of each product and restock the supermarket shelf frequently, based on what the customer actually takes away. Small laminated kanban cards could be used to say when an operation should be trigged.

4. Level Out the Workload – Work like the tortoise, not the hare. Eliminating muda (waste) is only one third of achieving flow; eliminating muri (overburden) and smoothing mura (unevenness) are equally important. The only way to realistically create a continuous flow is to have some stability in the workload. Toyota works to find many clever ways to level the workload, spikes and peaks are handled through flexible workforces brought in from contracting companies and suppliers. Look for a smaller number of part number and that are big in demand and perhaps even seasonal,

build those when you have few real orders and then keep those in inventory, goes against principle 3.

5. *Build a Culture of Stopping to Fix Problems, to Get Quality Right the First Time* – When there is a problem, do not just keep going with the intention of fixing it later. Stop and fix the problem now. Productivity may suffer now, but in the long run productivity will be enhanced as problems are found and countermeasures put in place. It is necessary to stop the line if companies want to continually improve the process. The closer you are to one-piece-flow, the quicker quality problems will surface to be addressed. The employees feel the responsibility – they feel the power – they know they count. Keep quality control simple and involve team members.

6. Standardised Tasks Are the Foundation for Continuous Improvement – Toyota has found that standards actually can help people control their own work. Standardisation is often confused with inflexibility but for Toyota it is the best practise methods. If the worker had followed the standard list and a problem occur, then the standards need to be modified design and improved upon. Capturing knowledge is not difficult, the hard part is getting people to use the standards and contribute to improving it.

7. Use Visual Control So No Problems Are Hidden – Clean the work place, make every part or item visual. Use 5S (sort, straighten, shine, standardise, sustain) to obtain reduced cycle times, increased floor space, improved working conditions, better work team performance etc. People are visual creatures. They need to be able to look at their work, look at the parts rack, look at the supermarket of parts, and easily see whether they are in a standard condition or a deviation from the standard. People looking at well-designed charts on a wall can have very effective discussions.

8. Use only Reliable, Thoroughly Tested Technology That Serves Your People and Processes – Toyota has had experiences with pushing the latest and greatest technology, and now avoids repeating this mistake. Adoption of a new technology must support your people, process, and values. But Toyota is always interested in being current in their technology and encourages their people to “think outside the box” when considering new approaches to work. Personal contact makes a difference and improving the process is the only way you can control inventory.

9. Grow Leaders Who Thoroughly Understand the Work, Live the Philosophy, and Teach It to Others – Toyota are growing their leaders rather than purchasing them. Because changing the culture each time a new leader comes into office necessarily means jerking the company about superficially, without developing any real depth of loyalty from the employees. It is the basic way of thinking that goes back to principle 1. Lean Productions is only effective with the right management and the right philosophy.

10. Develop Exceptional People and Teams Who Follow your Company’s Philosophy – People drive continuous improvements; invest in people and in return get committed associates who show up to work every day, on time and are continually improving their operation. Toyota has a strong internal culture that they often refer to as their DNA. Toyota is very conscious of the importance of maintaining this DNA in all their associates and works hard to continually reinforce the culture. But do not implement work teams before you do the hard work of implementing the system and culture to support them. After that it is all about challenging them to do better and respecting employees at the same time.

11. Respect Your Extended Network of Partners and Suppliers by Challenging Them and Helping Them Improve – The power of supply chain is far more than Information

Technology, it is the power of ingenuity and relationship. Find solid partners and grow together to mutual benefit in the long term. Have high expectations for your suppliers and treat them fairly and teach them the definition of respect.

12. Go and See for Yourself to Thoroughly Understand the Situation – Go to where it happens, *Gemba*, observe the production floor without preconceptions and with a blank mind, repeat why five times to every matter do get deeper down to the problem. There is a basic belief in Toyota that people solving problems and making decisions need to have a deep understanding that can only come from personally verified data: seeing for yourself. Even high-level managers and executives should go and see for themselves as much as possible.

13. Make Decisions Slowly by Consensus, Thoroughly Considering All Options; Implement Decisions Rapidly – A thoroughly considered technology that has been carefully investigated and proven through trials will be implemented quickly and very effectively. Nothing is assumed in a project, everything is verified. Thorough consideration in decisions making includes five major elements; 1. Finding out what is really going on (Gemba). 2. Understanding underlying causes that explain surface appearance – asking why 5 times. 3. Broadly considering alternative solutions and developing a detailed rational for the preferred solution. 4. Building consensus within the team including Toyota employees and outside partners. 5. Using very efficient communications vehicles to do one through four, preferably A4 report.

14. Become a Learning Organisation, Through Relentless Reflections and Continuous Improvement – A learning organisation does not only adopt and develop new business or technical skills; they plan how to learn new skills, knowledge and capabilities. View errors as opportunities for learning rather than blaming individuals. Standardisation and learning goes hand in hand and are the basic for continuous improvement.

Reflections on the Principles

Jenner (1998) writes that Lean production system has been successful world wide because it is a self-organizing and a dynamic system. With a flexible, creative and adaptive structure that occur in a wide range of physical and biological fields. But the lean system is poised at a delicate balance between chaotic behaviour and order. Managers has to use the principles as guidelines for transforming their own organization into flexible, lean, self-organizing structures. Since each principle must be adapted to the specific circumstances and characteristics in each organization the most effective results would be achieved if each principle were introduced with careful monitoring of results and with continual modification and experimentation of each change to determine the approach that works best in each setting. Schonberger (2006) writes that in most companies the lean management is only skin-deep and relies only on consultants with insufficiency employee involvement. The companies often lack of larger ideas in how to work with lean, the limitation is to sustain the energy to work on an idea, and that could be traced back to not enough encouragement.

These findings from Jenner and Shonberger supports what Mehri (2005) writes in his article *The Darker Side of Lean: An insider's perspective on the realities of the Toyota Production System.* The real cost of this system can be clearly and empirically seen in its adverse impact on employees—the human cost—that extends beyond cultural relativism. Mehri writes that all the 14 principles could be seen in the company he was working for and that the TPS is certainly lean, but it is also unhealthy and dangerous. His article questions the very fundamentals of the lean work system. In the office for example, "lean" means engineers are overloaded with tasks. In the factory, it means

that workers on the line are continuously at risk of being seriously injured. TPS talk about high productivity with a constant flow and work after a pull principle and strive towards perfection. But on the assemblies' lines, workers must work every second of every minute, without a moment for a break and fast line speeds contribute greatly to work-related accidents and health problems. About 50 percent of all workers have work-related illnesses but are still forced to work according to Mehri. The principles talks about using pull system to avoid overproduction, but there is no chance for over production because there are too few workers that had to work hard to even keep up with the line speed. He also question that TPS needs less space in the manufacturing, the reason lean work consumes less space is not due to a superior production system but to gross negligence by the company, which subordinates the safety of its workers to lowering plant costs. He was shocked to find machinery jammed into every square inch on the line, creating constant safety hazards and it were difficult to see and use visual control so no problems are hidden in that environment. The work on the line was after standardised instructions but the workers had little or no chance to change the procedure. Stop and fixing problems works after the principle that no one cares if a worker has a small problem, but when a great problem accords and needs to stop the line, the worker get help but often experience that he did something wrong that did slow done the work pace. Improvement meetings are also vital to the way Japanese work, it was a job requirement for all workers to meet every Tuesday after work to discuss improving safety and production. But mostly did the meetings not lead to any improvements, so no one pays attention to them. On the principle that grow leaders that understands the work and lives the philosophy it became clear that this were just possible if you follow three rules; first the written one, second the unwritten once, and third the cultural roles, with 'what you are supposed to feel and say' and 'what you actually feel and say'. The company hierarchy and relationships within the organizational structure made sure that only the right minded that followed the unwritten rules had a chance to advance in the organisation.

Tools in Lean Production

It is important to realise that Lean Production in itself is not a tool that could be applied in a company and expect success straight away. It is a way of thinking. It is important to understand the concept and go the whole way in the company, with workers, suppliers and consumers to make it work. But the concept of Lean Production involves many tools that could be applied in a company to become Lean. The benefits are that the whole value chain are been focused, from that the material comes in to it leaves as a product. No other philosophy has before united these aspects as efficient as lean. Some, far from all, of the tools will be presented in this chapter. The focus is on which tools could be used in a small company and explain them.

Waste; Muda, Mura, and Muri

Ohno discovered when he was walking through the factory that there were three different kind of waste; *Muda, Mura, and Muri*. All three fit together as a system and just focus only the eight wastes of *Muda* could cause more problems to the production and its people than helping. Toyota are working with focus on all three, continuously – not in spurts.

- *Muda – Non value added*; wasteful activities that cause; lengthen lead times, extra movements, excess inventory, or waiting. See next part.

- *Mura – Unevenness*; which is waste from unevenness or variation caused by up and downs in the demand or production problems. Mura makes it necessary to have extra material, equipment, and operation on hand in anticipation of the highest demand, even though the average demand might be much less. Mura also causes the next kind of waste.

- *Muri – Overburdening people or equipment*; the waste resulting from overburdening people and equipment, and pushing them beyond natural limits. This results in safety and quality problems.

Ohno originally specified seven Muda wastes. An eight waste were later added;

- *Overproduction*; Producing more or earlier than necessary. This is the worst of all the wastes because it causes several other wastes as overstaffing, storage, and transportation cost.
- *Unnecessary Transportation*; Moving work in process (WIP) items long distances from one stage of a process to another, inefficient transport, or moving materials, or finished goods into or out of storage or between processes.
- *Waitin*g; Delays because of equipment breakdowns, material work because of stock outs.
- *Defects*; Production of defective items and the cautions against with inspections, repair or rework, scrap, and consequences of producing them.
- *Inventory*; Unnecessary or excessive raw materials, WIP, or finished goods causing longer lead times, obsolescence, damaged goods, transportation and storage cost
- *Unnecessary Motion*; Motion employees have to perform during the course of their work such as reaching for, looking for, turning for, etc. Also walking is waste.
- *Overprocessing or incorrect processing*; Steps or procedures in a process that is unnecessary, or ineffective due to poor tools or product design, also when providing higher-quality than necessary.
- *Unused employee creativity*; Losing time, ideas, skills, improvements, and learning opportunities by not engaging or listening to your employees.

Lean game

The Lean game is one way to understand the principles in Lean Production, the different wastes and productions techniques. It is a short education into the subject when a company wants to implement the principles. The focus on the education is on the basic principles and how to work with them in the daily work. Everybody in a company should take part in the education to get the benefit of it. It normally takes a day and where the theories about Lean are been combines with different visual exercises. As a result of the game all the participated persons will understand several fundamental Lean methods and the interplay between them.

5S

5S is a system of steps and procedures that can be used by individuals and teams to arrange work areas in the best manner to optimise performance, comfort, safety and cleanliness (Peterson & Smith, 1998). The literature talks highly about 5S and that an implementation will improve organisational efficiencies and enhance overall performance. 5S are original Japanese and table 2.1 shows the original name, translation into English and the meaning of it.

Table 2.1

Japanese S	English S	Explanation of the 5S's
Seiri	Sorting	-Proper arrangement -Determining the frequency of usage for every item in the workplace -Marking the items that are not used -Disposing of the nonessential items -Eliminating sources of clutter and unwanted items
Seition	Simplify	-Arranging items in the work area after frequency usage and establishing guidelines -Labels every tool, part or items used -Everything should be within easy reach
Seiso	Shine	-Cleaning every day and identifying abnormal or potentially problematic situations -Visually sweeping to identify and correct repeated problems, tools out of place, manuals out of sequence, inventory in incorrect area
Seiketsu	Standardise	-Makes information about location more recognisable, if all labels are formatted the same way it is easier to read. -If procedures for retrieving and returning items are uniform, it is easier for everyone in the group to locate them quickly.
Shitsuke	Sustain	-Self-discipline is the routine practice of all the steps that precede it so 5S become a habit. Do not give up.

Benefits after implementing 5S have been reported in a number of articles. For example, Peterson & Smith (1998) gives example of this as; reduced cycle times, increased floor space, improved working conditions, better work team performance, reduced lead times, improved inventory management, improved morale, reduced search time, improved delivery time, improved access to information, and increased levels of commitment. Some company also add a sixth S for Safety and can show figures reduced numbers of accident and lowered incident rate after implemented 5S. It is important to know that there is nothing wrong with being devoted about 5S. But well organised and sparkling clean waste is still just waste! You need to move on down the spiral and get to true flow.

Research Method

CHAPTER 3

Investigating a small company

To understand how a small company in Sweden is working without Lean Production, an investigation on site in a company was necessary. Most practical was to only chose one company to be investigated more careful and this was just to be able to follow the time limitation and restriction. Contacts were taken with some small companies around the Gothenburg region. One company accepted to be investigated in how they are working right now and how it could be possible for them to implement Lean Production. The main reason for their acceptance was that they had increased their production with over 50% the last year and the forecast for the next year were at the same level. They needed someone to investigate if it were possible to effective their production with the same personal.

Österbergs Förpackningsmaskiner AB

The company was Österbergs Förpackningsmaskiner AB (Österbergs) which is located in the eastern part of Gothenburg and has around 30 employees. They develop and manufacture machines for packing of consumer products in distribution wrapping. The company are owned by equal share by Stora Enso Packaging AB and Peterson Emballasje AS. The company's products are custom made one by one for mostly the food and chemical industry. The owners are responsible for the sale of the machine and the major markets are the Nordic countries. The organisation of Österbergs is made up of one project department, one manufacture workshop, and one assembly workshop.

Interviews in four companies

In order to understand how Lean Production is working in companies that have implemented Lean Production here in Sweden some kind of investigation had to be done. Four companies that successful have implemented Lean Production were selected to be interviewed. Information about the companies was found in articles

about examples of several successful 'lean companies' in different Swedish technical production magazines. Time was also spend to look after 'none successful lean companies', to investigate why they fail to get lean. But no such companies were found. The successful companies were then chosen after how long they have been working with Lean Production. The idea was to spread the time axis of implementation over the last ten years, to investigate if the work changes over time and how they had handled the different stages in the implementation. Also, that they should not be a too large company, since Österbergs only has 30 employees, and preferably with a similar business concept. The four participants are presented in this chapter and the information about the companies was collected throughout the interview. Interviews with managers, were all are working with Lean Production, in these four companies were chosen to get more wide perspectives about the lean work in different companies, how they implemented it, and which results they have from the work. The interviews were also a reason to be able to go to the companies and on site see how they were working.

Lindab Steel AB

Lindab Steel AB central steel processing unit are located in Grevie, in the northwest part of Skåne, whose role is to provide the Lindab Ventilation and Lindab Profile business areas with an efficient supply of sheet metal, but it has also large external sales to customers outside the group. Lindab Steel was founded in 1989 after an overtaking of a business in Lagan, Småland. Lindab Steel are an modern steel company that was early to focus on ISO 9000. In 1997 did they started to work with continuous improvement (Kaizen).

Lindab Steel AB has around 70 employees, a turnover around 1 billion SEK/year and handle around 500 tonne steel/day so it demands well organised logistic. A small mistake could destroy material for several thousand SEK and affect the profit margin. Lindab Steel has since they started working with Kaizen been on the top ten lists from the Swedish institute for Suggestion Schemes nine years in a row for companies that are successful with in continuous improvement.

The contacted person at Lindab was Tomas Wikström, Development Manager, after been reading about Lindab Steel in Underleverantören (2005). The interview took place in his office and after that Wikström showed the factory.

Haldex Hydraulic System Division

The Hydraulic Systems Division, one of four divisions of Haldex AB, has been a worldwide leader in the design and development of hydraulic gear pumps and power units for over 75 years. To meet the demands of today's global market, Hydraulic Systems Division has product engineering support located at all four manufacturing locations-Rockford, Illinois, Statesville, North Carolina, Hof, Germany and Skånes Fagerhult, Sweden.

Haldex Hydraulic in Skånes Fagerhult, Sweden has 107 employees and 2,880 m² area for Manufacturing and Stores. The turnover are around 260 million SEK with focus on manufacturing Pumps/Motor Packages, Hydraulic Valves, Complete AC DC Power Systems for Stationary and Mobile Applications for the European and a part of the Asian market. They started to work with Lean in 2000 and Haldex AB introduced the Haldex Way in 2002 in all four divisions. Haldex Way is founded on three core values: Customer First, Respect for the Individual and Elimination of Waste.

The contacted person was Maria Wilsborn, Lean coordinator in Skånes Fagerhult, after been reading an article of their continuous improvement work in Ständiga Förbättringar (2006). But it was the Production Manager Sven-Arne Bertilsson that welcomed to Haldex and first showed around in the factory. After the visit the interview started and Wilsborn joined in after 15 minutes. So the answers are both Bertilsson and Wilsborns.

AB Lundgrens Mekaniska Verkstad

AB Lundgrens Mekaniska Verkstad is located in Hjärup, south west of Lund. They develop and manufactur packing machines and other equipment to primarily the provision- and pharmaceutical-industry. They have 57 employees and had a turnover of around 140 million SEK 2006. They are a wholly owned subsidiary of Midway Holding AB that has around 900 employees and a turnover of around 2 billion SEK. They started to work with WCM (World Class Manufacturing) in 2003.

Lundgrens was established in 1912, at that time, work centred on general engineering and included the manufacture of carbide lamps. A few years later, the company produced Malmö´s first street cleansing machine. For over eighty years, they have united innovation with experience and today they have acknowledged manufacturing skills in engineering, electronics, pneumatics, hydraulics and automation. Their technically advanced production areas include a 1600 m² workshop and 2300 m² assembly hall. As a subcontractor, they manufacture machine parts, test high-tech equipment and carry out advanced assembly work.

The contact was taken through the CEO at Österbergs, Bo Stenberg to the CEO at Lundgrens. They arranged that I was welcome to Lundgren and interview Ola Örnhed, Lean coordinator at Lundgrens, about there WCM implementation, their continuous improvement work and a visit in the factory. Since their business is quit the same, the arrangement was that no notes could to be taken in sensitive questions.

Santa Maria AB

Santa Maria AB was founded in 1946 as Nordfalks AB, they changed the name to Santa Maria in 2001. The head office and two factories are located in Åbro industrial estate, south of Gothenburg, one more factory in Skåne and a warehouse in Kungsbacka. Santa Maria AB as a group become ISO 9001 certified in 1994. The visit and interview took place in the Spice factory that manufacturing dry blended Spices to consumers and food service.

The Spice factory has around 70 employees in the manufacturing and they have recently started to work with Lean Production, the implementation took part in January 2006. The Spice factories workers had a course in 5S some years ago but the effort to accomplish something more ran out of power because lack of understanding from other employees in the company and insufficient vision. During 2006 have all of the workers played the lean game and the principles have started been adapted in the rest of the business concern.

Information that Santa Maria Spice factory recently had started to work with Lean Production was obtain at Lean Forum conference 2006 and a contact was taken with Mr Henrik Dahlquist Production Manager at the Spice factory through Mrs Sigbritt Oskarsson, Human Resources. The visit at Santa Maria stated out with a tour through the factory and ended up with the interview.

Investigation Methods

Questionnaire

A questionnaire was designed in order to measure the status for the workers at Österbergs and to compare their situation with companies that has implemented Lean Production. This approach was chosen in order to stay objective towards Österbergs and to analysis how the employees thinks about their work at the four lean companies. The questionnaire was in Swedish, since it was going to be answered of Swedish employees, see appendix A for the questionnaire and appendix B for the questions and results in English. It has 17 questions that are based on questions from the book by Lean Enterprise (1999), with some own developed questions and considers the working conditions at the employee work stations. The questionnaire consists of two opposite statements on either side of a one to five number scale. The first statement, placed to the left nearest the number one, was formulating to be less lean. The second statement, placed to the right nearest the number five, was formulating to be pure lean. The employees were asked to mark the number that best fit with the working conditions he or she was working in. The target was to get 20 responses from Österbergs and then at least five responses from each visit company. The questionnaire was e-mailed beforehand so a manager within each company could study the questions. The questionnaire was handed out to the employees by the author in the four companies. In the fifth company, the questionnaire was handed out by a manager.

The questionnaire was structured that at least one question covered one of the 14 principles Liker (2004) writes that Toyota has in their Production System. It was structured in this way to test how much the employees thinks that the company has fulfil the principles and to see if it is a different between a company that is not working with lean compare to them how does. The hypotheses was that the staff was more involved in their work, felt that they contribute more and were feeling more satisfy coming to work at ‘lean companies’ then the investigated ‘none lean company’.

Interview Questions

In order to investigate the thoughts behind why these four companies chose to implement Lean Production, how they implemented the lean concept, how they work with it and what results. Questions were developed based on the 14 principles Liker (2004) writes about. Maybe had they chosen the five principles that Womack, Jones & Roos writes about. Or if they had chosen a more Swedish way to work with Lean Production, that could be helpful for small companies if the chose to implement the production system. The question is presented in table 3.1.

Table 3.1 Interview Questions

Company Goals:

1. What did you want to achieve with implementing Lean Production?
2. Why did you start to implement continuous improvements?
3. Did you study and compare yourself with other companies before the start of the improvements?
4. Does the company have a strategically goal that everybody knows about?
5. How far into the future are these strategically goals?
6. Do all workers know what they should do to support these strategically goals?
7. Do you have some time limited target that you are continuality are following up?
8. Are the work with contentious improvements well support of the board?

The implementation:

9. How did you think when you planned the implementation?
10. Which time perspective did you have when you started the work?
11. Did you plan the work in different phases?
12. In which area did you focus on first?
13. How did you educate your staff within continuous improvements?
14. How did you motivate your co-workers when you started?
15. How do you motivate your workers now when the process are rolling?
16. How does your company share information?

Employees

17. How were you thinking that your employees would contribute?
18. How much time involves continuous improvements?
19. How do you check your work with continuous improvements?
20. Are everybody committed with the Lean work?
21. Are the workers more committed to the work now compared to before?
22. How is the work order from that an idea is born to it are fulfilled?

The Results

23. Have the company gain any benefits, economical with profit or more commitment from the staff since implementation?
24. Has the work with Lean Production changed the way you have been working?
25. Do you evaluate and develop your system with continuous improvements?

Interview Procedure

A meeting was booked with the different managers at their companies, hopefully would it also be a tour in the company's factory in order to get an insight in their Lean Production work were it happens and hand out the questionnaire. The questions and the questionnaire was been sent out in advance to the interviewees. The interview was taped with a digital tape recorder, which was later written out. The questions were then divided into tables so it could be possible to compare the different companies' answerers. See appendix C.

CHAPTER 4 Results and Discussion

Interview

This chapter summarise the answers from the interviews questions (see table 3.1) and the findings is discussed. The full answers to the questions from the interviews managers could be found in appendix C.

Company Goal

Questions 1 to 8: Why should a company start to implement Lean Production and which strategic goals should the company has in that case?

Two of the four interviewed companies decided, in order to develop themselves, to introduce Lean Production to get more engagement from the employees. They wanted to accomplish more with teamwork so a workgroup together sees to the possibilities and discover problems closer to the work place where the problems are. The companies also wanted a better and more efficient organisation with higher quality. They had realised that they could not stay in the traditional Taylorism ways of working when the employees do not need to be involved in the planning and steering of the work. As Haldex expressed it ‘we have hired the whole person, not just the muscle power’. The answerers said that it was mostly for the employees but as Santa Maria did put it there are serious questions behind the implementation of a new way of working ‘to have the ability to compete in the future’. This compared with Lundgrens that started in order to specify the value to the most important customer. The idea that most of the companies had was that everybody in the companies should start working in the same way and not to separate different questions as; economy, working environment, environment issues or quality. Customers want long partnerships and we have to develop ourselves to stay in business. Companies have to make sure you get better all the time and Lean Production is a good way of doing that.

It is important that after a company have decided that they want to change and implement a new way of working that they really investigate the principles and go out and study different companies that already have implemented Lean Production. It is a good way to get inspiration from different directions but a company should have in mind that it is hard to compare different business so the executive director, production manager and other persons in the board have to investigate continuous improvement and support the change. It is important that the company has goals and visions in how the change of an implementation of a new working scheme could improve the economy, quality, work environment, and environment issues. The goals should be of that part that it would be able to divide into smaller bites that every group on the company could work after. See it as how they could contribute to the whole picture in how the company should perform their vision. It is important to realise that instead to take big improvement steps sometimes it is better to focus on to be a bit better every day and that in the end that will lead to something really good. It is important in that case to look back, point out and show that 'this is was we have achieved' when now direct improvement could be shown directly. Santa Maria said that their vision is that their products should be better than their competitors combined that with Haldex three keystones; Customer first, Respect for the individual, and Reduce of waste and a company do get a god ground to found their own vision. The targets for the companies were to have a long term plan for the visions and goals so the work with continuous improvements becomes a part of their work. It is always good with some pressure from above that question the work if no progress is being done.

It is important that all co-workers should know about the vision a company has for implementing Lean Production. One way as Lindab has done is that they have let different groups been away and discussing the vision, how that affects the group and also the targets the group would need to have for the next year in order to fulfil the company goal. One other way as Haldex has done is to create it is own book where the vision, the targets, but also which methods are to measure them, are printed in an easy way so everybody could read and understand. All the companies has measurement methods, not just Haldex, where they measure, for example, economic, quality, working environment and environment issues continuously. Every area are not measured at the same time. One company divided it up and touch one area each month so after four months they were back at the starting point and could compare the differences. It is important that all work with continuous improvements is well supported by the board and that they realise that it takes time in the beginning to change the way of working to a more Lean Production way. As Santa Maria put it 'old fashion quarter capitalism is a dangerous competitive to Lean'.

Implementation

Questions 9 to 16: How should a company implement Lean Production, what should they focus on, which time perspective should they have, and how should they plan and arrange the work?

In order for the companies to develop themselves to get more engagement from the employees, better, and a more efficient organisation all four have educate everyone in the company, or are on the way. It is two courses that the companies have educated the staff with, the first one are the Lean game. The second are a 5S course. Not all companies did it in this order and some companies develop improvements groups before the different courses to the group together did get the training, some afterwards. They all follow almost the same concept, train first, let the concept be understood and the implement it in an easy visible area of the company so everybody sees that something is happening. They also divided goals along the way of the implementation. In order to do small steps along the way they also looked back and pointed out what they had achieved. In the beginning it could be a good way to test very different techniques in order to test what is working on the own company. All the companies had a implementation plan in how they should dived the organisation and how the education should be divided. Then they developed a future state plan to get the work sustainable and as one company said 'the time limit is to focus on the eternity'. Because implementing Lean Production is not a project that has a time limit. It is a philosophy, a way of working.

Try not to do any difference between manufacturing and administration departments with the implementation. One company do have a weekly information meeting in the factory with at least one from every group that reports back to the group, so everyone in the company knows what is going on, which orders are been worked on now, how the results from different analysis was, and which different group based improvements jobs that are being done. The companies have been very clear about that the work is being done for the employees and no one else. If the company wants to stay in business in this tough market all the employees have to work together. The interview also discovered that the staff has realized that it is more fun to work when you can change the work place and are being encouraged to ask why. You have to be one step ahead of your competitors and one way is to have worked with continuous improvements. Everybody has a possibility to contribute and to change the workplace that motivates. One important part is that the companies' productions managers often are out in the organisation and talk to them at the worksite. It is very important that decisions are being taken out there, discussing their problem there and not in the office. It is important for everybody to realise that if nothing happened there will be no improvement. Lindab also put up before and after reports to show that it has become an improvement and what the benefit was of it. In all of the interviewed companies, every team had an information whiteboard where all relevant facts about the groups production and improvement was put up. Teams then had morning meetings every day around the board with the production manager to discuss the days work, yesterdays result, sickness, improvements, improvements suggestions and other issues. Lundgrens had a fixed agenda that every group was followed and report directly into the computer system and the teams statuses were later seen on a big screen so other could come and help out if a team were behind.

Employees

Questions 17 to 22 How do a company motivate and educate its employees and how much time will they have to spend on Lean Production in its daily work?

As said before, all the investigated companies wanted to get more engagement from the employees with the implementation of Lean Production. The focus was that it should be team based and to focus on team dynamics, right person on the right place. But the team should not have a fixed team leader, instead should that responsibility be moved around in the team with one month each time. And with more information about the company visions, goals and how the status are in the whole company, make all employees realise the whole picture of the company that their work really counts. After the implementation all the companies could see three groups of people, one group that understand the concept and were using the tools and techniques, one group that were neutral to it and did not work with it nor did work against it, and one group that were against the new way of working. The tips from the interview companies were to place the focus on the group that are neutral to the concept, win them over and two third of the employees are on, the last group will come later on.

In consideration how much time the employees spend on continuous improvements the companies only has one thing in common, daily morning meetings whit the team around the teams information white board that takes around 15 minutes. Then Lindab had monthly meetings as a fixed point where you have to work with improvements. Haldex had team meetings once a week on a fixed time focusing on improvements work. When Lundgrens had one hour every second week, compared with Santa Maria that closed down the factory once a week for a factory meeting with at least one from every group and the rest of the employees focused on improvements work and ideas. All companies in the investigation do measurers their work and improvements they are just calling it different things. The common between the companies are that the employees had had education about the way of measure and been explained why the analysis are going on. Then did the companies focus on different things that were important for their company.

One interesting thing was that everyone in the visited companies was in improvements teams, from the directed manager and down (except Santa Maria, but they had improvements team in the area where they had implemented Lean Production). The philosophy was that it is important that everyone has a chance to be involved, even if you choose not to. So no one can come after a change and say that this is not what I would have done. At Lundgrens everyone also has a small area in the company where he or she checks the area, with focus on 5S standards, that everything is in order or if it could be arranged in a different way. This work has made the staff more committed at all companies they said it is a whole different climate. Now is the feeling that the employees are working for the whole company and had notice a greater commitment from everybody's part.

Results

Questions 23 to 25. Which benefits could a company gain when changing into Lean Production?

The thoughts behind the implementation of Lean Production in these companies were to get everyone more involved and all companies answered that they had succeeded with that. The implementation has also gained a positive process progress in both economical and quality aspect, and also work environment has been better as improvements from the employees and new layout of the factories have been implemented. All four companies said that the result is hard to measure in money gained but it has had an extreme productive implementation when producing products and that the quality of the products has raced. And again it is important to realise that it takes a lot time in the beginning and the education cost a bit but the companies can now see it as well invested money.

The way of working has at some companies totally changed the way of working. Lindab has for example become totally customer demand with extreme flexibility where the customer gets an order in a week but their supplier in their turn has a delivery time in two to three months, so they have to have large stocks of raw material build on forecasts. In Lundgrens case for example, has the planning become an important factor in order to reach a better flow through the factory and finished products. The manufacturing of parts is planned in a whole different way in order to fit the assembly of the machines better. Every team also gets a work plan for the week so they can divide and level out the work within the team in a whole different way than before. They have also started to discuss a new order and the project plan with one member from every team in the beginning of a project This was to develop a more sense of responsibility for the product so everyone feel as a part of the company. In order to follow the work been done Lindab have recently introduce a monthly newsletter that are focusing on the continuous improvements work that has been done and it tries to focus on something from every department so everyone can feel that their work in the group are being focused on.

On the question if they evaluate the work the system with continuous improvements three of them answers that they are doing it as a big audit once a year in order to see if they meet their targets and which new one they should have. Lindab auditing through statistic from their computer system that they have developed from a standard product, Haldex are being auditing of an external group that investigates the company once a year over the continuous improvements works. Lundgrens do it by themselves and have now reached a point where they will not extend the system more before they feel safe in what they are doing. For Santa Maria that is in the beginning of their implementation the evaluation of their work is that they are reaching their targets that they have planed to August 2008.

Questionnaire

This chapter shows the result and discuss the findings from the questionnaire with comments and results from the comparison of four 'lean companies' against one 'none lean company'. Detailed comments and figures for every question can be found in appendix B. The reason for this arrangement were to show the investigated company, Österbergs, status in different questions and show in which areas they can be better. The companies' different mean values to every question will be showed in figure 4.1.

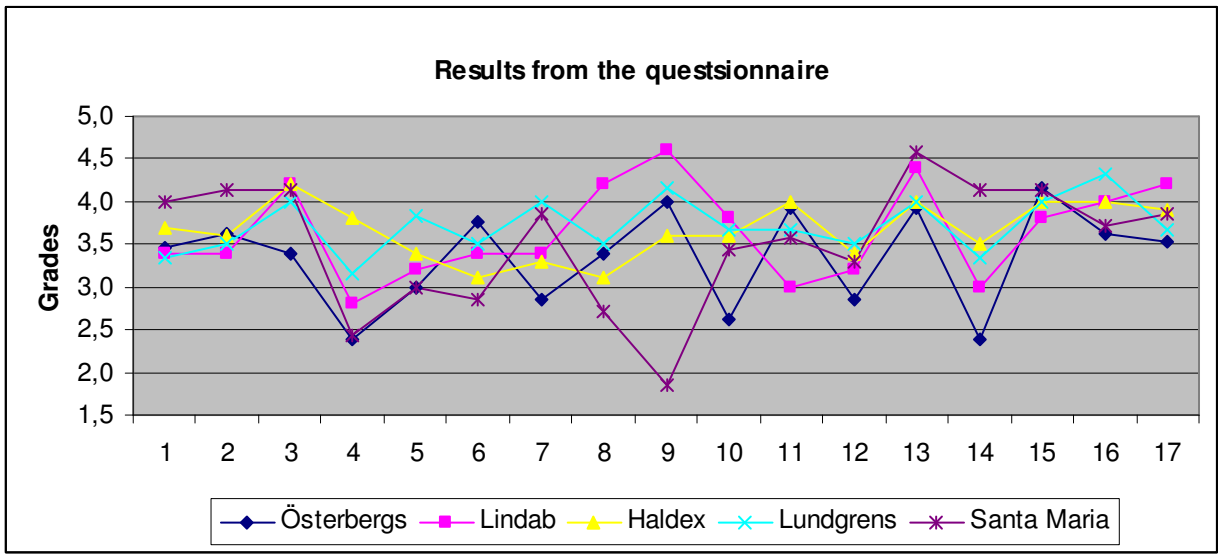

Figure 4.1. Result from the questionnaire whit each company answers presented.

No questions in the questionnaire were directly focused on what the company had for an objective when the company started to implement Lean Production, nor did it investigate why a company should start working with Lean. Or what the company had for a plan when the company implemented Lean Production. It was not the questionnaires purpose. The purpose of the questionnaire were to measure the status for the workers at Österbergs compared with companies that has implement Lean Production and to analysis the how the employees think about their work in the four lean companies.

The result from the questionnaire showed that the information from this investigation of four Lean Production companies and one none Lean Production company are not enough or satisfying to draw any conclusion if Lean Production are a good way of working for the employees. But the results from the questions showed that Lean companies have better information and teamwork ant that they react and analysis the cause of a problem better than none Lean company. Which were what the investigated companies wanted with the implementation of Lean Production, to accomplish more with teamwork, to get more engagement from the staff and a develop a more effective organisation.

The questionnaire shows that the investigated none Lean Company is worse than Lean Companies in some areas; The place of work is in general more messy and less organised then the compared companies (Question1). There are material all over the montage workshop, no clear place where you can place stuff, 'we have space here' syndrome (Q2). Employees do get information about what is going on, but it is very informal, no real feeling that you are a part of a project (Q3). The equipment is maintained on an okay level, no really need in the process to focus on that first thing (Q4). Each and everybody are working in its own pace with no real team work (Q10). The continuous improvements work could be a lot better, some suggestions on the

monthly meeting but it takes time to carry it out ‘you have to ask on a good day’ (Q12). The analysis of root case are really bad, the same mistake are appearing over and over again (Q14). No real feeling that everybody knows the company business goal and what you can do to fulfil them (Q17).

But the questionnaire also shows that the company that has not worked with Lean Production is better in some areas; Waste is not so common, because of the manufacturing is project based. One machine at a time, but it could be a lot better with better organised work flow (Q6). Manufacturing to customer, some to stock but just to have job to do meanwhile low demand, to be able to build a machine fast when a customer requires it (Q8). The work flow and demand of the work are good, with some peaks last year. The customers really control the demand (Q9). The all-around knowledge is high in the company, but do not stay there (Q11). Reaction at mistake are good, to solve the current machine. But what happens after that? The employees have confidence for the company and you can influence the place of work and the employees feel very motivated (Q15).

Conclusion

CHAPTER 5

What is Lean Production?

Lean Production is a production system that was developed by Toyota Motor Company that during the 1950 was over in the USA and visited the large automobile companies in Detroit. Engineers from Toyota felt that it was just in the final assembly line that everything in the line was moving along in a smooth, synchronous pace. Virtually every other stage of the process, parts and materials were produced in discrete large batches. They developed the American way of making automobiles to produce the parts efficiently in small batches in Japan, when they needed it, and synchronised the whole production, not just the final assembly line. Information about the production system started to slip out from Japan during the oil crises in the late 1970 and articles started to be written about this new waste saving way of production. The characteristics of a lean organisation are that it is greatly reduced chain of command levels, they are dynamic and highly adaptable to a changing market. The lean production system are summarised under a few fundamental principles that a company could specify value of the manufactured product from the point of view of the customer, with the focus on the value stream for the product and material through the organisation. So the flow of material is smooth running in the manufacturing and assembly workshops where the workers should try to attain a pull production and in every step of the manufacturing the employees should focus on to make perfection. But do not implement lean culture without listen to the organisations own personal, the meaning with lean is not to work harder, with more hazard environment as a result, instead it is developed to work smarter. This thesis has hopefully shown that it is possible to implement a lean production philosophy in every company, but be clear that it has to be developed into the own business in order to obtain perfection.

Company Goal

Why should a company start to implement Lean Production?
There were quit different answers from the interview companies why they started the work with the implementation. From Lundgrens that wanted to focus on its larges important customer and focus to specify the value from the point of view of the customer. This is the first principle of Lean Productions according to Womack, Jones and Roos (1990). To Santa Maria that focus to stay in business and implemented Lean Production as a long-term philosophy, even at the expense of the short-term financial goals. That is the first principle of the Toyota Way according to Liker (2004). Compared to Lindab and Haldex that almost had the same philosophy, they started the new way of working in order to focus more on the employees in the companies. They wanted to accomplish more with teamwork so a workgroup together sees to the possibilities and discover problems closer to the work place where the problems are. The companies also wanted a better and more efficient organisation with higher quality.

Which strategically goal should the company has in that case?
It is important that the management decisions are based on a long-term philosophy, even at the expense of short financial goals. The investigation has shown that change takes a lot of time in the beginning and to educate all employees cost both time and money. It is also important that everybody should know about the company's business goal, why they have started to change. No one of the investigated companies was in some kind of financial problems when they started to change that could work as a start. So they all started to focus on to describe the current position, the plan and why everybody should work with this new way of working. It is good to compare the own company with others, go out and see how other companies have done in order to convince the employees that it is a good philosophy to work after.

- Make the employees step outside the box and question the way everything are been done in the company with why.
- Make sure that the Lean Production concept has the executive board confidence and that they care about what is going on. That they takes parts in the weekly meetings, discuss suggestions with workers on site, were it concern.
- Let the own employees implement and drive continues improvements change in order to make it sustainable. With clear goals for everyone in the company concerning finical goals, quality goals, work environment and environment issues.
- Focus on the small steps, continuous, a bit better every day.

Implementation

How should a company implement Lean Production?
All the interviewed companies all had more or less clear objectives with the implementation, they were prepared that it was going to take some time to teach the employees so they understood and worked after the philosophy. The investigated companies divide the staff into different improvements team within the same branch of an occupation. They started to teach them in the teams and started with a pilot in a small easy visual area so everyone in the company could see that something were actual happening

What should a company focus on?
In the start of the implementation of Lean Production, the interviewed companies did make sure that the whole companies' employees did get the same education in how the concept worked. So the flow of information started to be right from the beginning. All of the companies had the confidence from the executive board and that they care about what is going on and how the progresses were. The companies were faced three different kinds of groups after the implementation, one that had understood the new way of working and were working after the principles. One that had not really had understood why to change but were curious about it and did not work against the new organisation. And the last group that did not want to learn or had learned but did not want to change the old way of working. The suggestions from the companies were that focus on the two first groups, maybe a bit more on the middle to get the two third of the employees on the train to Lean Production. The last group will hopefully adept themselves and in two of the companies they did and it was almost them who become the best teams when they choose to work with Lean Production. So let the implementation take the time it takes and make sure that everyone has the possibility to be involved in morning meetings. Where the days work are been planned, yesterdays results presented, if it is any sickness etc, and any improvements work that has to be done.

Which time perspective should a company have?
Working with Lean Production has no time limit, according to the interviewed companies. That must be the first thing a company has to realise when start to plan the implementation. But all of the companies had more or less a plan in how to start the process and different tools were tested and evaluated during the start up in order to see if it were working at their company. The companies did not try to make any differences between different teams, as manufacturing or administration. Instead they tried to have the same type of agenda at productions meetings or administration meetings, the ways of thinking are alike.

How should a company plan and arrange the work?
As for a plan a company should have when they choose to implement Lean Production, it is important that the company take this decisions slowly with all employees knowledge in why the company choose to change the way of working. They should start out in the top with convincing and get the executive board to fully understand the principles. Take middle managers outside the company to planned visits to other companies that are working with Lean Production to show them how the system works. Then involve from the bottom and up with the concept of; teach the concept first, understand how the process works, then start to change the way of working. Make sure the company has clear objectives with the implementation, with a focus not to be satisfied with 'this is the way we are working'. New targets all the time but make sure to point out what the company has achieved. Hire the unknown knowledge about Lean Production with a consulting firm and teach them with courses as the Lean game and 5S. If it not convinces the employees, let them go and see for

themselves in other companies in order to thoroughly understand the concept and how others are working with it. Focus on the small step continuous, a bit better every day. Make sure that the different improvement teams that created do get clear goals for everybody concerning financial goals, quality goals, work environment and environment issues. Make sure that the managers takes part on the weekly meetings, discuss suggestions with workers on site, where it concern. But most of all have fun with the implementation and support suggestions.

Employees

How does a company motivate and educate its employees within lean work?
A lot of elements controls the work environment and this thesis has just shown that that after the implementation of Lean Production the companies were focusing on team based improvements and to give more responsibility to the team. With this the employees felt more secure in their work when they got more information about the companies' goals, visions, current orders and economy balance. This work has created assurance in the employees that the company has a long term interest to develop the business. The result from the interview and the questionnaire in this thesis has showed that the investigated 'lean' companies' employees felt more motivated and engage in their current work. All of the four interviewed companies felt that the personal take more responsibility after the implementation and that it is a whole different working condition within the company. But in the same time did the questionnaire show that the none Lean company had workers that felt more confidence for the company and that they could influence their way of work better then the Lean companies.

How much time will they have to spend on Lean Production in its daily work?
The investigation has shown that there are no right answers to this question. Some guidelines are that a company that is producing in large series has benefits of team based morning meetings every morning. Companies that are more working in projects and has a long producing time for a product will benefit of having a small team meeting once a week with large weekly company meeting. And also that everybody in a lean production company should be able to take time of its ordinary work to work on lean production development. All companies should focus on more team organisation, rotate leadership in the team, and continuous learning as a part in the daily work as for an employee strategy to have when implementing Lean Production. It is important to create engagement in the whole organisation which creates more creativity. The teams should be given the responsibility to break down the company goal and adapt them to their place of work so they feel that they are contributing to the company welfare. Tidiness in the work areas increased the floor space, improved working conditions, and lowered incident rate. This is the base for continuous improvements. Then how much time a company should spend on Lean Production in its daily work are totally up to the own corporation.

Results

Which benefits could a company gain when changing into Lean Production?
All the interviewed companies gave the answer that it is hard to measure the real benefits a company could gain in real money when implementing and working with Lean Production. The benefit all these companies has instead experience, that it has definite made all employees more involved with their work. And this in turn has lead to better quality of the products. The work has now days a different kind of planning of the work, it is more team control over the job so the team could decide more individual in which order the job should be done. The improvements suggestions have raised at most of the companies and this have made the work environment much better after accomplishment of the suggestions. In order to measure if the Lean Productions job stays in a high level and hopefully gets better, it is important to measure the work and three of the companies are doing it as a audit once a year. Answers in the questionnaire have shows that it is a greater interest into participant in improvement in Lean companies and the interviews showed that this is a large part of good results.

Recommendation

CHAPTER 6

Recommendation for Österbergs

The aim of this master thesis has been to investigate how to implement the concept of Lean Production successfully in a small company. As shown in chapter 5, it is important to adjust the concept in a way that is in line with the existing business and how the company is working. Every business is different to the other and therefore every company that wants to implement Lean Production has to develop it in accordance with its own standards. Chapter 6 will give Österbergs Förpackningsmaskiner AB suggestions on what to do, which areas they should change, and how they should do it in order to implement Lean Production successfully.

Education

There is no way that a big change as implementing Lean Production could be done over a night. The implementation has to be carefully planed, the understating from the employees has to grow and the top manager has to carry through the plan quite hard without losing the employees trust or motivation. Österbergs Förpackningsmaskiner AB should focus on three things when trying to educate their employees.

Lean Game

The aim of the game is to create an understanding for the Lean Productions philosophy in the whole company. It illustrates the importance of cooperation and communications in the production and the advantages of continuous improvements. My suggestion to Österbergs is to hire a consultant – as all the companies analysed in this thesis had done – that will teach all employees at the company the basic principles of Lean. Since there are different kinds of games, make sure that it is one where participation will stimulate a manufacturing company, with its products and customers. Make sure that different solutions are being tried out through the day, so

that, based on experience, there will be possible to create a better flow and an effective elimination of waste.

Go and See
When the lessons of the Lean Game have been learned, go out and visit other companies that have implemented Lean Production. The employees will by visiting another company get a deeper knowledge about Lean, and its possibilities as a part of the production process. The executive group as well as all the employees connected to production should take part in a visit. After a visit, start to discuss different ways of implementing Lean Production at Österbergs manufacturing workshop, preferably in special improvements groups.

5S
A few weeks after having been educated in accordance with the Lean game, and having visited a company, the plan for the implementation should go on with 5S training for all the employees. Right after that, when all have the new way of thinking in there minds and hopefully are convinced that this could work, a layout change should take part. Start to change the layout in the assembly workshop as a fist step to show everybody that there is a belief in Lean and that this is henceforth how the work will be done.

Organisation

The companies that took part in the interviews have all created an improvements team in order to develop more team work. Lindab Steel looked upon it this way: '[T]he group as a whole could see to possibilities and discover problems closer to the work place, where those problems are easiest found'. The organisation at Österbergs should eventually consist of five, clearly separated, different improvements teams: 1. Manufacturing, 2. Mechanical- and Electrical assembly, 3. Test and purchase, 4. Construction, 5. Administration.

The teams of the companies interviewed were gathering every morning for a short meeting to check the status of the work within the group, so that everyone in the group would know how they were doing. To implement morning meetings at Österbergs could be one to large step in the beginning, instead start with a weekly meeting were the group could discuss the next week work on the team and divided it between themselves. The last week work, are we behind or in head and why are we that. Discuss suggestions that has develops during the week that would be put on the IAC-list. Have this meeting on a fixed time every week that the team by them self decides and after that should the statuses for a project be updated on the information whiteboard. A special Lean Coordinator post should be created and that persons should be the shop-floor manager or similar. That person should be part of the weekly team meetings but not leading them, just be part to answers questions and make sure that the group run out of time. That person will also report the Lean work at the company to the Executive group.

Start also to have one production meeting a week where all employees in the production should be present. Have this meeting at the information whiteboard that will be presented in chapter 6.1.4. The meeting should focus on the status of each machine that the company has an order on. For example; have this meeting every Wednesdays afternoon, where every group leader can describe the statues for the team. It should not take more than half an hour, but be aware that this will take a longer time in the beginning.

Change layout

Figure 6.1 shows a suggestion for a total makeover in the assembly workshop. Looking at the current status of the workshop it seems almost as if the principle “there are some space, let us build the new machine there” has been followed. This does not just cause unnecessary movements when transporting parts to the machine when other machines are in the way, but the workplace gets really messy when workers do not know if a pallet is being used by the workers building a machine nearby, or if it just takes up unnecessary space. The status of an assembly process of a machine is also hard to determine instantly when it is being built in a no real order.

This suggestion of a new layout focuses on the major elements that Österbergs could implement to make Lean Production work in the assembly workshop, see figure 6.1. First of all it is Customer Focused according to the principle of One Piece Flow. Focus on the machine that is in turn to be delivered to the current customer that has ordered the machine. Elimination of Waste is a big part of the changing process with better Workplace Organisation. The layout also makes it easier for transports when assembly areas are organised in the middle of the workshop, with large transports areas along the sides. The layout is also Visual Management focused where it is easy to see where in the process a machine is being assembled, and with the information from the whiteboard tell if the assembly is in time. The new organisation will hopefully also lead to more Employee Involvement and Teamwork when the employees easier can see which machines that currently is in need of help, to be able to skip to the customers in time. This whole new model is based on that the employees will make suggestions of how their work could be easier with Continuous Improvements that hopefully doesn’t stop there.

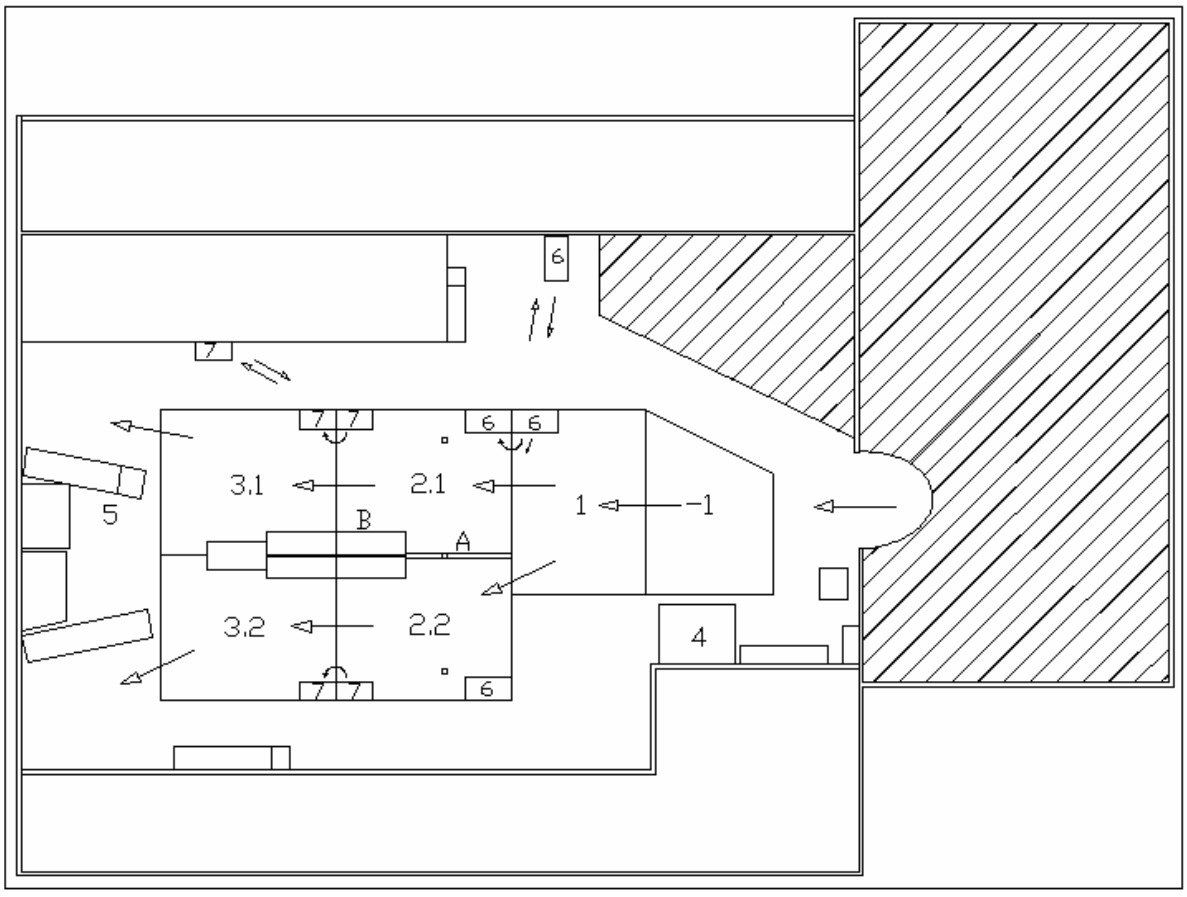

Figure 6.1. Suggestion to better flow in the assembly workshop.

Explanation to the figure

A machine has been tested and approved for delivery and been delivered. Space is given in area 3, clean area 3 and move over the current machine in area 2, with its wagon of parts, to area 3, clean area 2 and move over the current machine in area 1, with its wagon of parts, to area 2, clean area 1 and space is now given in area 1 to start building a new machine. In area 1, four or more wheels should be mounted on the machine frame. The wheels should be lowered with compressed air cylinders in order to lift up and move the machine between the different areas easily.

A. Rebuild the Wall

The current wall as it stands right now is dividing the workshop and is preventing a better flow in the production. The suggestion is that the wall should be rebuilt with a turn of 90 degrees. The suggestions are also to place the tools needed in the Pre Assembly close to that area on the wall, to place all the screws and bolts that at the moment are on different carriages on the walls, showed as mirrored in the layout, so that the same amount of needed screws and bolts are on both sides.

B. New Tool benches

In the middle of the assembly area, build new tool benches so that the employees get more solid benches to work on than the current small tools carriages. Larger tools that are not in frequent use could be kept on the tool wall above the tool benches. The area could also serve as tables where blueprints could be folded out and be studied. Be sure to keep the assembly of chains away from this area, and focus instead on keeping it tidy, following the 5S principles.

-1. Buffer Stock

This area should be used as a buffer stock where the right parts for the next machine to be built are to be kept. Larger parts are currently being made outdoors so those parts could be checked. Important parameters should be accurate; the amount of parts accurate, the quality should be high, etc. Do not start building the machine before there is enough space in area 1 to make it possible to build, instead focus on the machines that should be finished first.

1. Pre Assembly

In the pre assembly area should the frame and other larger parts are assembled together, this area is also close to the other manufacturing areas and the parts should be in oiled if needed here.

2.1 and 2.2 Mechanical Assembly

Area 2 should be the mechanical assembly area, where focus should be on the mechanical adjustments but no hard lines should be drawn between the different areas. The electrical assembly could start in this area if a machine is being tested in area 3. Mechanical adjustments could be done in area 3 as well, if it is enough space in area 3 and it is time for the machine to move to then next step.

3.1 and 3.2 Electrical Assembly and Test

Area 3 should be the electrical assembly and test area. This because the distance to the current pre electrical area where the control board is being made is short, and the distance to test material in the shelves and the new build refrigerator is short. A Cable rack should also be built next to the tool bench in order to organise the cable reel more efficiently.

4. Information board

The information whiteboard could be placed in area number 4. The current two work benches will be needed to be taken away and maybe be replaced of a one larger bench that only should be used when manufacturing the new version of protection glass. The table are then been pushed up against the wall when it is not in use and the

information whiteboard could be placed underneath the table, facing up when the table are against the wall.

5. Cardboard Press
In order to reduce unnecessary movement and waste, the cardboard press should be moved towards the testing area of the new machines, where cardboard boxes are being made and need destruction. This also facilitates the transport of cardboard bale from the machine out from the workshop for recycling.

6. Made Parts Carriage
The new developed made parts carriage already existing should be manufactured in a total amount of four, maybe with new larger wheels in order to transport them easier. This in order to use a kanban way of filling it up, for example; when a wagon is empty in area 2, it should be filled up with the right parts from the stocks according to a list for the machine that is planed to be build, and then moved to area -1 when space are given.

7. Purchased Parts Carriage
A new wagon should be developed for purchased parts. Instead of the current system of putting the purchased parts in half a pallet that spills over with parts, that the employees then has to search for in order to find the needed one. The carriage should not be more than half a meter wide in order to be able to take the carriage into the stock-in-trade. The amount should be five or six here in order to use a kanban way of filling it up. For example; when a wagon is empty in area 3, it should be filled up with the right parts according to a list for the machine planed to be build, and then moved to area 2 when enough space is given.

Information whiteboard

The interviews have showed that all the companies have, after the implementation of Lean Production, started to make the information about the production more visual and closer to the actual work area for the employees, through team based information whiteboards. For Österbergs a whiteboard for every team would be too much - there is not enough space for it right now. Instead the company could focus on one information area.

Layout

The layout could for example look like figure 6.2. One area that visuals the production, one area that deals with suggestions, one other that focuses on the analysis and the results from it, and one team based area.

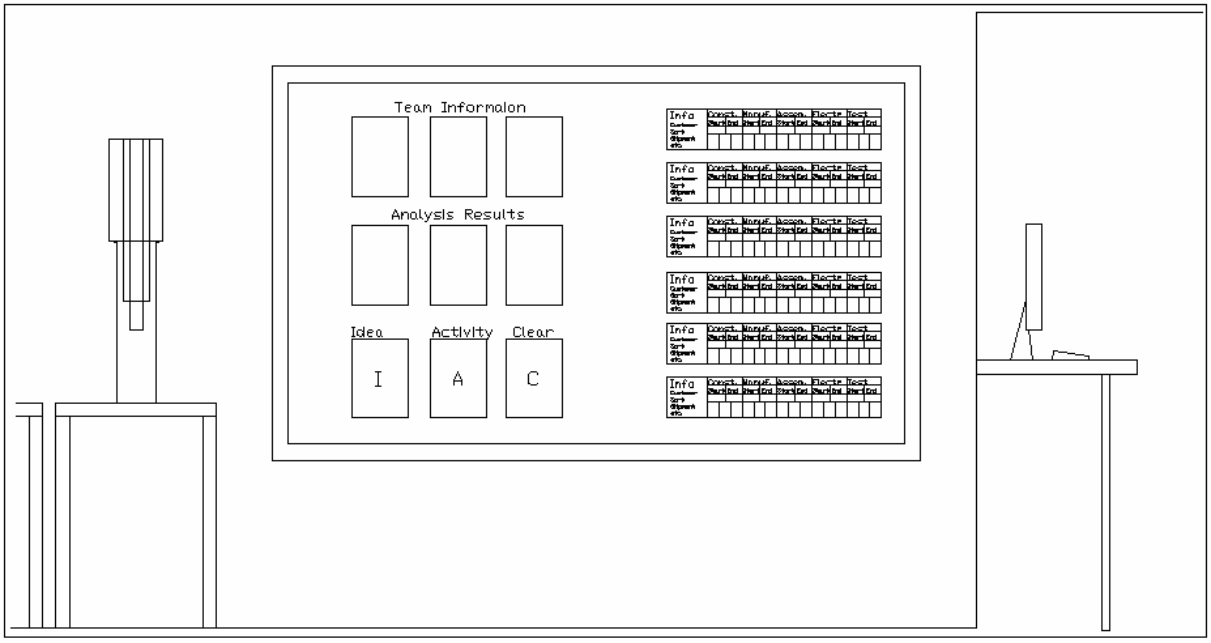

Figure 6.2 Suggestions for an information whiteboard layout.

Visual Production

In order to visualize which part of the project a particular machine is involved with, a sign, for example looking like figure 6.3, should be created. The sign should be mobile and consist of a whiteboard material so that texts could be written on it. The machine that is in turn to be delivered should be on the top or the visual production column. A week after the order has been received the project leader should create a new sign for that particular project at the Wednesday meeting. The project leader should talk about which kind of machine is in question; any special design, delivery date, the start and end in every stage of the production. Every stage has then three squares where the time assigned is divided in four parts. The progress is then visualized, with coloured buttons, by the team leader when the date has passed. Green for on time, yellow for project on hold, red for project is behind.

Info	Const.		Manuf.		Assem.		Electr		Test	
Customer	Start	End	Start	End	Start	End	Start	End	Start	End
Sort										
Shipment										
etc.										

Figure 6.3 Visual information in which stage a project are in on the white board.

Suggestions

Here, ideas could be shown for everyone in an easy, visual way, for example I-A-C (idea-activity-clear). It is better to take small steps all the time: write down all ideas on a piece of paper, explaining which group that has the idea, how to realize it and estimating time/cost. At every weekly meeting two or three ideas should be transferred to the activity list and be handled during the week. On the next meeting the status of the process should be discussed – or if the work is finished – if it has been done satisfactory. Every idea that a group comes up with could be divided into four levels; level 0, is an idea that cannot be carried through instantly, and therefore should be kept for later work. 1, is a team based work that can be done directly if it doesn't cost more than 5000SEK. 2, is a teamwork with higher cost that needs management decision. Finally, 3, factory based work, needs board decision.

Results

Three important areas for Österbergs should be measured every third months, and be put up on the board so that the present status can be compared with previous results. All employees must be determined to improve these areas, with a focus on the goals that the board has decided for the company in the future. Every team should know how the analysis has been done and how it could influence the result.

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Appendix

Appendix A: The questionnaire, in Swedish.
Appendix B: The questionnaire results.
Appendix C: Answers from the interviews.

Appendix A

Utvärdering av din nuvarande arbetssituation

Ringa in den siffra som bäst motsvarar din omedelbara uppfattning om ***din*** arbetssituation. Tänk snabbt och markera spontant.

Berarbetningen av svaren görs av Stefan Andersson, student Chalmers Tekniska Högskola och alla uppgifter kommer att behandlas anonymt.

1. Arbetsplatsen						
Arbetsplatsen är rörig, dåligt organiserad och ofta ostädad	1	2	3	4	5	Det finns en plats för allting och allting finns på rätt plats. Rent och snyggt överallt
2. Utformning						
Material finns spritt överallt och det blir många onödiga förflyttningar	1	2	3	4	5	Allt material har givna platser längs tillverkningsflödet. Få ytor är outnyttjade
3. Information						
Det saknas tavlor med aktuell information. Du måste fråga för att få veta var saker finns och vad som pågår	1	2	3	4	5	Informationstavlor finns och det är mycket tydligt vad som händer med företaget och vad som är aktuellt just nu
4. Utrustning						
Utrustningar lagas först när de går sönder. Det är vanligt med spilltid	1	2	3	4	5	All utrustning rengörs och underhålles ständigt. Det är ovanligt med spilltid
5. Slöseri						
Det är vanligt med slöseri med resurser i olika former i alla delar av verksamheten	1	2	3	4	5	Alla former av slöseri har påtagligt minskat och hålls hela tiden under uppsikt
6. Tillverkningsflöden						
Tillverkning i stora partier. Många mellanlager och långa ledtider i processerna	1	2	3	4	5	Enskilda artiklar bearbetas och förflyttas snabbt genom hela bearbetningsprocessen
7. Arbetsprocesser						
Var och en utför sitt arbete på sitt eget sätt och så bra som fastställda omständigheterna tillåter	1	2	3	4	5	Arbetsrutinerna är enhetliga med optimerade möjligheter för maskinerna att nå bästa möjliga resultat och engagera medarbetare
8. Arbetstakt						
Arbetstakten är ojämn och baseras på månads - eller veckoplanering samt tillverkning i stora partier	1	2	3	4	5	Kundernas verkliga behov styr arbetstakten. Arbete utförs enligt dags eller timplanering

9. Produktion						
Produktionen styrs av prognoser eller vad som för tillfället kan tillverkas	1	2	3	4	5	Kundernas verkliga behov styr tillverkningen
10. Lagarbete						
Alla arbetar individuellt enligt arbetsorder. Få arbetsuppgifter förutsätter lagarbete	1	2	3	4	5	Arbetet sker i lag som styr sitt eget arbete enligt rutiner som de ständigt förbättrar
11. Mångkunnighet						
Jag har min egen befattning, yrkesroll eller maskin att sköta	1	2	3	4	5	Jag har lärt mig många uppgifter, är mångsidig och kan flytta runt vid behov till andra arbetsuppgifter
12. Förbättringsarbete						
Få deltar i förslagsverksamheten eller visar intresse för att delta i förbättringsarbete	1	2	3	4	5	Stort engagemang och omfattning på arbetet i förbättrings lag. Förbättringar i verksamheten är vanliga
13. Reaktioner vid misstag						
Inga uppmuntras att stoppa tillverkning när de upptäcker fel. Felaktiga produkter kan tillverkas under lång tid	1	2	3	4	5	Alla har rätt och skyldighet att stoppa tillverkning samt att vidta åtgärder så fort de upptäcker fel och brister
14. Analys av grundorsaker						
Åtgärder vidtas när problem upptäcks, men det är inte ovanligt att de återuppstår	1	2	3	4	5	Alla engagerade i problemlösning. Grundorsaker till problem söks alltid
15. Arbetssituation						
Jag känner mig hårt styrd i mitt arbetssätt och har ingen möjlighet att påverka denna	1	2	3	4	5	Jag känner förtroende för företaget och kan påverka min arbetssituation
16. Arbetsmotivation						
Jag känner mig inte motiverad i mitt nuvarande arbete	1	2	3	4	5	Jag känner mig väldigt motiverad och engagerad i mitt arbete.
17. Företagets målsättning						
Jag har inte riktigt koll på företagets strategiska mål och hur vi ligger till för att uppfylla dem	1	2	3	4	5	Jag vet vilken målsättning företaget har och får kontinuerligt information om hur vi ligger till förhållande till den

Tack för att du tog dig tid att fylla i enkäten

/Stefan Andersson, Chalmers Tekniska Högskola

*Frågeformuläret är en vidare utveckling från på frågor i boken Lean Enterprise Institute Sweden (1999).

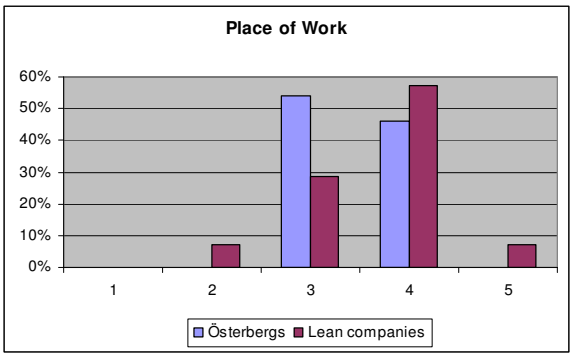
Appendix B

Questionnaire Results

All the questionnaires were answered by employees at their own place of work. 13 answers came from Österbergs. A total of 28 answers came from Lean companies; 5 from Lindab, 6 from Lundgrens, 7 from Santa Maria, and 10 from Haldex. The responses from Lean companies were too few to present their result separately. The answers were calculated into percent and made into diagram to make the answers more visible.

Question 1. Place of Work

Statement 1: The place of work are messy, badly organize and often untidy.

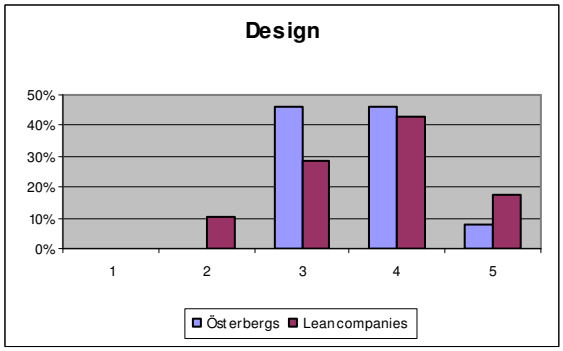


Statement 2: Every part and tool has a place and everything is in right place. It is clean and tidy.

The mean value for Österbergs: 3.46 against Lean companies: 3.64. Which indicated that the place of work is less organized and messier then the other investigated companies.

Question 2. Design

Material are spread everywhere and there are a lot of unnecessary movements.

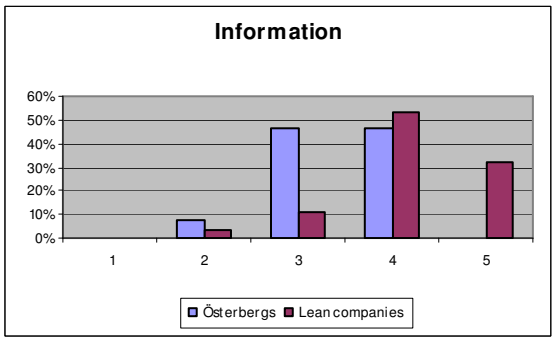


All material has a place along the work process. Few surfaces are unused.

The mean value for Österbergs: 3.62 against Lean companies: 3.68. It indicated that everything has a place along the work process but the reality is different when comparing. Österbergs has a 'lets build here because here is space syndrome'.

Question 3. Information

There are no information boards with updated information. You have to ask to get information.

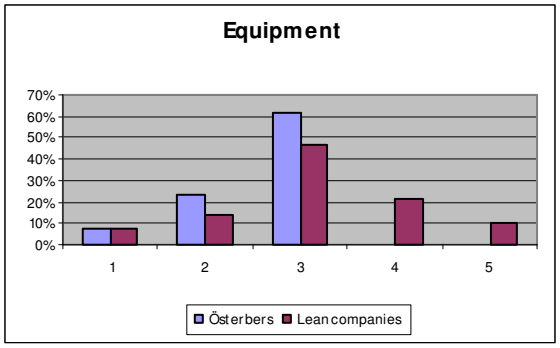


Information boards exist, it is cleared what is going on in and with the company.

The mean value for Österbergs: 3.38 against Lean companies: 4.14. This indicated that the employees get information but it could be much better.

Question 4. Equipment

Equipment are been repair after it is broken. It is common with waiting.

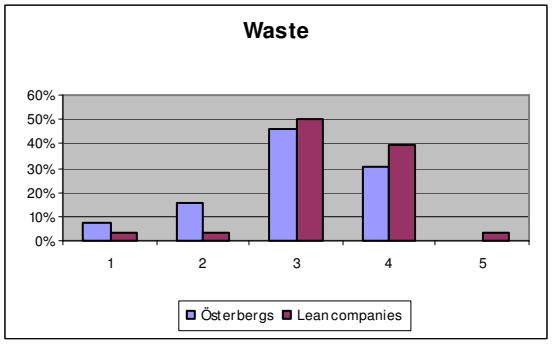


All equipment are constantly maintained. It is unusually with waiting.

The mean value for Österbergs: 2.38 against Lean companies: 3.14. This indicated that the Österbergs do not have a plan for how to keep the efficiency of the machines. They fix them when they brook down.

Question 5. Waste

It is common with waste in different shapes in all part of the organisation.

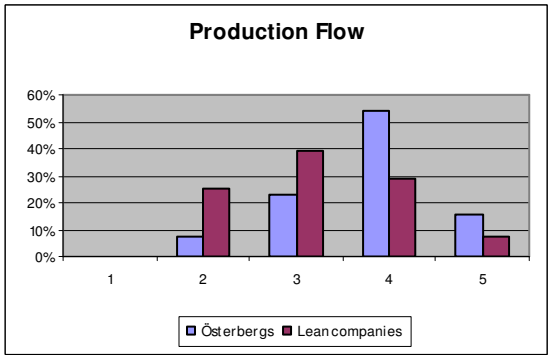


All forms of waste have reduce and it are been kept under control the whole time.

The mean value for Österbergs: 3.0 against Lean companies: 3.36. This indicated that Österbergs have a good planning and

Question 6. Production Flow

Manufacturing in large batches, several stocks between work stations and long lead time in the process.

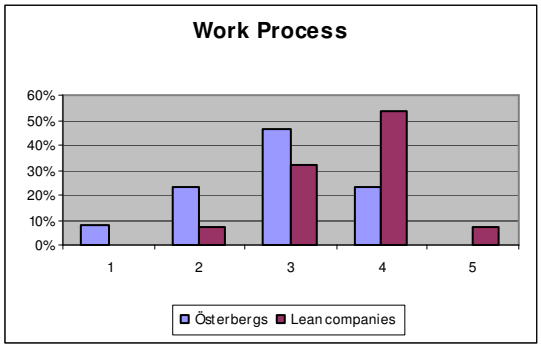


Work with individual items is being done and moves quickly through the process.

The mean value for Österbergs: 3.77 against Lean companies: 3.18. Österbergs has a very good production flow. They are building special machines directly to customers order.

Question 7 Work Process

Each and every one are doing the work on an own way as good that circumstance allows.

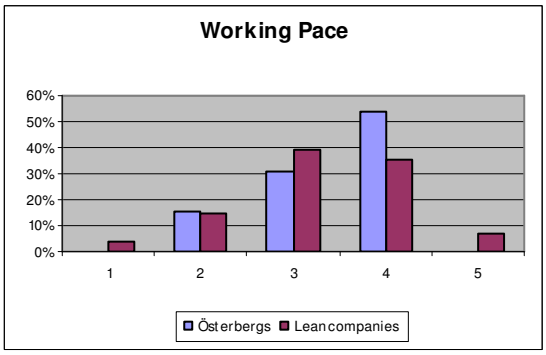


The working process are uniform with optimize machines to reach the best performance and engage employees.

The mean value for Österbergs: 2.85 against Lean companies: 3.61. It indicates that each and everyone are working in an own pace as good that circumstance allows. Österbergs could be better here.

Question 8. Working Pace

The working pace are uneven, are based on monthly- or weekly plans and manufacturing in large batches.

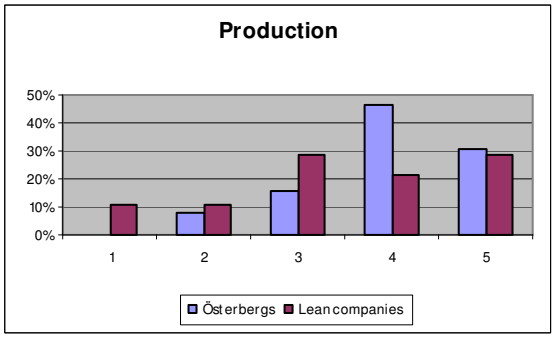


Customers demand is controlling the work pace. Work base on day or time plan.

The mean value for Österbergs: 3.38 against Lean companies: 3.29. Customers' demands are controlling the work pace at Österbergs, but it could be better.

Question 9. Production

The production is based on prognosis or what for the moment could be manufactured.

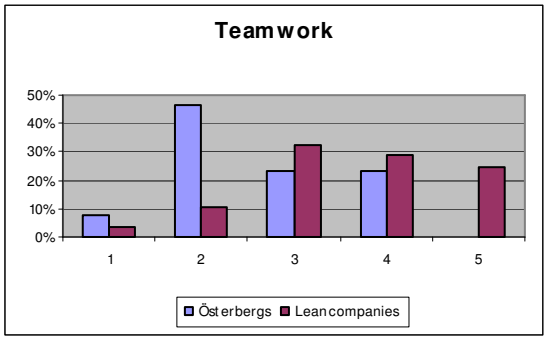


Customers demand are controlling the work

The mean value for Österbergs: 4.0 against Lean companies: 3.46. Customers' demands are really controlling the production at Österbergs.

Question 10. Teamwork

Everyone is working individual. Few work orders presuppose teamwork.

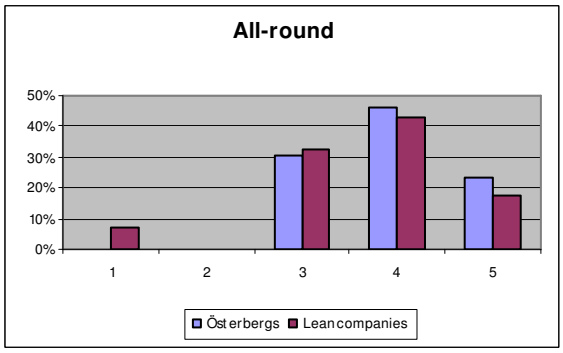


The work is being done in teams that controls it own work thru routines that are continuous improved.

The mean value for Österbergs: 2.62 against Lean companies: 3.61. It indicates that Österbergs employees are working much with individual work orders.

Question 11. All-round

I have my own post or machine to operate.

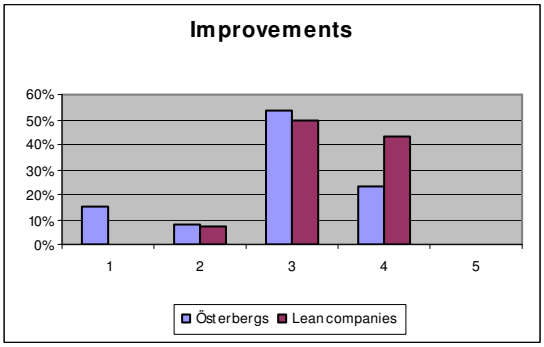


I have been learned many tasks, could move around at demand to different posts.

The mean value for Österbergs: 3.92 against Lean companies: 3.64. It both indicates that Lean companies employees are all-round workers, more then before implementation according to answers from interview, see chapter 4.1.3. And that Österbergs do have very all-round workers, but with comparing with questions 7 and question 10 they low in helping each other. So there is a possibility to help each other out more.

Question 12. Improvements

Few are involved with suggestions or show interested to participate in improvements.

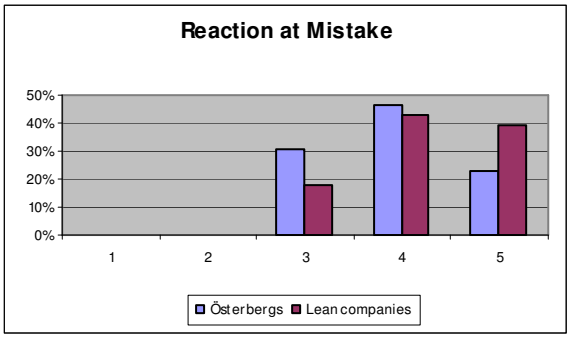


Great engagement and commitment to work with suggestions. Improvements are common.

The mean value for Österbergs: 2.85 against Lean companies: 3.36. It indicates fewer employees in Österbergs are involved with suggestions or show interested to participate in improvements then employees at Lean companies.

Question 13. Reaction at Mistake

No one encourage to stop manufacturing when they discovering failure. Incorrect products could be made for a long time.

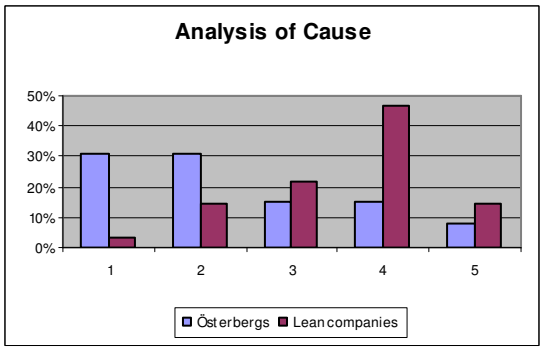


All have the right and obligation to stop the manufacturing when they discovering failure.

The mean value for Österbergs: 3.92 against Lean companies: 4.21. Reactions at mistake are good for all companies.

Question 14. Analysis of Causes

Actions are being made when failure are been discovering. But it is not unusual that it appears again.

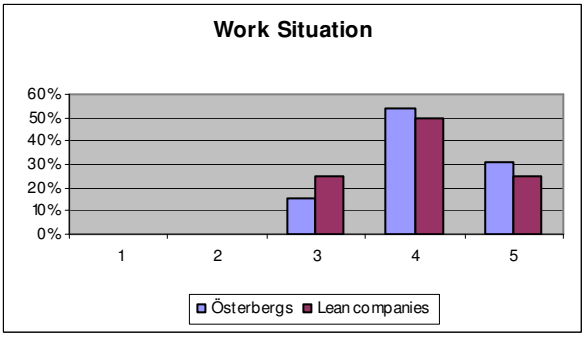


Everybody are engage in problem solving, the root case are always been analysis.

The mean value for Österbergs: 2.38 against Lean companies: 3.56. It clearly indicates that Österbergs do not follow up the causes of mistake, a big area that could be improved.

Question 15. Work Situation

I feel very hard controlled in my work and have few possibilities to influence it.

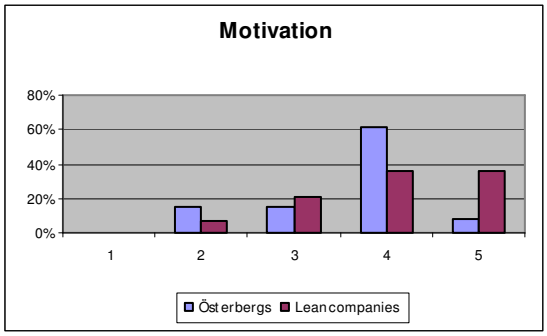


I feel that I have confidence for the company and can influence my work.

The mean value for Österbergs: 4.15 against Lean companies: 4.0. Employees at all investigated companies feel confidence for the company they are working for and can influence the way they are working.

Question 16. Motivation

I do not feel motivate in my current work.

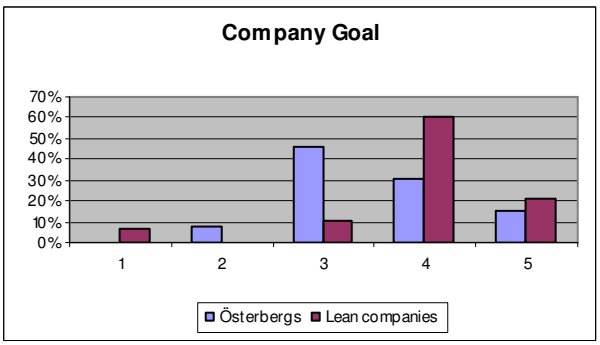


I feel very motivated and engage in my current work

The mean value for Österbergs: 3.62 against Lean companies: 4.0. Some advantage for Lean Companies in how motivated employees are.

Question 17. Company Goal

I do not really have knowledge about the company's business goal or how they are being fulfilled.



I know the company's business goal, do get continually information about it and know how they are being fulfilled.

The mean value for Österbergs: 3.54 against Lean companies: 3.89. It indicates that employees at Österbergs does has less knowledge about the company's business goal or how they are being fulfilled then employees at Lean companies.

Appendix C

Fully answers from the interviews with managers working with Lean Production at the four investigated companies. The interviews were recorded on a digital recorder and then transcript into words.

Question 1. What did your company want to achieve with implementing Lean Production?

Lindab	Haldex	Lundgrens	Santa Maria
To start thinking in a different way of working, accomplish more with teamwork so the group together sees to the possibilities and discovers problems closer to the work place were the problems are. Learn to identify a problem, find a solution but also to solve the problem by them self.	We started because we wanted a better engagement from the staff. We have hired the whole person, not just the muscle power. Many times the personal have more knowledge then a company is using them for, all we want to do is to make them use the knowledge even in the work.	Better and more efficient organisation with higher quality. Just to react on the customers complain and to fulfil the demands is not enough.	It was a security point of view, to have the ability to compete in the future. So in the bottom line it serious to survive as a company, but also to get the staff more engagement.

Question 2. Why did your company start to implement continuous improvements?

Lindab	Haldex	Lundgrens	Santa Maria
We become ISO 9000 certified in 1993 with focus on working environment. 1996 did we implement a new environment management system for the whole group and we integrate our management system in this. After that did we not separate the different questions as; working environment, environment or quality. And we needed the staff to work in the same way so in 1997 did we implement Kaizen.	Haldex Way was a concept, ordered from the group executive board to be implemented in all factories. Everybody should start working in the same way. It is a way of Lean Production that we renamed. This was not anything that you could choose to start to work with, and in a way it was a good way to get the whole organisation to work in the same way.	It was because the customers want long partnerships and we have to develop our self to stay in business. That is why we chose to develop us together with our larges customer and choose WCM (World Class Manufacturing). We are the manufacture division for them and we can not compete with low cost countries in terms of prices so we have to focus on something else.	We started of from a good level, but it is unwise to say that you are safe for that. Instead you have to make sure you get better all the time and this is a very good way of doing that. The situation we are facing right now is a bit strange when our customer starts to be our worst rival and they are seeing which products that are selling best and do their own products. In the end of the day it is them how can deliver best and in time to the lowest cost gets the job.

Question 3. Did you study and compare yourself with other companies before the start of the improvements?

Lindab	Haldex	Lundgrens	Santa Maria
No we were so early in our work, it is now a big internal bench marking against other Lindab Companies. And we have been on the SIVF (Swedish institute for Suggestion Schemes) top ten list in nine years now. Last year was we 7th and Lindab Vent was 4th so it is a prestige competition among us. Of course do we study different companies and looks on different ideas but we did not do it when we started.	We were a pioneer in the concern when we in 2000 started to look at an organisation change. We started to implement team organisation to get more motivated and engaged personal. So when The Haldex Way was introduced 2001-2002 it was just to continue our project with continuous improvement as 5S.	The COE, production manager and some other in the board started to investigate continuous improvement and TPM in 2002. So when TetraPak in 2003 come and offer us to join the WCM program were they already had contact consulting agencies for training and a ready implantation program. We join the train and become the second wave with four other Swedish companies and four Italian companies.	Not really, we were out and study different companies but it is hard to compare our business. If I should be honest it is nice to first in our niche. We do have two other factories, that I am responsible to implement Lean in. It is very difficult to order someone to start working with Lean. In that case you just go on and work with it and do not get the real spirit, I believe that you really have to have the spirit to be successful with lean.

Question 4. Does the company have a strategically goal that everybody knows about?

Lindab	Haldex	Lundgrens	Santa Maria
Our targets are to be the most innovative and creative steel company to the European market. The do we have goals in four different areas; Economic, Quality, work environment, and environment, in how we should perform out vision.	Instead to take the big steps so do we focus on to be a bit better every day and in the end will that lead to something really good. We have three keystones; Customer first, Respect for the individual, and Reduce of waste is what we are focusing on.	Concerning goals, so do we have one big company goal with our business and for the different teams to full fill them. (The board does not what that to be taken notes on.)	Our vision are that our products should be better then our competitors. I know since previous work that when you start a new concept and promising gold, there are many that duck for it. So I have not said that we are now going to be Lean and it will be so good. But I more than happy to look back, point out and show that 'this is was we have achieved'.

Question 5. How far into the future are these strategically goals?			
Lindab	Haldex	Lundgrens	Santa Maria
For the company in big it is high delivery in time rate and reliability in combination with a clear concentration on quality and environment. We have been working with contentious improvements for a long time now so it is a part of our work.	There was no schedule when they started the project but there is an unofficial target where every factory should be up on a particular level in 2010. So there is some press from above and the work is being questioned if no progress is being done.	With respect for the company did I not to take any notes.	With respect for the company did I not take any notes but there are targets to implement Lean in different phases. See question 7.

Question 6. Do all workers know what they should do to support these strategically goals?			
Lindab	Haldex	Lundgrens	Santa Maria
All co-workers should know about it, for example have production been away on activity under some days and had fun, discussed our targets in the productions and which targets should we have for next year. Every group will do so from now on.	The Haldex executive board have made a book called 'The Haldex Way' and there are the way we are working and our targets presents. Which KPI's that will be measured and what to full fill to be on a level an go on to next one.	I do hope so, they do get information about it. (With respect for the company did I not to take any more notes.)	We have a weekly meeting in the Obeya were someone from every group get information and are then responsible to inform the group.

Question 7. Does the company have some time limited target that you are continuality are following?			
Lindab	Haldex	Lundgrens	Santa Maria
We have targets in the four areas; Economic, Quality, working environment and environment that we continuality are following up to reach our vision.	We do have meetings about 5S and contentious improvements every month. We run GAP-analysis once a month to see were every group is standing. Everything according to the plan from the board that are presented in 'The Haldex Way'.	We measures selected KPIs that helps us with our fixed purpose to engage everybody and to focus on waste reduction. We have selected the KPI ourselves and it comes from our Lean House.	We are measure the different machine by hand to see how they are working. Have started to plan and formulate a document that will lead the implementation in stages, every section has points that have to be achieved with in a time limited.

Question 8. Are the work with contentious improvements well support of the board?			
Lindab	Haldex	Lundgrens	Santa Maria
Yes definitely, our four targets are being made in the board every year and every group then has to divide the goals into group level and make own goals from that. For example; level of reclaims, handling times, delivery precision, and product quality.	Absolutely, the system are own by the factory board with demands from the company board. The workers can see that they are not giving up and it has a plan for the future with this. That working with contentious improvements is as important to produce.	Yes, it was them how started to look at a new systema and then did our most important customer with an already system.	I am a member in the board so it was easy to influence, but there are still some person that are thinking in the old way. They are still waiting that this will show in real money. It is a benefit that we are not a company that has to show black numbers every quarter. Old fashion quarter-capitalism is a dangerous competitive to Lean.

Question 9. How did the company think when you planed the implementation?			
Lindab	Haldex	Lundgrens	Santa Maria
That we would achieve more with teamwork, everybody did get training and kaizen groups developed. The team worked more with the improvements work instead on individual basic and it become more creative with minor suggestions from the start. Then to hold it on a high level the whole time and that have we achieved.	We are a manufacturing factory and it was most natural to start in the workshop even if we are working with it in the whole business now. With weekly and monthly meetings with different analysis, so it is not unique for the manufacturing part now days.	We started with an pilot phase were you are shooting from the hip and run different project as 5S, lead time, quality projects and try different tools and methods. In the beginning was there not so many teams involve or was the results of the different analysis that was important.	We had course about 5S for several years ago with out any one asked why, that work died. So we had to start up the implement of the Lean work with some stratagem and started in the factory first to later on slowly involve everybody in the work.

Question 10. Which time perspective did the company have when it started the work?			
Lindab	Haldex	Lundgrens	Santa Maria
None particular, it was a new way of working then in 1997. The thought was to introduce the way of thinking and then work with it because there is no time limit with continuities improvements. We had a schedule to implement the work.	First did we have a plan with the education and how we should organise the work. Then do we now have a future plan to reach the highest level in the 'The Haldex Way'.	We are still in the implementation phase, it will maybe take 7 years or so for us to be real World Class Manufactures. You take some steps and then do you get back some. It demands great resource to implement it.	The time limit is to focus on the eternity. It is not a project that has a time limit, but we have gates that are clearly explained. It is a philosophy, a way of working now.

Question 11. Did you plan the work in different phases?			
Lindab	Haldex	Lundgrens	Santa Maria
Purely practical in different departments and then in teams were the training took place.	We divided it up in different teams and trained everybody in the Lean game. Then in 5S and why we are doing the GAP analysis, teach them how to read the tables and explain why we are measure what we are.	The traing from the consutling agensisys was well planed with a preparation phase, pilot phase and now are we in a expand phase.	You can see it like that; we started the training in the factory, then to customer service, and the quality department. We now want to get the market and development department to join the train so everybody starts to talk the same language.

Question 12. In which area did you focus on first?			
Lindab	Haldex	Lundgrens	Santa Maria
The focus was in the beginning on the manufacturing parts. But we have realised that it is very important to focus on the administration parts also. Because when it goes wrong in the productions it could traced back to a bad instruction. So everybody need to talk the same language.	We do not try to do any different between manufacturing and administration departments. The way of working and analysis is of course different but the base is the same with weekly meetings with the same agenda.	We focus on the manufacturing and the assembly workshops first. For example did an operation reduced from nine to one hour. It started with 5S training, were we focus on the whole value chain, realised after interviews in the team that the logistic part with right location of different wagon was as important as clean up the work space.	Everybody in the factory has now been playing the Lean game, not all are thinking in the right way but they had a go in it. Now do we slowly implement the old way of work with 5S so it gets a meaning this time.

Question 13. How did you educate your staff within continuous improvements?			
Lindab	Haldex	Lundgrens	Santa Maria
Though the Kaizen Institution, they were competent and inspire people. Showed us good examples, how other had done, how you should work and different tools. Then did they let us implement the work, they show us a way of working and pointed out that you can get real far with it.	Started with the Lean game and training with 5S. Then do we educate the staff continuously, last fall did we big follow up training, what is The Haldex Way, what is Lean Production, how do you work with it and why. And then did all team give suggestions on own goals, different measurement tools and own targets to work towards.	First education about WCM principles and then 5S, recently have they get trained in OEE and similar tools and we have start using them. It is easy to say that we are going to measure this and it is a scale on the efficiency, but compare to what? Train first, understand the concept and then implement it.	We have had several sets of the Lean game in the canteen so everybody sees that something is going on. The 5S training years back and project teams has been on conferences or been out studding other companies.

Question 14. How did you motivate your workers when you started?			
Lindab	Haldex	Lundgrens	Santa Maria
We were clear with we are doing this for us and no one else. If we will stay in business in this tough market do we have to work together.	It comes from above and it is a piroterd task. This is nothing you choose to do, it is the law. Then has the staff realized that it is more fun to work when you can change the work place and are being encouraged to ask why.	We hade been looking on different system before, realised that we can not stand still if we want to stay in business. Then did our most important customer and 'demand' us to work this way so everybody understand that it was important.	To start of you self, show the way. I do have a good team around me so I did put in some time to train them, make them go on conferences before we started to implement it. I have the benefit of look after my self and do not have any boss's running over me. That is an important condition to succeed.

Question 15. How do you motivate your workers now when the process are rolling?			
Lindab	Haldex	Lundgrens	Santa Maria
You have to be one step ahead of your competitors and one way is to have work with continuities improvements. Everybody has a possibility to contribute and to change the workplace, that motive.	We motivate our workers through explaining why we are doing it, what the benefits are and what we could gain on it. One important part is that we often are out in the organisation and talk to them at the worksite. It is very important that decisions are being taken out there, discussing there problem there and not at the office.	Well we have had a short back before the summer and not really come back, but we had a meeting a couple of weeks ago and now can we see some raise in the statistic. It is important for everybody to realise that if no suggestions are been handle in there will be no improvement. We also put up before and after reports to show that it has become an improvement and what was the benefit of it.	We are quit young in this work, you can see some how is on, some more that are neutral and some less that are going against the work. That is not acceptable but it is important to deal with them in the right way, you can not just throw them out even if that would have been a good signal. Instead do I welcome the conflicts so they can express themselves.

Question 16. How does your company share information?

Lindab	Haldex	Lundgrens	Santa Maria
We have a central information board, but are trying to have more and more information in our management system. Then do every group have there own whiteboard were they decide which information that should be put up.	Every team has information whiteboards were IAF (idea-activity-finish) list are been put up, latest GAP analysis, picture of everybody in the group and what they are doing. We have morning meetings every day around the board with the production manager and then a large meeting every week.	Information whiteboards on every groups, a morning meeting every day were we have an decided agenda, every second week a meeting concerning continuities improvements.	Morning meeting every day at the teams information board, no standard how the board should look like. Once a week is the factory closed and one from every team are in the Obeya for a factory meeting, the rest of the group are working with improvements.

Question 17. How were you thinking that your employees would contribute?

Lindab	Haldex	Lundgrens	Santa Maria
Team based and we focus on the team dynamic, that we are working and improve together.	To make them realise the whole picture, use the right person on the right place. Work with the persons that were on or neutral to the concept in the beginning, let the other be left along because they will come later on.	Tried to make the teams more self going and let it be some bench marking between the groups. They are moving around the responsibility as a team leader every month so new ideas come up.	My feeling controls it much; we have an implementation plan to August 2007 in how we should work that we have formulate by our self.

Question 18. How much time involves continuous improvements?

Lindab	Haldex	Lundgrens	Santa Maria
We have monthly meetings as a fixed point there you have to work with improvements work, but everybody can take time any time they like it to work with a suggestion.	Morning meetings, 15 minutes every day. Team meetings once a week on a fixed time, and we demand that you work with improvements during the week if you been delegated a task and are responsibility for a suggestion. We spend much time on continuous improvements if you add it up but we gain much from it in the next step, especially assembly time and quality of the product.	Morning meeting every day were the group update , then one hour every second week in pure continuous improvements work where we measure our KPI and are following up the results.	Meetings every day and once a week do we close done the factory for improvements work.

Question 19. How do you check you work with continuous improvements?

Lindab	Haldex	Lundgrens	Santa Maria
We are working in a program called Munkeby in Control that are dealing with everything we need, for example; reclamation from customer, deviation in the production, quality with report and improvements suggestions.	On the weekly meeting do we check the previous week, the results from the GAP-analysis, IAF (idea-activity-finish) list. Everybody are bound to give suggestions, on the meeting we discus if an activity has satisfy the ideas requirements and are then passed on to the finished list and some other are being transferred from the idea list over to become an activity for the next week. You can not do it all in one week, a bit better every day.	We have an agenda on the morning meeting that are reported into an Excel document that are been send to the coordinator and on the improvements meetings we discus our KPIs that we are measuring and decides what we are going from there.	We have nine main targets that we are measuring against, we visual these results to secure that information goes out and that we fulfil the targets. If we do then we are going on to the next target.

Question 20. Are everybody committed with the Lean work?

Lindab	Haldex	Lundgrens	Santa Maria
Everyone is in an improvements team, from the COE and down. It is important that everyone has a chance to be involved, even if you choose not to, and that you have done an improvement, from idea to a change. So no one can come after a change and say that this is not good.	Yes now, not from the beginning. There were some teams that did not following the standards, we did let them be left alone and after some time did they started 5S work voluntarily and did it really good.	Everybody has been involved and then there are people that are working with more enthusiasts then other. Everyone, from the COE and down, has a small area in the company were he or she checks with focus on 5S standards.	Not yet, our target is to get everyone involved. It is a long way to go but we are getting there.

Question 21. Are the workers more committed to the work now compare to before

Lindab	Haldex	Lundgrens	Santa Maria
Definitely more committed staff, but it goes in waves. But in the big has it raised very much.	It is a whole different climate in the company now, a better culture. Only on the last three years has we notice a greater active part, people question decision in a nice way and has a thought behind the question.	Before was the work order that you did your part and then went for a cup of coffee. Now is the feeling that you work for the whole company and you are going to the other group to help out if it is needed and you get help if you need it yourself.	You notice a greater commitment from everybody's part, even if we are just in the beginning of our journey.

Question 22. How is the work order from that an idea is born to it are fulfil?

Lindab	Haldex	Lundgrens	Santa Maria
In with it in the computer system, the ideas are divided into four levels; 0, is an idea that is not doable right now, are being saved in the system for later work. 1, is a team based work that they can do directly if it not cost more then	Team based, put you idea down on the IAF list and then do the team decide on the week meeting if they will do it and how it will be done.	An idea should be put done on paper and handed to the coordinator that will decide a responsible person for the implementation of the idea. It is a bit more administrative but you do not get the frustration that nothing is happening.	Our objective is that everyone should put down an idea on the group board, the responsible should be in the group and everyone should try to implement an improvement. Still long to go.

5000SEK. 2, a team work with higher cost, need management decision. And 3, factory based work, need board decision.		We have discovered much less frustration, stress and overtime since the implementation.	

Question 23. Have the company gain any benefits, economical with profit or more commitment from the staff since implementation?

Lindab	Haldex	Lundgrens	Santa Maria
Positive progress in both economical and quality aspect, work environment has been better as improvements have been implemented. I belie and hope that the employed feels satisfied it the new way of working and that was the aim, to get everyone involved.	It is hard to measure the result in money, but you can see it as we are producing more complex parts in less time now. If you add all the time you had put down in the continuous improvements work then we had had an extreme productive implementation. Even the quality of the products has raced, now even operators are suggestion that 'can we not also measure this…' to make sure the pieces have good quality before delivery.	It took very much time in the beginning and the education cost a bit but we can now see it as well invested money. It was expensive but now it gains more than it has cost so we have black number for the implementation.	Absolutely, many and many more to come. Everything from a better communication , less waste, better service, lower stock, and last but maybe most important the staff commitments has raised.

Question 24. Has the work with Lean Production change the way you have been working?

Lindab	Haldex	Lundgrens	Santa Maria
We have become totally customer demand , in good and bad. When we had had a expansive time has it been tough for the customer. You have to be very flexible and if something does not work, find a solution so it works to the	There is a decided way in how a new project are planed an implemented. We are working with APQP that is a framework of procedures and techniques used to develop products, the system comes from the automotive industry. If you want	The delivery time has a more planed flow since the implementation, we plan the manufacturing against the assembly workshop so they get the parts when they need it. A project are been planed in MS-Project and every	We have decided that we will not follow the principle of one piece flow, yet. Even if the marketing department are planning for it and we are doing some test for it in the warehouse so are we not lean enough in

next time. Our supplier has a delivery time in 2-3 months and our customer can get a product in a week so we are very flexible.	to make a change in a product that are in manufacturing do you have to send a report about the change to a group that evaluate the change with the customer.	team gets a work plan every week so they can divide and level out the work within the team. In the planning phase for a new machine, a short meeting is being held to discuss the project plan with one member from every team. This is to develop a more sense of responsibility for the product so everyone feel as a part of the company.	the production for it yet. We are getting there but how and when do we not know now. Small steps develop your people and make sour that everyone are onboard before the next step.

Question 25. How do you evaluate and develop your system with continuous improvements?

Lindab	Haldex	Lundgrens	Santa Maria
Though statistics from the system, it shows when we have a down period and then you have to change. We have recently introduce a monthly newsletter that are focusing on the continuous improvements work that has been done and it tries to focus on something from every department.	Internal are we doing it, by the minute, day, week and month. So all the time, plus we have an external group from Haldex that investigate the company once a year and do an audit over the work.	I have been develop our work but we have now decided that we will not extend the system more before we are safe in what we are doing. The system is quit complex now so we have to make it more sustainable before we take the next step.	We are being implementing it right now, and the evaluation is if we are reaching our targets. The CEO and I will be really clear about that it is lean that we are working with from now on.