

SOP's in production to create customer value

LAB University of Applied Sciences

Master of Business Administration, International Business Management

Spring 2022

Vesa Lintinen

Abstract

Author(s) Linttinen, Vesa	Publication type Master's thesis, UAS	Published 2022
	Number of pages 53	
Title of Publication SOP's in production to create customer value		
Degree and field of study Master of Business Administration		
Name, title and organisation of the client Koskisen Oy, Panel industry		
Abstract <p>Creating customer value is one of the main questions to companies. Koskisen Oy operates in forest industry and in Finland forest industry is one of the main industrial sectors. Forest industry is already quite sustainable as wood material binds the carbon dioxide. Koskisen plywood mill uses mainly birch as a raw material.</p> <p>There are currently different kind of trends in the market such as digitalization, artificial intelligence, making business more direct with cutting middlemen out and sustainability as a part of conscious consumption.</p> <p>LEAN manufacturing is aiming to reduce waste in the processes and therefor increasing sustainability as material usage becomes more efficient. There are plenty of different LEAN tools to use and standard operating procedure (SOP) is one of them. SOP is all about standardizing work so that the chosen process will become more efficient. It has also effects to quality levels, lead times and profitability.</p> <p>Koskisen have done LEAN in the past, but activities have not been that successful. Mainly there have not been enough time to do the LEAN tasks and follow-up. Due to that environment has turned little negative towards ne LEAN activities.</p> <p>Without standardizing the methods and tasks in production, process variation will be greater and waste in processes larger. Without constant follow-up, activities will faint away and actions regress. By creating SOP process to Koskisen Oy it will help to maintain needed and agreed actions in production and with that generating more value to customers.</p>		
Keywords LEAN manufacturing, Plywood, SMED, SOP, Sustainability		

Contents

1	Introduction.....	1
1.1	Research approach	1
1.2	Research questions and objectives	2
1.3	Research methods and limitation of study	2
2	Company introduction	3
2.1	Koskisen Oy.....	3
2.2	Plywood manufacturing	3
2.3	Forest industry	6
3	Customer value	8
3.1	Definition of customer value	8
3.2	Quality management.....	9
3.3	Market trends in customer value.....	12
3.4	Sustainability.....	13
4	LEAN manufacturing	17
4.1	LEAN benefits and definition of waste	17
4.2	History of LEAN	19
4.3	House of LEAN	21
4.4	Gemba, Muda, PDCA, OEE	22
4.5	5S	23
4.6	Total Productive Maintenance	25
4.7	Value stream mapping.....	28
4.8	A3 and problem-solving tools	28
4.9	Single-minute exchange of die (SMED).....	31
4.10	Standard Operating Procedures (SOP's).....	32
5	Lean at Koskisen Oy	35
5.1	History and current state.....	35
5.2	Problem space and findings	44
5.3	Solution space	45
5.4	SOP process.....	45
6	Results, reliability and validity of the research	48
7	Conclusions.....	49
	References	50

1 Introduction

1.1 Research approach

Creating customer value is one of the most important things to companies. Companies measure their success by customer satisfaction. Therefore it is crucial to make customer happy and to feel happy customer needs to feel that they are getting value or values from suppliers or products. When customer feels that they are getting direct value or added value for products or services from supplier they become more engaged and loyal to this specific supplier.

This thesis is done to company Koskisen Oy and it is aiming to create SOP, standard operating procedure, process to use in production to reduce waste and by that inflecting to customer value. SOP's are part of LEAN manufacturing and LEAN manufacturing is specifically concentrating to reduce waste and by that gaining benefits for companies that they can for example reduce delivery times or product prices. This thesis is done to Koskisen Oy's panel industry and more specifically to plywood mill and that why is concentrating more to plywood production. SOP's and LEAN manufacturing are very universal way of leading different kind of operations and learnings in this thesis can be used in other fields as well.

Koskisen Oy operates in forest industry and this thesis is taking a look to forest industry and company itself. After that customer value is studied and LEAN manufacturing impact to customer value is explained. Company wants to deliver customer satisfaction and therefore for this thesis is creating SOP process to enable better value for customer.

Since Koskisen Oy has already have some experience of LEAN manufacturing this study is done by using qualitative research methods. Qualitative research is done by gathering data from interviews and company databases. People chosen to interviews are managers and operators who has been involved in LEAN action in Koskisen Oy. Purpose of the study is to gain viable and important information and data to be able to understand the current situation.

Data collection is an important role and typically qualitative research is not only seeking what people think, but also trying to understand why they do think so. In industrial environment and when mill has a lot of people as operators it will become more crucial to understand what they think to be able to find process bottlenecks for previous LEAN actions. Only that way new model can be modified so that the new actions and processes will stay in action and they become more time lasting. (Creswell John W. 2014)

1.2 Research questions and objectives

Main objective of this study is to find answers how can standard operating procedures (SOP's) in production create extra value for the customer. Second objective is to analyze Koskisen Oy's current state in LEAN manufacturing by interviewing and checking outcome of the survey for the blue collars. Last and final objective is to create SOP process for the Koskisen panel industry.

1.3 Research methods and limitation of study

New ways of work need to be built in a way that operators feel it also as their task. Research methods are not limited only to interviews, but also observations and surveys of LEAN in Koskisen.

This study is limited to involve only Koskisen Oy plywood mill operations and it is not straight applicable to other areas of business. Interviews and observation are done in ply-wood mill environment and only people involved with that are a part of this study.

2 Company introduction

2.1 Koskisen Oy

Koskisen Oy operates in forest industry it has two separate industries, panel industry and sawn timber industry. Koskisen Oy is a family-owned company and was established in Finland in 1909. Turnover of the business is around 270 million euros and Koskisen has around 1000 employees. Founder of the company is Kalle Koskinen and Jukka-Pekka Pahta works as a CEO. Main mills, plywood mill, chip board mill and saw are located in Järvelä, Finland.

2.2 Plywood manufacturing

Plywood is a very good product to use in different kinds of construction, transportation and packaging industries, die cutting and also for furnitures and other interior products. Koskisen manufactures mainly birch plywood, but also uses other wood like spruce and aspen for example. Plywood is a sustainable product because wood binds carbon. Plywood is manufactured by peeling thin plies (veneers) from wood logs and then gluing them cross-laminated to panels. Pile of veneers can be seen in image 1.



Image 1. Pile of veneers. (Koskisen intranet)

History of plywood manufacturing started at late 18th century. All though already ancient Egyptians and Creeks were creating plywood type of wood products Samuel Bentham can be described as a father of plywood. Bentham applied for patents for different kinds of plywood/veneer machines. About half a century later Swedish engineer Immanuel Nobel invented rotary lathe for peeling logs into veneers. Rotary lathe was a great invention because it enables efficient way of doing peeling. Because plywood production was developed in England and later in USA industry still uses units like feet and inches. First panel was 4 feet x 8 feet, meaning 1200 mm x 2400 mm and this size is most typical size nowadays.

Wood procurement is doing sourcing and purchases wood logs. Raw material sourcing is not that simple in Finland because we have quite limited markets and there are 3 big companies operating in forest industry.

Plywood production is a process of creating plywood panels from raw material, this process includes many steps. First the logs are soaked in warm water to get them in desired temperature and moisture to enable best quality veneers after peeling. After debarking, scanning and crosscutting comes peeling. Wood is peeled into 1,4 mm or thicker veneer mat and it is cutted into sheets before drying. After drying sheet are graded into different quality grades. Graded sheets then go to process where they are prepared to gluing, sheets can be for example scarf jointed, composed or patched. In a gluing, veneers are cross laminated and pressed in a high temperature and pressure. Plywood panels are then finished by sawing and sanding and be coated with different films or otherwise modified with CNC machines etc. When panels are ready, they are packed and shipped to customer (Image 2). (Clark 1961, 3-16.)



With standard packing the panels are stacked on wooden pallets, covered with cardboard, and strapped with plastic bands. On request packages can be made in accordance with the customers' wishes.



Image2. Readymade pallet of plywood (Koskisen intranet)

Koskisen Oy is producing their plywood mainly from birch. Birch gives plywood high specifications and strength abilities. Over 90 % of product goes into export.

Plywood manufacturing process can be seen in Figure 1. Not all products go through all stages of the process and process itself can be quite complex. In Finland and in Koskisen high processing is a key to success because of high labour costs.

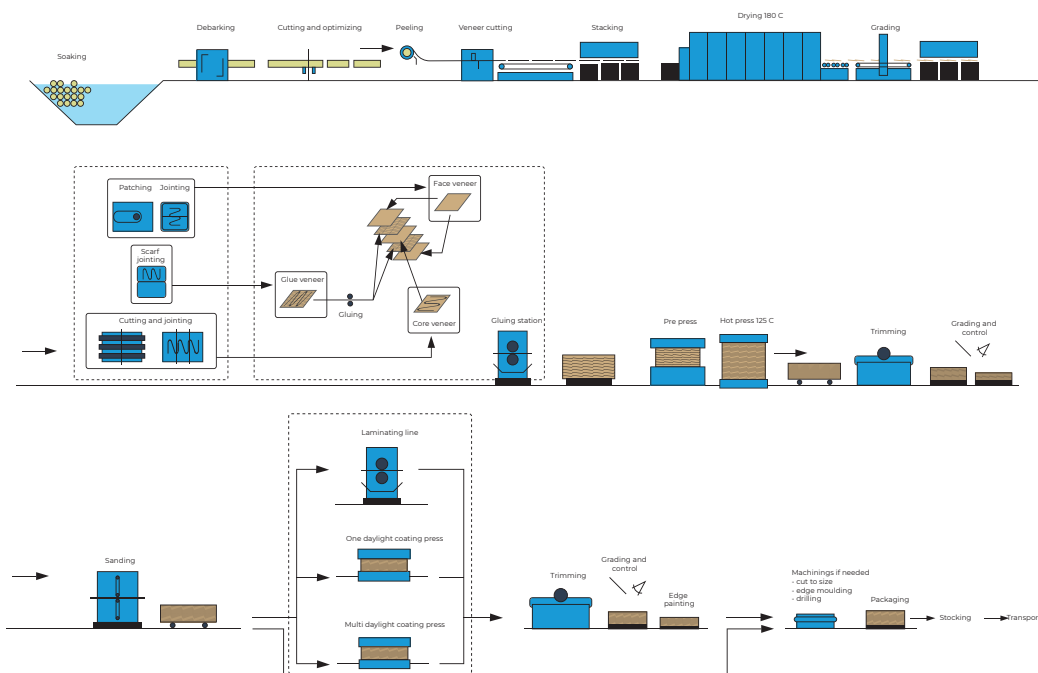


Figure 1. Plywood process (Koskisen intranet)

2.3 Forest industry

Forest industry means all industry that is using wood as their raw material. Wood processing is very important sector in Finnish industries. Gross value of production of forest industry was over 23,4 billion euros in 2018. By reaching that it is nearly 1/5 of all production in Finland. (Forest industry in Finland, <https://mmm.fi/en/use-of-wood/forest-industry>)

Before 19th century wood was mainly used as firewood and building houses. When the first industrial revolution started in late 18th century by inventing steam engine wood processing became also more efficient and new innovations started to rise up. Mainly steam engines were used in saw mills, but also transportation came easier.

Like mentioned above sawn timber was the first field of forest industry and nowadays different panel products such as plywood, chip board, fibre boards and carpenter together with highly engineered wood products combines industry all in one.

Forest industry is one main sector of Finnish industries and it is around 19% of all industries in Finland. Sector has been growing since 1960's, but for instance paper industry has decreased for years now. Development can be seen in figure 2. forest industry production volumes since 1960.

Forest industry production volumes since 1960

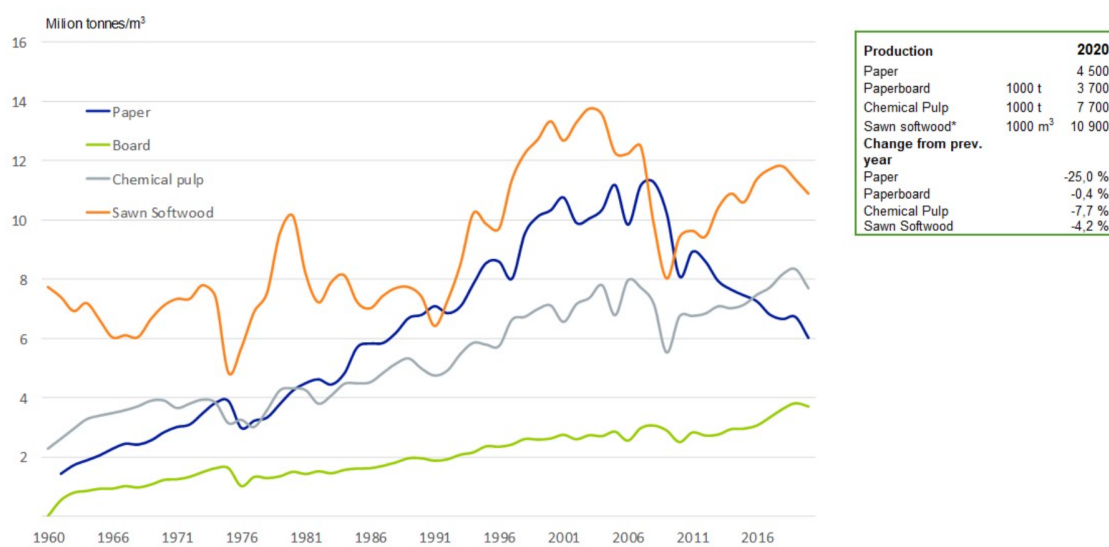


Figure 2. Forest industry production volumes since 1960. (Forest industry production volumes since 1960)

3 Customer value

3.1 Definition of customer value

Value for customer can be defined in many ways. When it comes to question of value it is often a personal question and it is also related to quality of a product or a service. Also need of customer will give importance of certain value. For instance, pricing. If price is low, but quality level still high enough it can give value for customers money. On the other hand, if customer have green values, he or she may value sustainability over price.

Definition of value variates, but if we put it in a simple way, value is benefits to customer when they offer money and get technical, economic, social or service in receive. This is quite typical approach to value. Professor of marketing Valarie Zeithaml also described value like, value is price and what I get for what I give. (Anderson & Narus 1998)

Holbrook was a pioneer of value definition, and he created a typology of value. He identified economic, hedonic, social and altruistic and separate these into different types:

- 1) Excellence, this refers to customers personal admiration or appreciation of product ability to create value like quality or certain functionality.
- 2) Efficiency, if product is convenient for usage and efficient in terms of output / input
- 3) Status, like if product gives customer a impression of higher status or personal success
- 4) Esteem, customer can have feeling that he or she is valued due to product or service he or she is using.
- 5) Play, product creates playlines and causes joy to customer
- 6) Aesthetics, product gives intrinsic appreciation of usage
- 7) Ethics, this is not self-motivated reason to consume, but instead ethical way of consuming for other sake.
- 8) Spirituality, customer gets motivation or admiration form others when consuming or using service.

(Svee 2017.)

These types can be defined int self-oriented and other-oriented, active and reactive and extrinsic or intrinsic. Examples of these can be seen in figure 3.

		Extrinsic <i>Economic Value</i>	Intrinsic <i>Hedonic Value</i>
Self-oriented	Active	Efficiency [I/O Ratio]	Play [Fun & Leisure]
	Reactive	Excellence [Quality]	Aesthetics [Beauty]
		<i>Social Value</i>	<i>Altruistic Value</i>
Other-oriented	Active	Status [Impression]	Ethics [Justice/Morality]
	Reactive	Esteem [Possessions]	Spirituality [Sacredness]

Figure 3. Holbrook's typology of customer value (Loane 2014)

3.2 Quality management

As quality of a product or a service plays a vital role in customer experience and value, quality management has become crucial to companies. To be able to produce quality company needs to have a quality assurance. Like value also quality experience is dependent from customer's experience. Figure 4 shows some definitions of quality.



Figure 4. Definitions of quality (Pro QC 2021)

Like figure 4 shows quality can be described in a various way. Mr. Deming has been a forerunner when it comes to quality thinking. Deming described that quality is simply a meeting customer needs. Deming who was born in 1900 was a professor who not only focused to quality management, but also management in general. He for example created Deming's wheel which is also known as PDCA cycle. It stands for plan, do, check and act and it is widely used in LEAN manufacturing. It gives a backbone to lead projects further. First you plan your activities, then in do phase you execute them. Check phase comes after this where actions are followed-up and then in final act phase one needs to act if a project has not achieved its goals, in that case cycle starts from beginning. (Business library article, W Edwards Deming)

There are international standards such as ISO 9000, to guarantee that companies operate in a good and quality wise well manners. This ISO 9000 certificate has become almost a must to be able to do business.

Quality assurance is a part of quality system. Companies needs to define their own way of doing business in their quality system. This system can be seen as general instructions or

descriptions of how to operate. Inside the quality system lies quality assurance (QA) and quality control (QC) figure 5.

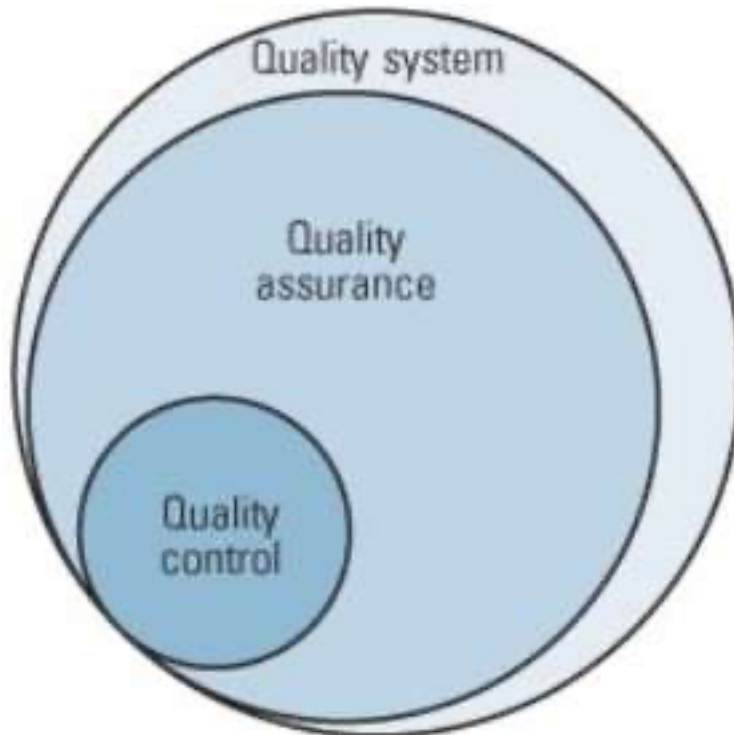


Figure 5. Relationship between QA, QC and general quality system (ASQ 2021)

Quality assurance is a larger function that defines how and with what actions company will full fill their quality KPI's. Quality control is a certain action or task to ensure quality performance. When executing these tasks as intended quality level and customer satisfaction will be greater.

Typically, in industrial surroundings quality control are done either manually by production operator or quality assurance personnel, but it can also be done automatically with cameras or sensors that saves data into database's and then data can be evaluated further. In a situation that customer claims some product data is reachable can production figures and performance can be checked after-wards. All of this is aiming to a more stable process where variations are smaller and ability to produce quality becomes higher.

3.3 Market trends in customer value

Covid 19 has changed the game and the world is not the same as we knew it in 2019. World is moving on with fast pace and companies need to adapt their behavior to it. Customer is the king is often heard from mouths of board of directors and to solve customer problems companies need to add real value for the customers.

Currently there are few trends on-going in a global market that customers may value over one another. Bernard Marr has made an article in Forbes where he describes biggest new trends in customer experience:

- 1) Chanel digitalization and expansion. Digital channels have grown significantly during past years. Customers not only want to use digital channels as add-on to traditional way, but requiring more and more digitality in way of working together. Covid19 pandemia has surely accelerated this progress when people are working from home offices and connected with teams or zoom.
- 2) The cognification of products and services. Artificial intelligence (AI) and internet of things or ne revolution industry 4.0 has made their way to global operations. Typically, in industry 4.0 machines are made "smarter" with sensors etc., but this trend brings AI into services as well.
- 3) Micro-moments and personalization. Customer like all people really want to feel special and they expect that companies also treats they as individuals. There must be some personal connection between the customer and company or its brand.
- 4) Subscription and servitization. When personal feelings are connected to brand or product it will become easier to get subscription-based services and products. This is nowadays more typical way of doing business than just sell a one single product.
- 5) Cutting out the middleman. Supply chain will become straighter, and noncomplex. Customers can be directly contact to seller or producer and middleman are being bypassed.
- 6) From B2C to all to all. Different digital platforms will enable faster and easier business interactions than before.
- 7) More immersive experiences. Virtual platforms that use virtual reality (VR) and augmented reality (AR) has increased its presense a lot. Customers as people they want to experience more and get more feeling by using new technologies. Customers becomes more engaged, and brand can get its value even higher.

- 8) Conscious consumption. Environmental topics and sustainability have become one of main issues when consuming products or services. People are more awake to these environmental topics.

(Marr B. 2021)

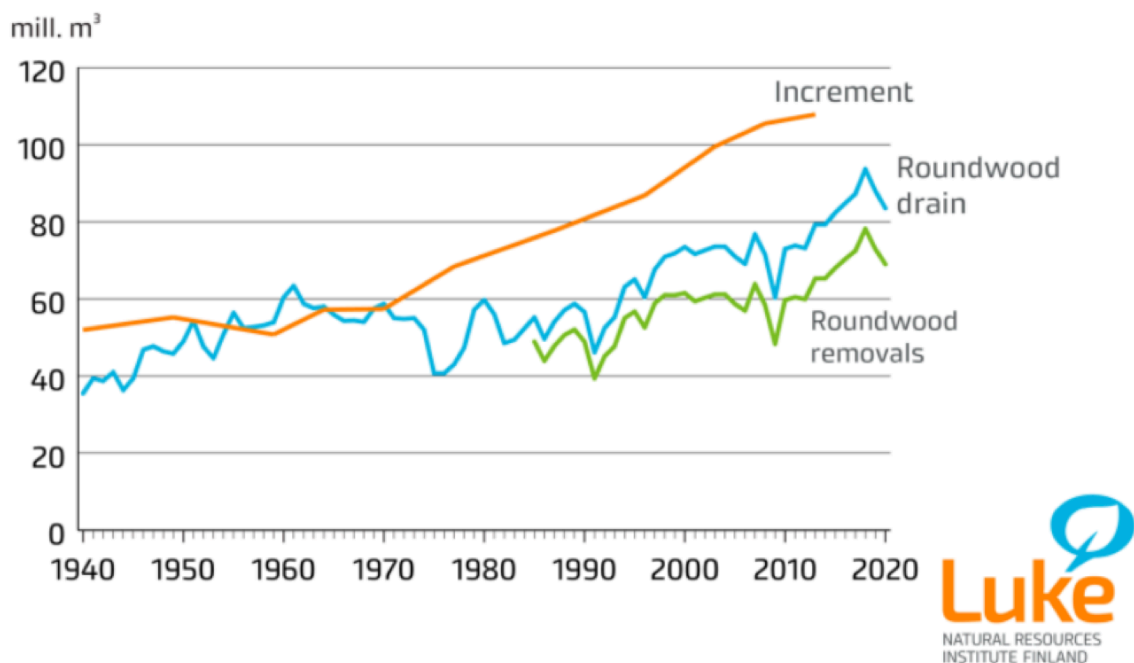
These are topics that companies should evaluate how to implement and with what level of operation they want to get added value for their products. Company doesn't have to take part of all the trends, but instead choose the correct ones to fit into their field of business.

3.4 Sustainability

Sustainability and environmental values are a trend that has been on-going and will continue to bloom in the future. It may become even most attractive value for customers when our planet is struggling with environmental change and temperatures are rising all over the globe.

Forest industry uses wood as their raw material and there for the products are highly sustainable. Over 75 % of Finland is covered by forests and with that Finland has the highest density of forests compared to the land size in Europe.

Finland has very responsible forest harvesting operations and annual harvesting is below of the forest growth, which means forest resources are growing all the time. Forests in Finland grows approximately 108 million cubic meters as consumption is around 84 million cubic meters. In a figure 6 it can be seen how forest increment has been larger than usage for years.



Annual increment of growing stock, roundwood removals, total drain of roundwood 1935-2020, million m³.

Source: Natural Resource Institute Finland

Figure 6. Increment vs usage in Finnish forests. (National resource institute of Finland 2022)

Environmental change is upon us all and it can be limited by doing action that are limiting carbon dioxide (CO₂) or other emissions. These greenhouse gasses are having an effect to global atmosphere so that our planet keeps warming all the time. Greenhouse emissions has been growing since 19th century and keeps going up (Figure 7).

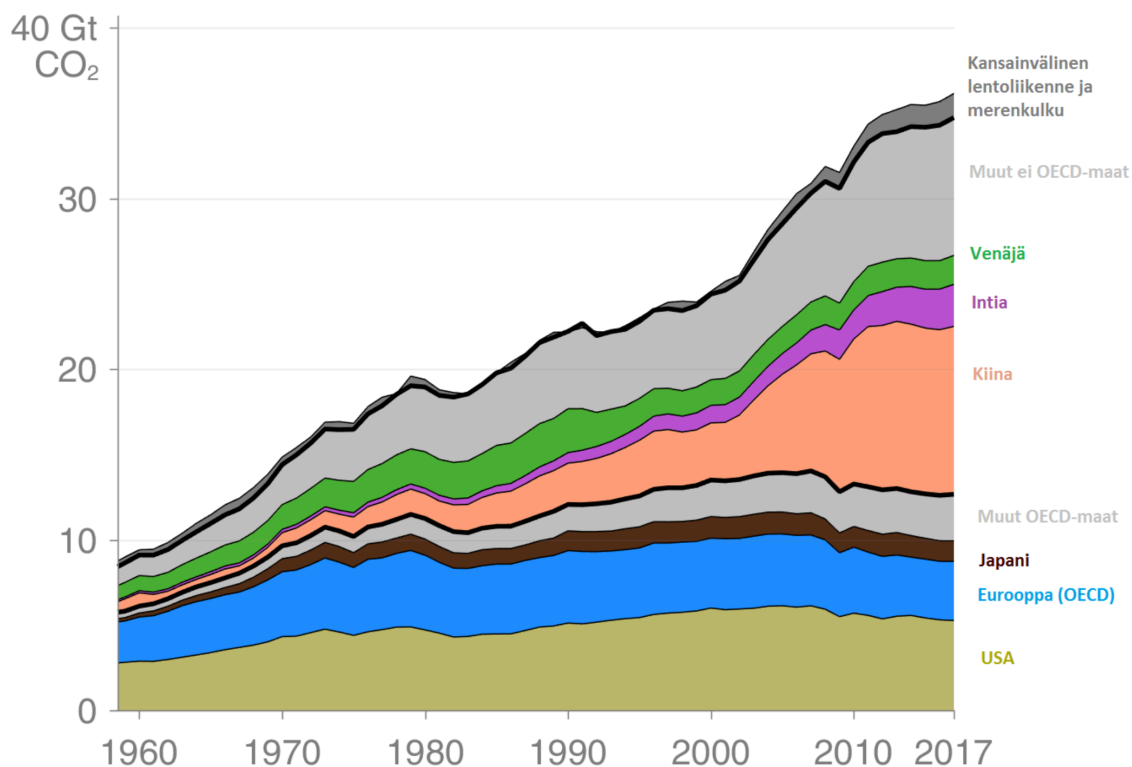


Figure 7. Greenhouse emission development since 1960. (Ilmasto-opas 2022)

Due to high emissions, there has been a lot of conversation of different carbon sinks. A carbon sink is kind of a storage that holds carbon in it and can be natural or created other-way. Carbon is one of universe most common element and it can be found anywhere where life and organic compound occurs. Companies and energy industry uses fossil fuels and by burning them creates CO₂ emissions, also burning wood, food producing or making cement etc creates emissions. Forests instead ties carbon in them and works as a carbon sink. Oceans also are in a big part of carbon cycle (figure 8, Niwa).

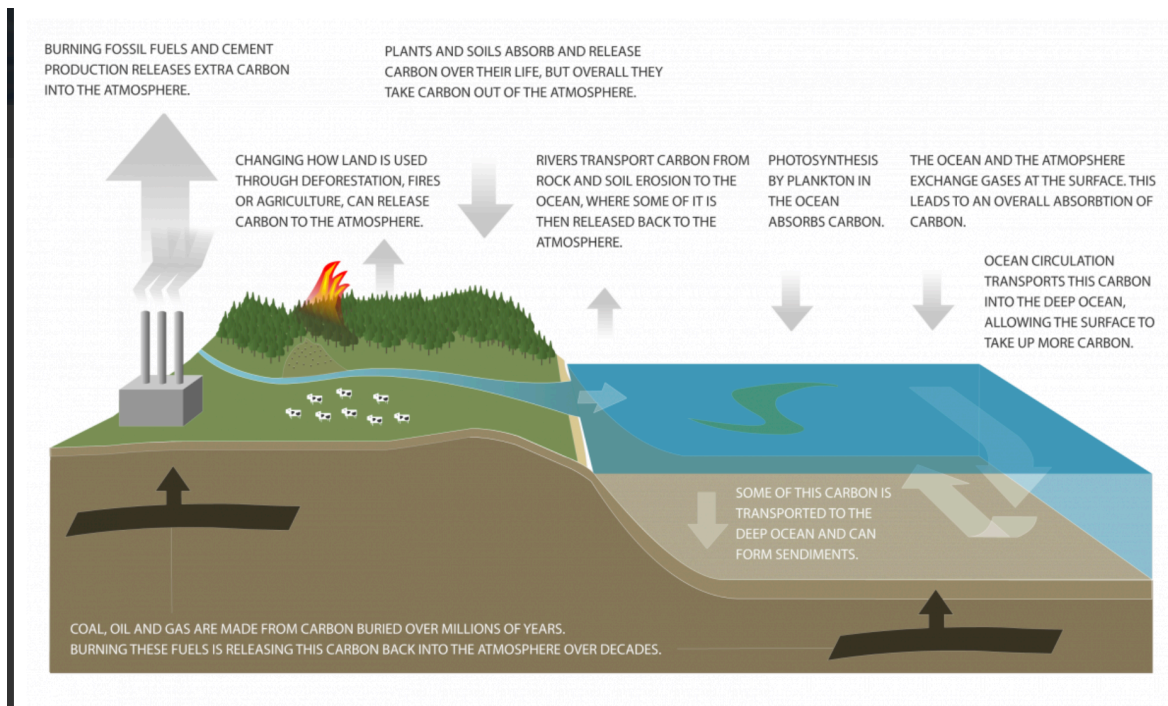


Figure 8. Diagram illustrating carbon cycle. (Niwa 2022)

Forests and forest industry products are great natural carbon sinks. This definitely gives a green image to forest industry and there for product can give this sustainable value to customers. If we compare forest industry into chemical industry which is using fossil carbon-based material to create plastic wood product reputation is a lot better and more sustainable.

Wood products holds a great sustainable value, and this should be used more in marketing and engaging customers to consume these products.

4 LEAN manufacturing

4.1 LEAN benefits and definition of waste

LEAN manufacturing is widely spread operation philosophy which give a lot of benefits to companies. Typically LEAN reduces waste, inventories, lead-times, rework and it increases understanding of companies processes and offer financial savings (figure 9).

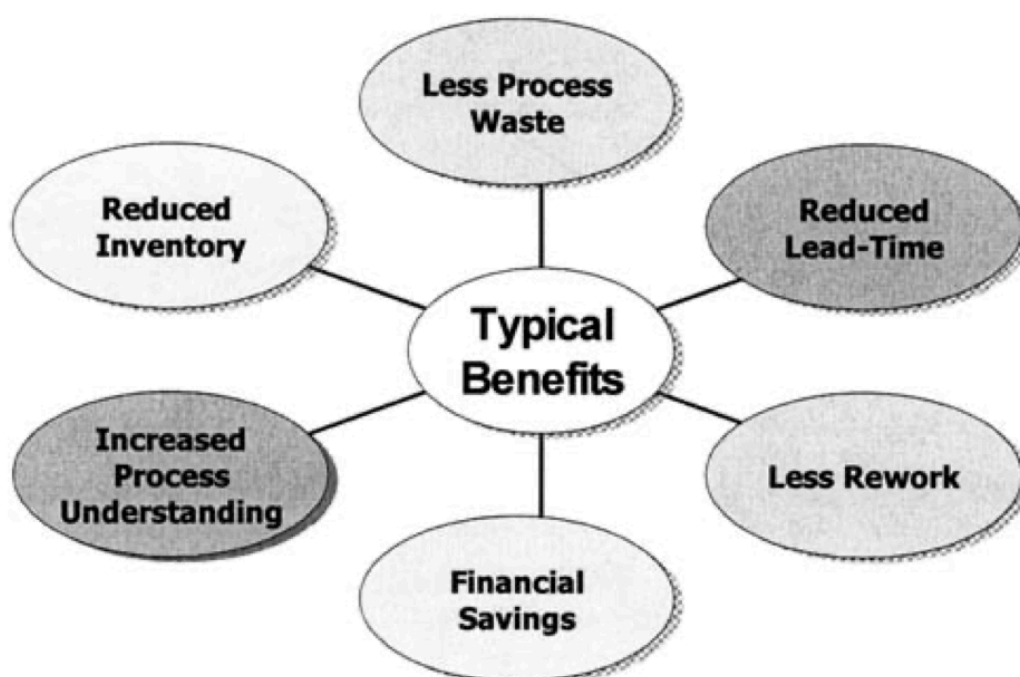


Figure 9. Typical benefits of LEAN. (The benefits of lean manufacturing 2005)

LEAN thinking is the main driver when talking about LEAN manufacturing and it all starts with customer and value to customers. Manufacturing can be seen as process of delivering value to customer. LEAN leadership is also a part of LEAN and all aims to reduce waste from the process. (Melton 2005, 1)

Earlier people talked about 7 wastes of LEAN, but nowadays typically it is mentioned 8 of them. Many of people who has been involved with LEAN and LEAN thinking has heard of TIM WOODS. Who or what is that? It is simply a memory game to 8 wastes which are:

- 1) T stands for Transportation

- 2) I stands for Inventories
- 3) M stands for Motion
- 4) W stands for Waiting
- 5) O stands for Over production
- 6) O stands for Over processing
- 7) D stands for Defects
- 8) S stands for Skills underutilized

If company is able to reduce these wastes from their processes, they can make much more profit. Transportation is also a sustainability topic as trucks and transportation causes a lot of greenhouse emissions. It doesn't make sense to move materials around the country or facilities. Inventories ties up capital, but they also make process flow less and causes other wastes. Excessive movement, motion takes time and also effect negatively to process flow. Waiting on the other hand is people or equipment down time when they do not do anything that creates value to customer. Over production in LEAN thinking is products that are manufactured without specifically focused them to a certain customer, this is big difference to industries that are making production to stock. If customer doesn't expect some specification or design from a product, but company still decides to do it it is called over processing. Defects are errors of manufacturing process and typically they require rework or additional steps in value chain. Last, but not least is skills under-utilized meaning if some people have special skills, but company doesn't recognize it or doesn't use it to create value then it goes waste.

In LEAN flow is one of main topics, but it is also quite hard to understand. When doing mass-production all material and process phases should flow and not cause bottlenecks. When looking into production value stream it should be created so that there are pull production, not push production. Difference between these two is thinking of the process. If company uses traditional resource effective way, then they easily generate push production. There different departments work as they own manufacturing units and stocks are typically high. In pull production material flows in value chain and it can be seen as one big process where following phase has little higher capacity than previous. This kind of production typically doesn't have bottlenecks and material flow is smooth.

LEAN thinking is a good way of doing production because of reducing the waste and it creates value. Normally only 5% of activities is a add value to customer, 35% doesn't create value, but are necessary to process and 60% doesn't add value in any way. So, if organization can reduce actions that are non-value by 50% over-all effectiveness of value chain increases by 30%, this is something to consider (Melton 2005).

4.2 History of LEAN

LEAN was created in 20th century in Japan. Taiichi Ohno had joined company called Toyo-ta and was hired to develop company efficiency. Henry Ford was a forerunner in automobile industry. He created new kinds of assembly lines to get high efficiency and by that reducing car prices. He had a one well known model called T-model. Ford created quite nice flow and it was a benefit to company, but that kind of production with moving assembly line was not flexible, meaning not creating customer value in a higher way.

Sakichi Toyoda founded Toyota in 1926. Taiichi Ohno and Shigeo Shingo created Toyota Production System (TPS) House of TPS can be seen in figure 10.

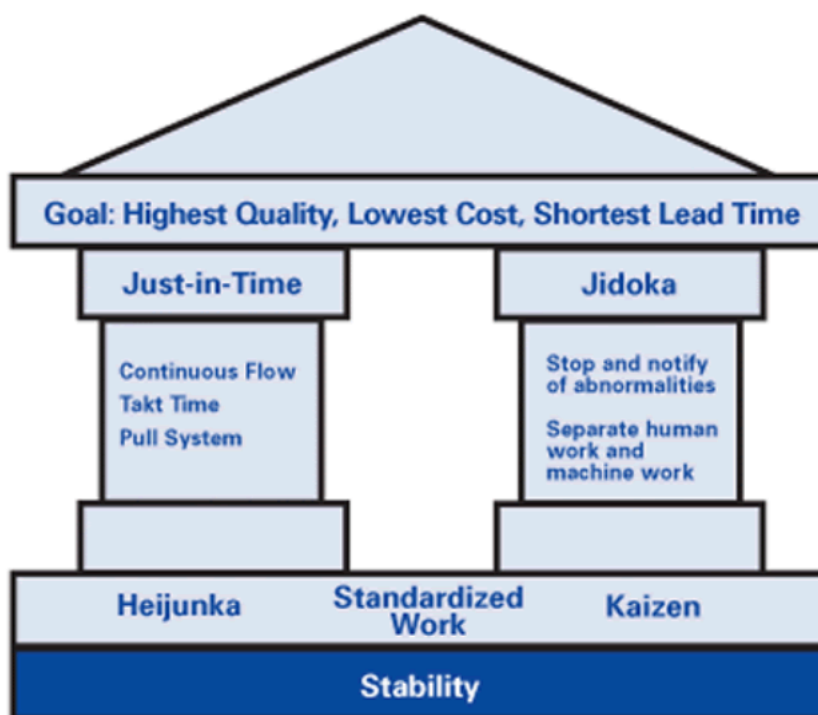


figure 10. House of TPS (the lean way 2022)

Their idea was to utilize individual machines and production equipment instead of tradition engineering type of manufacturing. They wanted to use right machines for specific products, have the real volume needed and make operations easy for the operators. They made production flow and by that reduced costs and made process flows with correct amounts of pieces to do the task in following phase. Main differences are that in mass production people are narrowly skilled and in LEAN manufacturing they are multi-skilled. Mass production typically have large single use machines and in LEAN they are more flexible. Also thinking how to lead supply chain is crucial for example are product made to stock or made to customer order and is product good enough or should actions aim to perfection.

LEAN manufacturing became easier, and Womack and Jones could put LEAN principles into 5 which can seen in figure 11.



Figure 11. Lean principles. (lean.org. 2022)

First value is to be identified and then map the value stream. After these the flow needs to be created and process phases fine-tuned so that pull is established. Then continuously improve the processes and seek perfection.

4.3 House of LEAN

Every company has to create their own strategy and ways to implement it. If company decide to take LEAN manufacturing as part of their way of work, they have to choose the level of implementation of LEAN activities and tools used.

Earlier house of TPS was presented and it can be modified to house of LEAN (figure 12). In LEAN house the roof is customer. At roof lies valuable things to customer such as short lead times, high quality, low cost and customer satisfaction. In the pillars that support the roof are things like just in time (JIT) and Jidoka. JIT is a concept where everything produced is done with correct amount and timing, this reduces inventories and lot sizes. This is possible when pull production is in use and material flow is smooth. Customer need is the pull and material flow through the processes in a stable way.

Jidoka is automated quality control with human touch, it is crucial to do root cause analysis (RCA) to be able to make process better. In the middle is people and usage of their skills supported by daily leadership. At the bottom, the foundation is standard work and standard working environment. These can be achieved with for example 5S and standard operating procedures (SOP's).

Kanban storage is a visual management stock that is followed by people. Kanban makes JIT production possible. In Kanban there are visual levels of equipment or material that is being used to manufacture product. Kanban can also be used to track process phases to see that flow is smooth and pull exists.

Heijunka helps operations to not get into overburden situations. This helps to reduce unevenness in production process and separate from mass-production it allows processes to vary depending on customer needs. Aim in heijunka is to reach stable flow by adjusting production so that customer need is satisfied, this can be done either levelling the type or volume.



Figure 12. LEAN house (Leanopedia 2022)

4.4 Gemba, Muda, PDCA, OEE

LEAN offer whole variety of tools to choose. Company needs to decide which tools they want to use in their daily operations. An eye-opening way to see the process and does it flow is to go Gemba. Gemba is a philosophy where people go to production floor and just look for Muda. Muda is basically waste and therefore it doesn't add value to process or customer. Kaizen is strategy of continuous improvement of whole company and that people are proactive in their way of thinking and eliminating wastes.

When executing projects or LEAN activities so called Deming's wheel is a good tool. It is also called as PDCA-cycle. Plan, do, check, act. This gives structure to project management and ensures that actions are followed-up.

OEE is a modern KPI for production. It comes from overall equipment effectiveness (OEE). It contains 3 elements: availability, performance and quality. OEE figure comes out when all these 3 are multiplied with each other. (Leanproduction 2022).

4.5 5S

5S is a tool to visualize working environment. It is aiming to reduce waste and also increase productivity. It has also a great effect to work safety as all tools and equipment are kept in order.

5S has 5 pillars and all 5 S's can be translated from japan language to English:

- 1) Seiri as sort
- 2) Seiton as set in order
- 3) Seiso as shine
- 4) Seiketsu as standardize and
- 5) Shitsuke as sustain

These pillars create a methodology that helps people to organize, develop, clean and as main step sustain their working area (figure 13). When all needed tools are in a right place many of LEAN's waste can be reduced for example motion and waiting. As a part of visual management 5S typically has a color-coded areas for different tools, material or equipment. (Lean thinking and methods – 5s, 2022).



Figure 13. 5S cycle. (Lean thinking and method - 5S. 2022)

Sort is the first step in 5S. In this part people are focusing to eliminate things that are not needed in their workspace. Usually in industrial workspaces same workstation is used by multiple operators and that is why standardizing is crucial. In the beginning of this stage so called quarantine spot is created, it can be like wooden pallet or cardboard box or similar to work as a place where all un-necessary tools and equipment are carried or transported. Typically, these things are equipped with a red tag. This red tag quarantine place is needed because may be not all operators are aware of the usage of that specific tool. For example, that tool can be used for maintenance task once in a year and is really critical, but for production operator it isn't needed. When things are stored at quarantine spot with red tag, which shows who has bring it and when, people can go and check if it is needed or can it be disposed or recycled or perhaps renovated.

Shine is a second a step. Once workplace is being sorted related to necessary tools and equipment it can be cleaned properly. When the workplace is cleaned well things like malfunctions like leaks or vibrations can be noticed better.

Set in order follow these 2 steps. In this phase tools and needed items are stored at their best places and labelled to help operators recognize which they are. Shadow board is board where tools shadows can be seen with different color than the board itself. This helps operators to easily see if some tool or item is missing from the board and that visually helps to check if all is placed and that why shadow boards should be considered as a workplace 5S tool. In this phase floor paintings or tapings are put into their place. First it is recommended to use taping as things may move around after 5S is put into practice and after a while when all items have found their best position markings can be painted to the floor. Some example pictures in image 3.

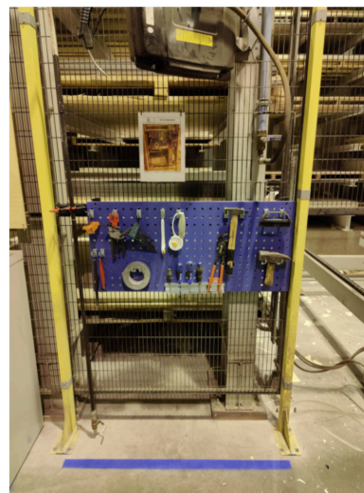
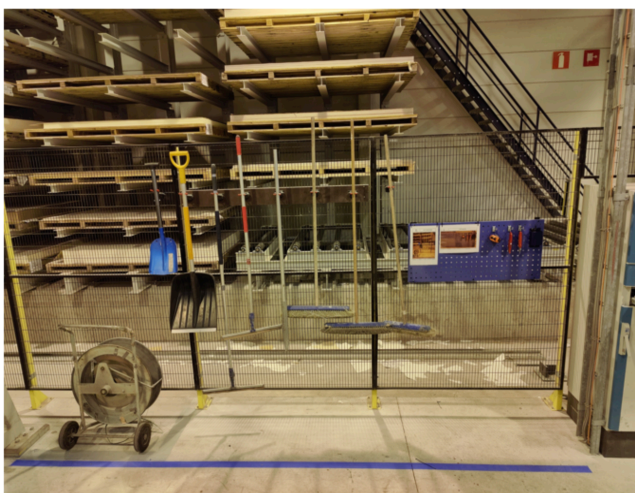


Image 3. 5S progress in set in order phase. (Koskisen Oy 2022)

After these 3 steps comes standardize. Standardize is a method to method to maintain first 3 steps This step implements and integrates 5S into daily work tasks. A new way of work methods are created and cleaning and checking are thought as part on daily work.

The most important S is the last one: sustain. This is hardest part of it all and requires a lot of attention from managers, supervisors and operators. If the 5S is not sustained old habits and old ways of working will come back and makes the whole process fail. To support this, audits and manuals and check-ins should be taken as a part of daily or weekly work tasks. (Lean thinking and methods 2022)

5S not only reduces waste, but also increases safety as all items are in a correct place and work environment is well though and clean. Slipping or stumbling can be avoided, and motivation and efficiency increased.

4.6 Total Productive Maintenance

Total productive maintenance (TPM) is a LEAN way of integrating production and maintenance activities. It is aiming to engage all levels of organization and maximize OEE of production. TPM can be seen as a brother of 5S, and they have a lot of similarities like cleaning, workplace organization, visual management and audits. Normally maintenance is doing maintenance tasks and only them are focusing on equipment management and technical topics. TPM is bringing different parties closer together.

Autonomous maintenance is maintenance done by machine operators, they are taking care of small maintaining activities, cleaning and checking. this increases machine lifetime and prevents breakdowns etc. If company decides to take TPM far and they can create equipment change with poka-yoke. Poka-yoke is a LEAN method that for instance is eliminating wrong way of assembling a device or performing a maintenance task.

The goal of TPM is to eliminate waste in a work process by keeping a equipment or machines in a good shape. This has a effect to utilization rate of equipment and malfunctions can be predicted better. (Lean thinking and methods 2022)

When thinking of customer value and weather it is pricing, sustainability or short delivery time TPM has an effect to them all. If maintenance is done poorly there can become six major losses into the process. Unexpected breakdowns that create costs form machine downtime and lack of yield. In a set-up, work changeovers can become longer which reduces yield. Unexpected stoppages can be generated for instance form poor cleaning of device or lack of visibility into machine condition like vibrations, bearing heating or similar.

Speed loss has an effect to delivery time when time to produce the same amount of production will become longer. Quality can decrease because machine is not functioning as it should, or machine is running off-specification. When a machine or equipment is not maintained well enough it leads to premature wearing and that is a capital investment loss which also increases maintenance costs.

TPM was developed in 1950's and it has eight functional pillars. These pillars can be seen as standing from foundation which is 5S.

First pillar is autonomous maintenance. Like mentioned earlier this is production operators performing some maintenance tasks and it gives maintenance crew more time to concentrate to more technical matters. Typically, these tasks for production are checking the level of oil or check if pressure is in a correct level or in a previously agreed pressure range. Tasks typically includes also cleaning, which is critical since most faults comes from dirt into machines, lubrication to allow smooth operation or some smaller maintenance tasks like tightening screws or bolts. When operators are performing these tasks, they get a better understanding of the equipment and can fine tune machine to meet product requirements and quality level.

Pillar number two is planned maintenance. When planning maintenance activities equipment or machine condition will stay in a better shape and capital investment need and maintenance costs are reduced. As planning is done in advance production planning can prepare production plan so that break does not have any impact to customer satisfaction.

Quality maintenance is the third pillar. This pillar means that equipment can be checked, and errors or faults can be detected in advance. This is basically condition based maintenance and it can be done either automatically with sensors or by human (Jidoka). If machine is equipped with automation and sensors operators can get information of machine status in real life and then analyze the results. This phase is often integrated into action with check phase in TPM. Operator goes around the machine and checks the figures from gauges or panels. Operator can also detect overheating, noise, smells or vibration when taking these tours. This phase may also require root cause analysis to understand the root cause of fault or error.

Pillar 4 is focused improvement. This is aiming to improve the machine or equipment by cross-function teams that are put together to get enough different viewpoints of the matter. Teams work together to get a new kind of solution of how to improve machine specification or performance level.

Early equipment maintenance is the fifth pillar, and it is done by using previous knowledge and experience from previous activities related to machine. The goal is to get new equipment running to desired level earlier than usual, make the start-up curve shorter.

Pillar six is education and training. Without correct training operators does not have knowledge to do TPM. Implementation of TPM will fail if not all necessary people are trained well enough.

Health, safety and environment is the seventh pillar. Workplace needs to be safe, and all health risks should be avoided. As companies are trying to produce the value to customer, they should not do it with the risk of people. When people can feel safe, and the work environment is safe then the productivity will also become better.

Last and eight pillar is TPM in office. This can also be called as human TPM. The aim for this pillar is to get the understanding into all levels of organization and this reduces silo thinking that large companies typically have. Implementation of whole TPM can also be done with higher efficiency and engagement when all the people are on-board. (What is total productive maintenance, 2022)

Company does not have to take all pillars into use and can choose the pillars that best fits into their environment, but if company wants to have maximum benefits of the system, then eventually all the pillars should be implemented. Pillars can be seen in figure 14.

Eight Pillars of TPM

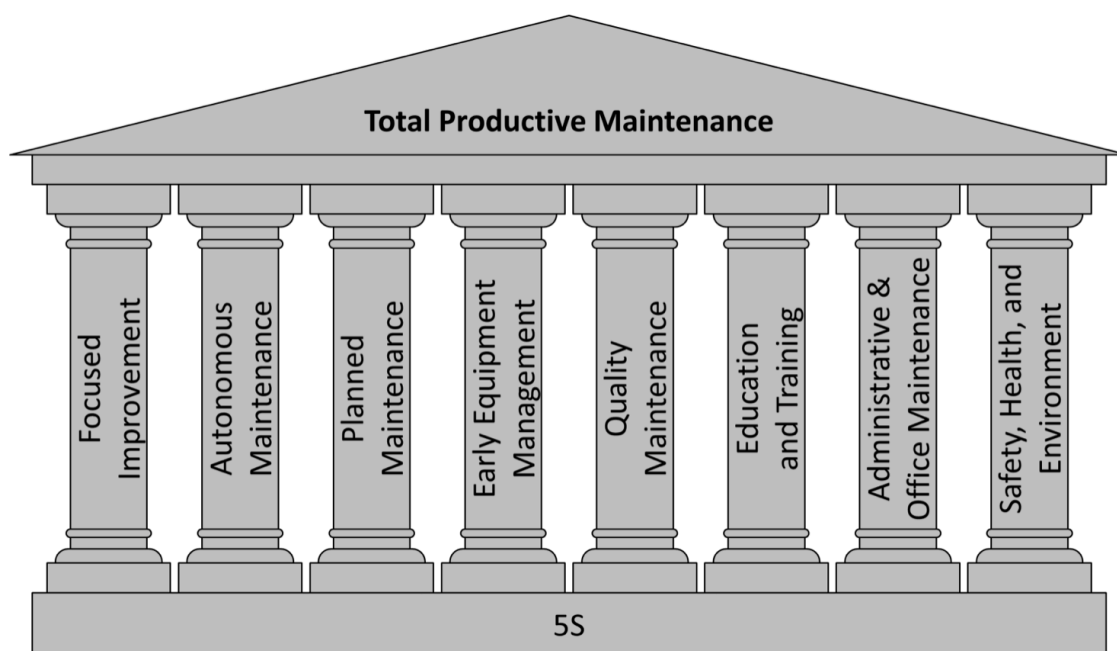


Figure 14. Eight pillars of TPM. (All about lean 2022)

4.7 Value stream mapping

To understand value streams of a product from supplier to customer company needs to do value stream mapping (VSM). VSM is done to visualize the value stream to get the understanding if there are wastes in the process. VSM shows all the steps of chosen process, it can also be the whole process form order to delivery

“Value stream mapping is a lean management method that allows you to visualize, analyze and improve all the steps in a product delivery process.”

By doing the VSM company can detect the wastes in the process and add more value to customer in a value stream. Value in LEAN manufacturing is everything that customer is willing to pay, nothing more. (Kanbanize 2022).

VSM is a great tool to managers to understand their processes. Like many others development of VSM started in 20th century with Toyota’s TPS. VSM will help companies to understand wastes in their processes, it will give clear view of activities and will allow companies to fine tune their processes into more efficient. VSM is a part of Lean six sigma tools and brings systematic approach to process improvement.

VSM is usually done in a classroom / meeting room environment with large free spaces in walls. All stages of process are put on to the wall with stickers. Green sticker activities are adding value to customer, yellow sticker activities are ones that are non-added value, but needed to produce the product, meaning supportive actions and red stickers are simply waste.

When the whole process is being described with sticker into the wall, it will be eye opening to people involved to see how much waste can be in a process. There are also a computer programs like Miro, to do the VSM and it may help to get it more readable version, like Koskisen Oy did, see image 4.

Image 4. VSM in plywood. (Koskisen Oy 2022)

4.8 A3 and problem-solving tools

Even though LEAN is a way of work, a manufacturing philosophy there are still continuous improvement projects which needs to be documented and reported to management. A3 is a good tool to do that. A3 is a problem-solving tool that gives structure and systematic

way to study problem. Taiichi Ohno said no to long reports and wanted that all necessary information is presented simply with one page. The name A3 comes from European paper size, and it was created with Toyota’s TPS.

A3 tool gives structure to thinking and helps people to dig into a problem, it generates logical thinking. It is presenting information in an open way without hidden agendas and it is sharing all important information with visual way. Actions should be according to company’s strategy and focus on developing vision that can be shared to all organization. (Kanbanize 2022)

There are different layouts to A3 and not all needs to look the same. Report can variate, but these parts could be in a A3 report: 1) Background that explains importance and how issue have been created. 2) Current situation explains the problems current stage and process description. 3) Targets and KPI’s, what should be achieved. 4) RCA by using for example 5 times why, or Ishikawa diagram. 5) Countermeasures explains possible solutions. 6) Implementation, action list responsibilities and schedule. 7) Follow-up, maybe with using PDCA-cycle. Figure 15 shows one possible template used by Koskisen Oy.

A3										
Ongelma:				Aloittaja:		PVM:				
				Valitaan 5xMiksi tai Kalanruoto						
Määrittele ongelma (step 1)				5xMiksi		Kalanruoto				
Mitä:				ONGELMA						
Milloin:				Miksi?						
Missä:				Miksi?						
Kuka:				Miksi?						
Tavoite:				Miksi?						
Hyödyt:				Miksi?						
Määrittele tiimi (step 2)				Pysyvät ja ehkäiset toimenpiteet (step 5)						
Vertäjä:				Pysyvät ja ehkäisevät toimenpiteet		Kuka		Tavoiteaika		Status
Osallistajat:										
Välittömät toimenpiteet (step 3)				Seurantasuunnitelma (step 6)				Vahvistaminen (step 7)		
Välittömät toimenpiteet		Kuka	Tavoiteaika	Status	Kuka		Mitä	Tavoiteaika	Valkutus:	
									Tulokset:	

Figure 15. A3 template. (Koskisen Oy 2022)

It is very important to recognize and understand the root cause, and that is why RCA should be in A3 as one part. RCA helps to fight the problem and tries to fix it so that it wouldn’t appear any longer. (Kanbanize 2022)

Five times why (5x why) is problem solving tool that is aiming to recognize the root cause. When having a problem, it is beneficial to understand that they are only symptoms of a bigger issue. 5x why is helping to get into that deeper issue with its persistency. When digging all the time deeper into the problem finally the root cause will come to observation. It is done simply by asking 5 times why to the problem, if only asked like 2 times, then the real nature of the problem will stay hidden. First team needs to be formed, then the problem defined and then the team can go into asking why. After the root cause is found then actions need to be implemented to fix the main problem.

Ishikawa diagram is a tool to understand the problem. It is also trying to find the root cause by focusing into different areas of operations such as: equipment, process itself, people involved, materials, environment and management.

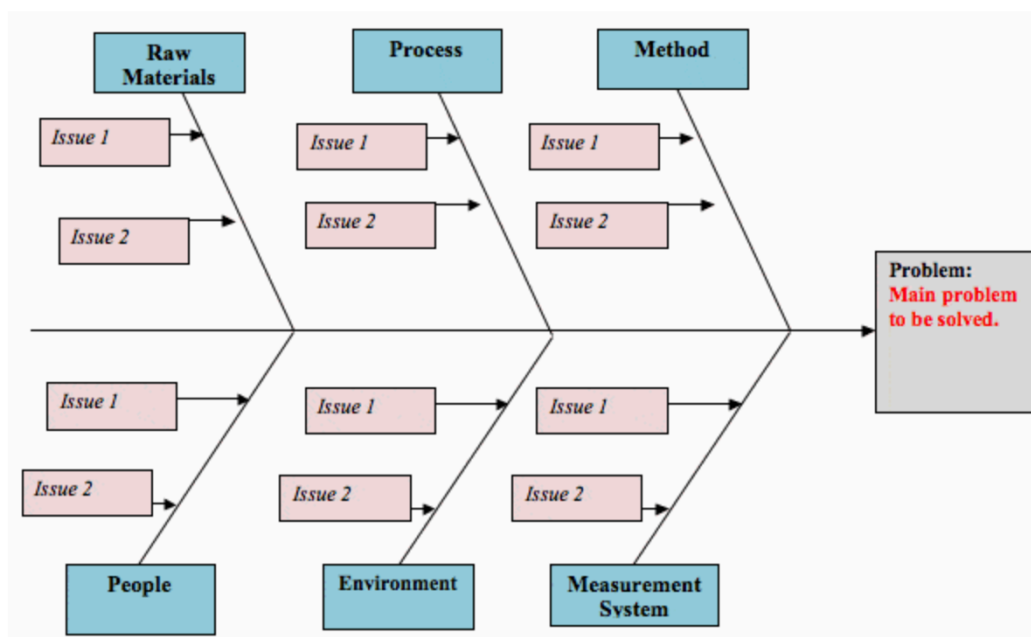


Image 5. Ishikawa diagram (Consuunt 2022)

Ishikawa diagram may be easier to operators to identify different aspects related to problem. This tool helps to identify the problem and for that specific problem 5 x why can be used to dig into deeper to that issue.

4.9 Single-minute exchange of die (SMED)

Shigeo Shingo was a Japanese pioneer in LEAN manufacturing and industrial engineer who helped Toyota to develop their own production system TPS. Among many other tools and he developed single-minute exchange of die (SMED). The idea of SMED is to reduce change over times in product manufacturing. Typically, there are many wastes in a changeover and by using SMED they can be reduced quite significantly.

Mr Shingo work was making count as he and his team reduced many processes by 94%. This sounds really high figure, but when fine tuning change over results can be found. For instance, if a normal people change their car tyres it can take up to 15 minutes, but in formula 1 racing it can be done below 10 seconds. (Leanproduction 2022)

When change overs are done often and they create big amount of non-productive time then SMED is a tool that company should consider. SMED is done so that first team is created, then roles assigned and then team goes to machine to look that specific work change. One can take time, that how long changeover and it's parts will take. Another one can draw a spaghetti diagram. Spaghetti diagram is done to see and make analyzing avail-able to operator movement, it clearly shows if the tools required in changeover are in a wrong place and motion becomes as waste. Then one is making notes that how the operator works. This is how current state is formed. After this team analyzes the outcome and then they create state of mind, how changeover should be done. After team has found consensus about new changeover model it will be done in practice. This is ones again recorded and results analyzed. If all agrees to new model and it can be put into a way of work, then guidance and training is held to operators and rules and work instructions created. In LEAN this is called standard operating procedure (SOP).

There are 8 different techniques to helps reducing changeover time in SMED. 1) There are internal and external activities in SMED (figure 16), these should be understood and differentiated. 2) External activities that can be performed when machine is running should be done while production is on-going. 3) Standardizing work (SOP's) 4) Machines can be designed and created so that they do not support high efficiency in changeovers, therefor machine may need modifying. For example, screws can be change into shorter ones, some adjusting device brought closer to operator. 5) Create aids to help things so that they can be external activities. 6) Sometimes bringing another operator to do parallel task in changeover will reduce time needed to internal activities, set up time will be reduced. 7) Adjustment of working material should be done so that they wouldn't require a lot of time, for instance some measure bars can de add into process to make adjustment time short-

er. 8) If possible, automation into changeover will help to avoid manual labour from changeover. (Mudamasters 2022)

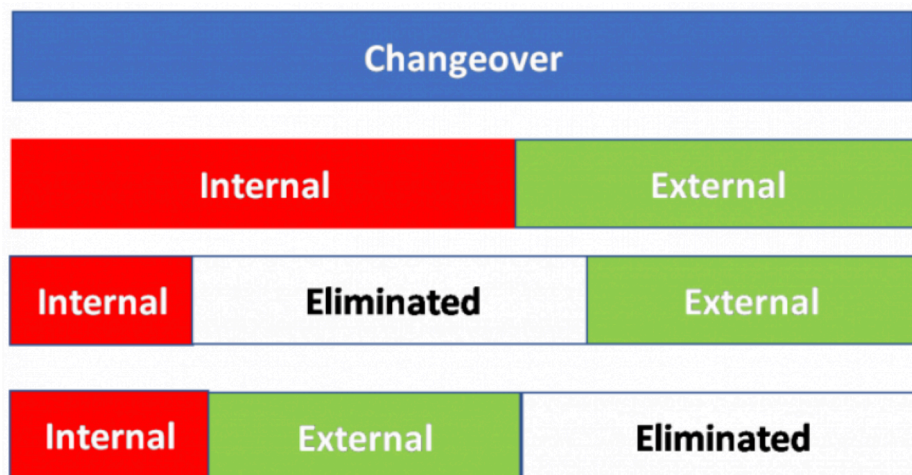


Figure 16. Changeover divided to parts. (Mudamasters 2022)

4.10 Standard Operating Procedures (SOP's)

Operators need work instructions and in LEAN these instructions are called standard operating procedure (SOP). SOP's are visual instructions for the operators to perform some task, changeover, or smaller set-up in a machine. Instructions are clear step-by-step guidance and aims to create specific and uniform way of doing the task.

SOP's can support production, maintenance, quality or safety procedures. Amount of SOP's can be quite high because every specific task needs a SOP of its own. Activities should be written in a detail form to avoid that SOP is limited. Like in all LEAN activities visual management should be implemented with pictures of needed tasks and sustaining these tasks is very important.

By having SOP's in production lines there are a lot of benefits like:

- It will reduce variation and make process smoother and make quality level higher due to better implementation of activities.
- It will make work safety better when instruction followed and executed in a safe in advance thoughtful way.
- Operators are trained according to SOP

- SOP will include compliance of organization.

Changeover times will become shorter, and risk of damaging machine will be reduced as tasks are performed in a right way. This reduces costs and lead times. Also, when quality level is higher the need for rework is less and material usage better, meaning sustainability and carbon footprint will be better.

SOP should be always created with local language, and it should be easy to read with visual management, photos, flowcharts or so. Instructions needs to be specific with step-by-step guidance. Once SOP is created and written then it should be reviewed and approved. Training of all operators involved should be done in a detail and efficient way. (Thinkleansixsigma 2022).

McDonald's have one the worlds well known hamburgers. Why they are so popular and successful? Because of SOP's. The quality level and hamburger content is the same where-ever people goes. In figure 17 benefits of SOP are shown. (Limblecmms 2022).

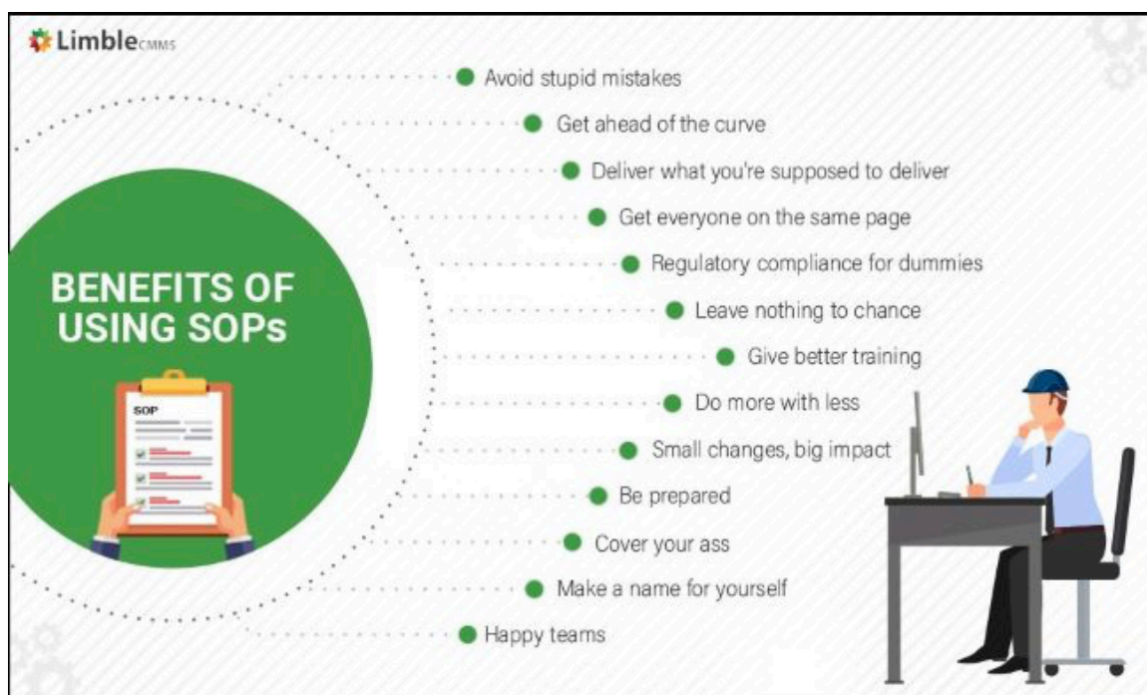


Figure 17. Benefits of SOP. (Limblecmms 2022)

SOP's can also bring employee satisfaction higher because they understand what is expected from them. Operators knows where to get support. They are engaged to process as their expertise is heard and they can have a big influence on improvement. When

SOP's are present managers doesn't have to micromanage operators. Work of operators are moving company forward and wastes are minimized.

5 Lean at Koskisen Oy

5.1 History and current state

Qualitative methods have been used in this research. Qualitative research methods are different than traditional quantitative methods. In qualitative methods typically include analysis of text, pictures and personal interpretation of all available data and interviews. (Creswell 2014, 232).

In this research data has been looked and analyzed from Koskisen Oy databases and carefully chosen interviews of persons who have been a part of Koskisen LEAN journey. Interview had an open-ended questions and data validation was done to understand the accuracy of answers. Databases include intranet and M-files data storage tables, figures, old meeting minutes and notes. Also pictures from the beginning of LEAN has been analysed.

Lean journey at Koskisen Oy started in 2008. In 2008 was a global recession and also plywood manufacturing was suffering low volumes. There was a one person from outside the company who was assigned to lead new production way with using Lean tools. Lean was started with 5S and people had a feeling that Lean was kind of a savior for the business. (Lehtinen 2022)

5S was started with high efficiency and when Plywood production manager Lehtinen started to work with lean it was already visible with tool shadow boards and some visual management markings. People had felt that they were forced to do it and they were not engaged to 5S at all. Both Korpela and Lehtinen mentioned that Lean had become swearword to people due to lack of engagement. People were not involved, but instead lead by too harsh management. Järvi also mentioned that operators in field felt that Lean is more like automotive industry thing since Toyota had been big in Lean development. Foreman also were not supporting the implementation and Lean activities were more like if nothing else to do, then do some cleaning. (Järvi 2022)

Since 5S had a negative echo all over the production it was left behind and not concentrated anymore by managers or operators. In that time markets were again on rise and production needed to focus to get production up to meet customer demand. Also, resources were very limited, and no one had time to take a lead on Lean matters. Implementation of Lean had failed. (Lehtinen 2022)

In 2016 Lean was broad up again and now with different kind of approach. First few people were chosen and trained to lean agents. Not all foremans could join the training and that may have caused some envy or mis-engagement from their side. (Korpela 2022)

After the second start of Lean in 2016, some SMED's and 5S was done again. This time Koskisen Oy had learned from the past and got more and more production operators involved in Lean activities and that helped on those specific lines. Company called Lean5 was chosen to help with Lean, but yet there were no human resources to execute all needed Lean tasks. Daily leadership meetings were started in 2017 and material flow and stock levels were fine-tuned to create better value stream. Also, quite big investments tied already small human resources out from lean activities. (Lehtinen 2022).

Daily leadership meetings were modified with help of outside consultant company in 2019.

Late 2020 Lean5 was again helping to take further steps in Lean at Koskisen. For the background it was already created Panel Quality House, which is a model that how customer and Koskisen is tied together, see Figure 18. Panel quality house, Koskisen Oy.

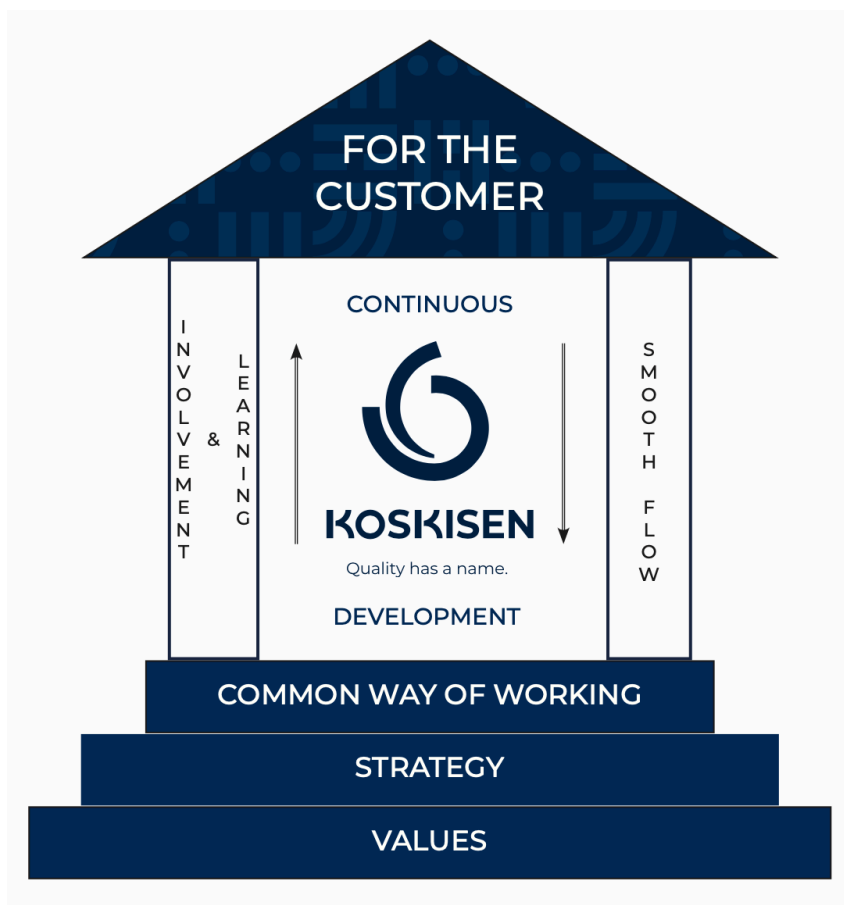


Figure 18. Panel quality house. (Koskisen 2022)

First the pilot team, with around 10 people, was formed with people all around the organization. Also, two people were assigned as Lean Coach. They were trained well, and their

task was to train the whole Koskisen organization. Trainings started in 2021. In May 2021 also first SMED's took place in selected production lines. 5S was re-started in autumn of 2021. (Järvi 2022)

Questionnaire for the Koskisen employees was done in late summer 2021. The aim of the questionnaire was to get information of what do people in the field think about LEAN at Koskisen plywood mill. Questionnaire was executed by using Webropol software. First there were 9 questions or propositions where operators could answer with numbers from 1 to 4. 1 meaning very poorly, 2 meaning poorly, 3 meaning well and 4 meaning very well after that there were 4 questions with text field to give answerer larger freedom to describe how all have went. Questionnaire was executed with Finnish language. Questions can be seen in figure 19.

LEAN Questionnaire questions	
2021	
1	How well was training executed?
2	How has LEAN activities like 5S started in your department?
3	How have supervisors and managers succeeded in leading LEAN activities?
4	Have you received enough support from your supervisors related to LEAN activities?
5	Have supervisors followed-up activities and are activities still on-going?
6	How have LEAN activity plan been informed?
7	How have supervisors been informing LEAN to you?
8	Do you feel that information have been good and have the reason of LEAN activities been told?
9	How well have LEAN activities succeeded in over-all?
10	What kind of expectations you had toward LEAN-training?
11	Is there something that supervisors could have done differently?
12	What factors or issues have post-poned possible LEAN activities
13	Have this new approach been better than previous ones?

Figure 19. LEAN questionnaire questions.

Over all 62 people answered to questionnaire, 45 of them was blue collars and 17 was white collars. Plywood mill has total 444 employees meaning answering percentage was only 14%. When having this small sampling results can only be seen as directive.

Answer distribution in results for the 9 first questions can be seen in figure 20.

LEAN Questionnaire questions	Very poorly	Poorly	Well	Very Well
2021				
1 How well was training executed?	4,8	17,8	61,3	16,1
2 How has LEAN activities like 5S started in your department?	21,3	50,8	24,6	3,3
3 How have supervisors and managers succeeded in leading LEAN activities?	15,5	51,7	27,6	5,2
4 Have you received enough support from your supervisors related to LEAN activities?	25,4	33,9	37,3	3,4
5 Have supervisors followed-up activities and are activities still on-going?	23,7	49,2	22	5,1
6 How have LEAN activity plan been informed?	21,3	44,3	27,9	6,5
7 How have supervisors been informing LEAN to you?	23,3	48,4	25	3,3
8 Do you feel that information have been good and have the reason of LEAN activities been told?	20	43,3	25	11,7
9 How well have LEAN activities succeeded in over-all?	19,7	57,4	21,3	1,6

Figure 20. Results from the questionnaire

First question was “how well was training executed?” This question of questionnaire got the best results of them all and respondents answered either well 61,3% or very well 16,1%.

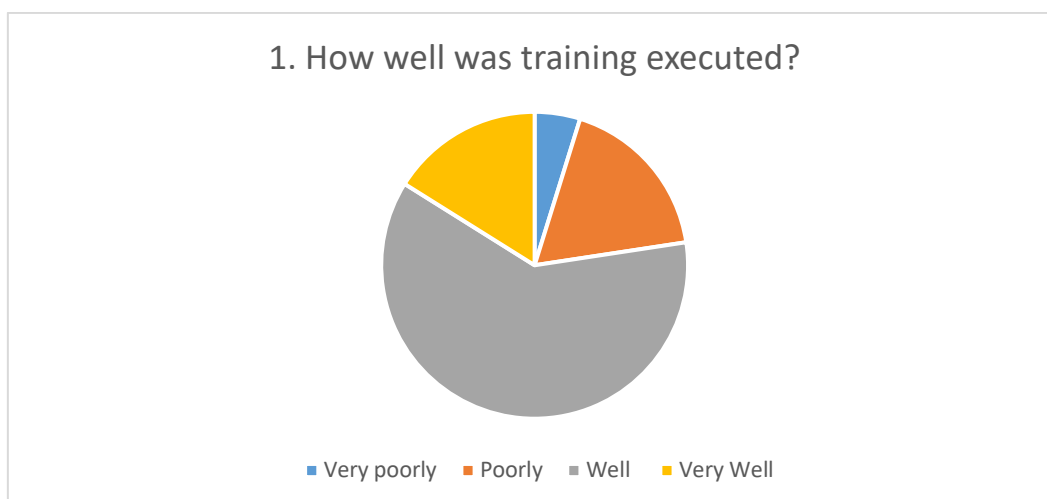


Figure 21. Question 1. How well was training executed?

Second question “How has LEAN activities like 5S started in your department?” had more divided results, but over 70% answered either poorly or very poorly.

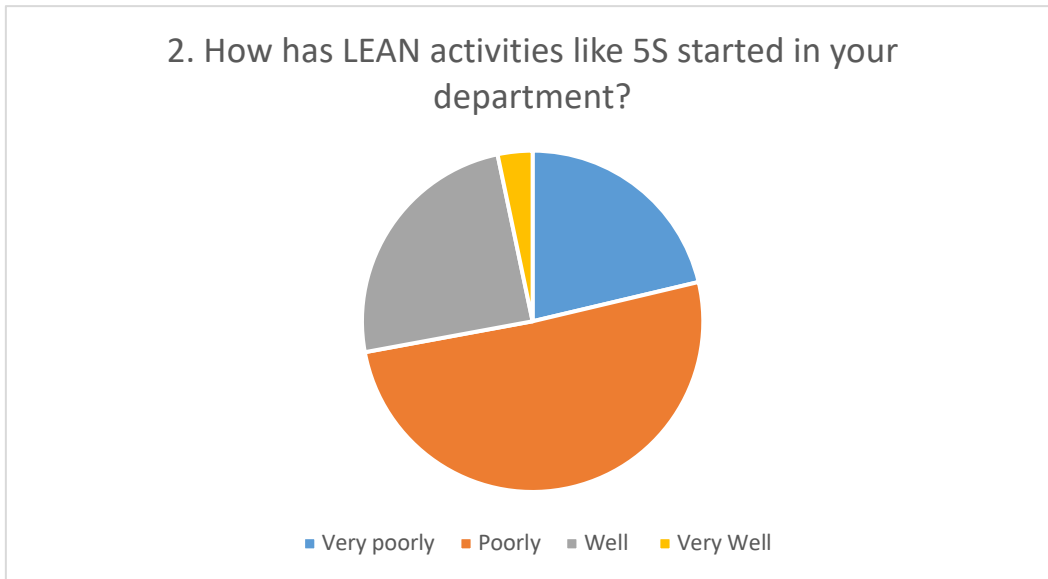


Figure 22. How has LEAN activities like 5S started in your department?

Question 3 was about how well foremans were performing with leading of LEAN activities. Question was “How have supervisors and managers succeeded in leading LEAN activities?” This was not that answered that negative than question number 2, but still over 67% saw this part also as poor.



Figure 23. How have supervisors and managers succeeded in leading LEAN activities?

Question 4 was “Have you received enough support from your supervisors related to LEAN activities?” This got second best results from respondents and almost 40% of them answered well.

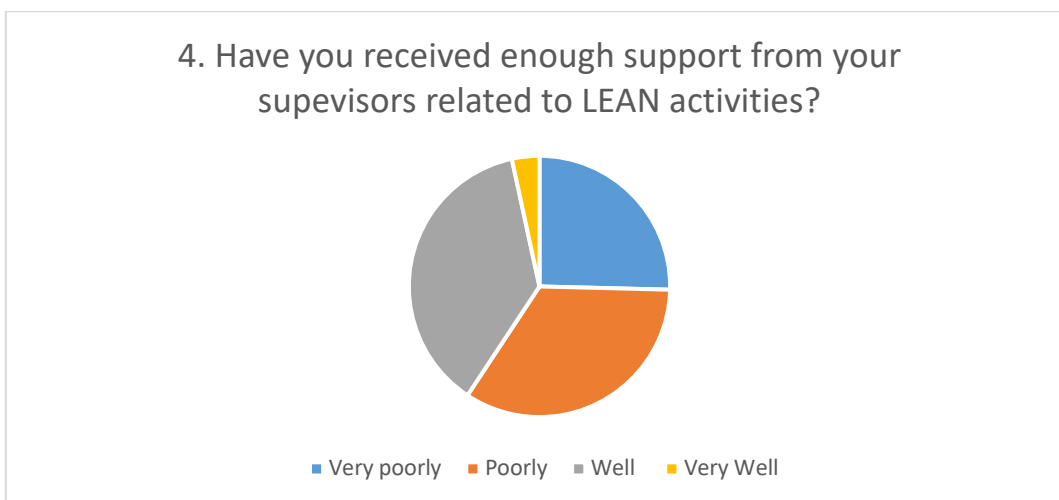


Figure 24. Have you received enough support from your supervisors related to LEAN activities?

Fifth question was about follow-up. “Have supervisors followed-up activities and are activities still on-going?”. Over 70% answered either poorly or very poorly.

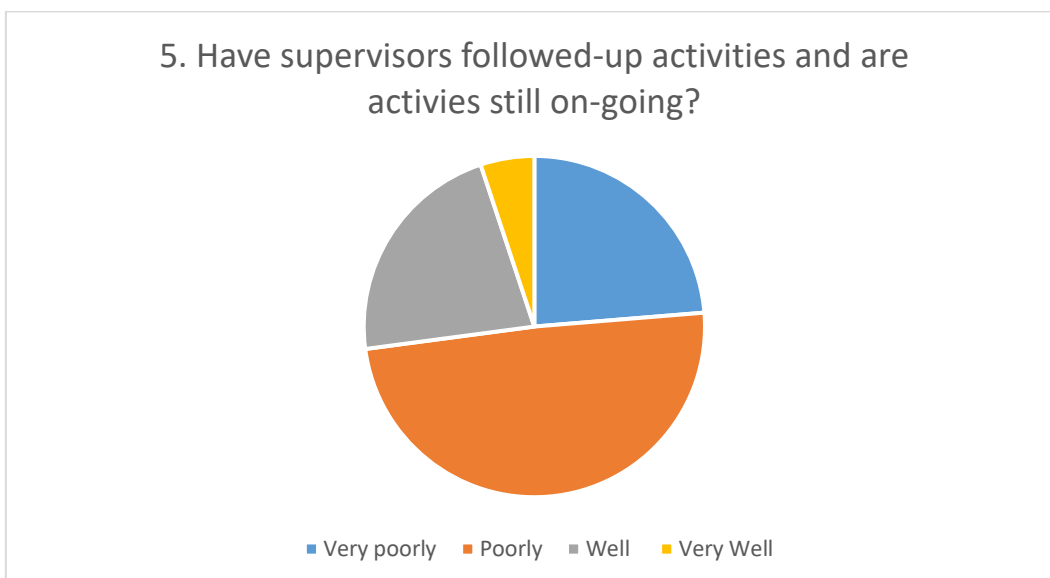


Figure 25. Have supervisors followed-up activities and are activities still on-going?

Question 6 was looking into information and communication. Question was: “How have LEAN activity pain been informed?”. 21,3% answered very poorly, 44,3% answered poorly, 27,9% answered well and 6,5% answered very well.

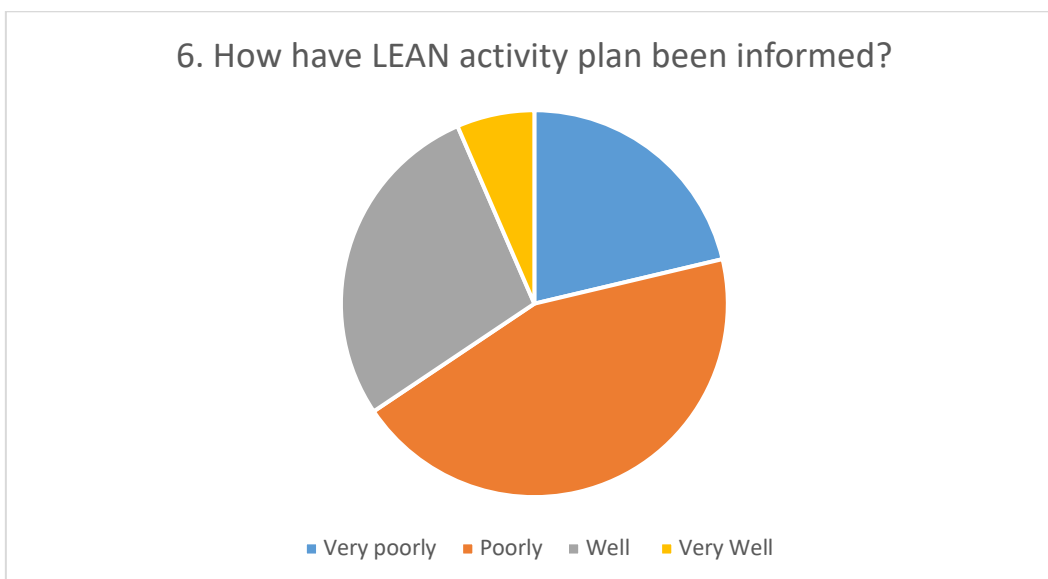


Figure 26. How have LEAN activity plan been informed

Question 7 continued about communication. “How well have supervisors been informing LEAN activities to you?” This got a little more negative results than question number 5, so it seems that general information have been better that one given by supervisors directly.

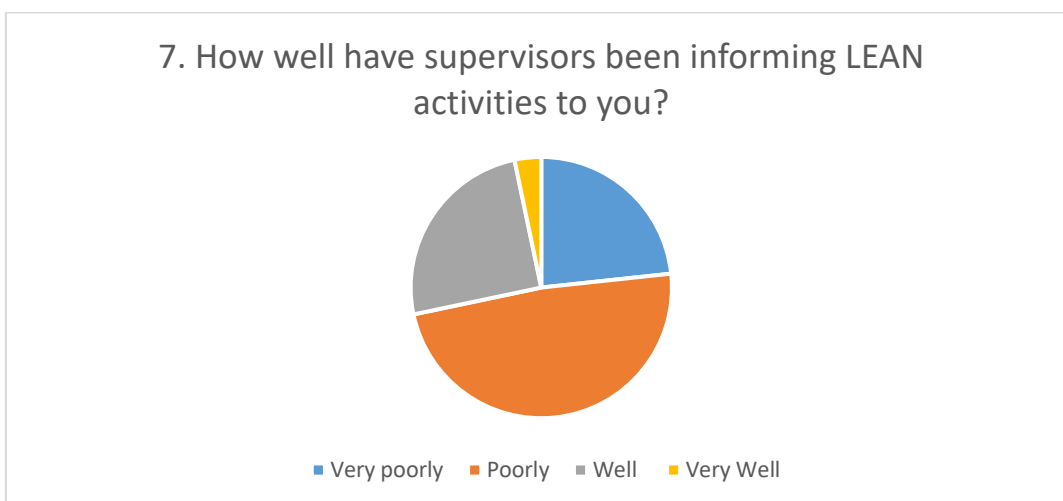


Figure 27. How well have supervisors been informing LEAN activities to you?

Question number eight was created to have information about the understanding of reasons of LEAN activities. “Do you feel that information have been good and have the reason of LEAN activities been told?”. Respondents have felt that this part was better than 2 previous ones. 11,7% answered very well and it was second best result in that category after first question.

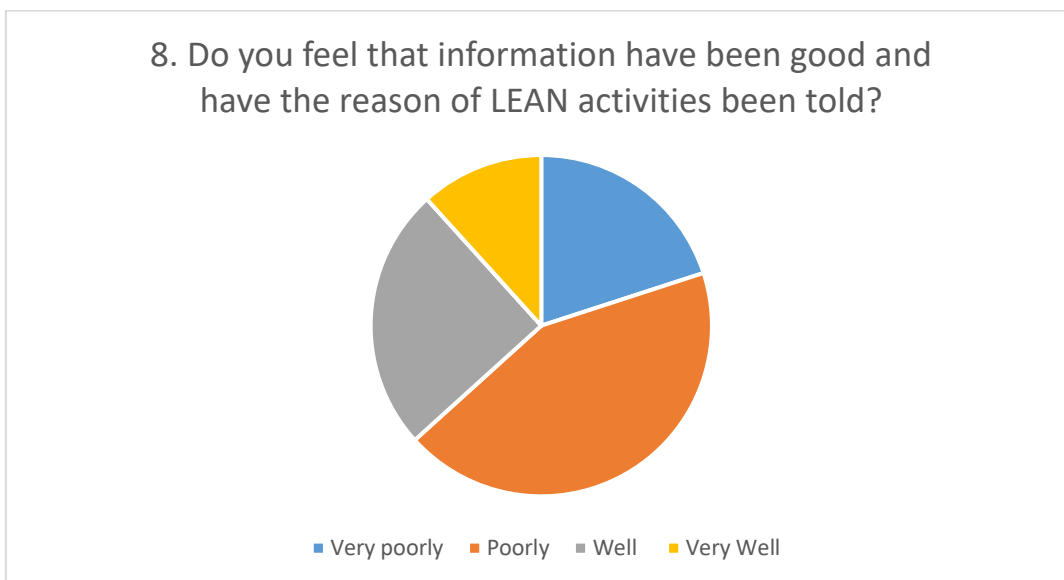


Figure 28. Do you feel that information have been good and have the reason of LEAN activities been told?

Last question with 4 answering options was question number nine. “How well have LEAN activities succeeded in over-all?” Majority answered poorly 57,4%.

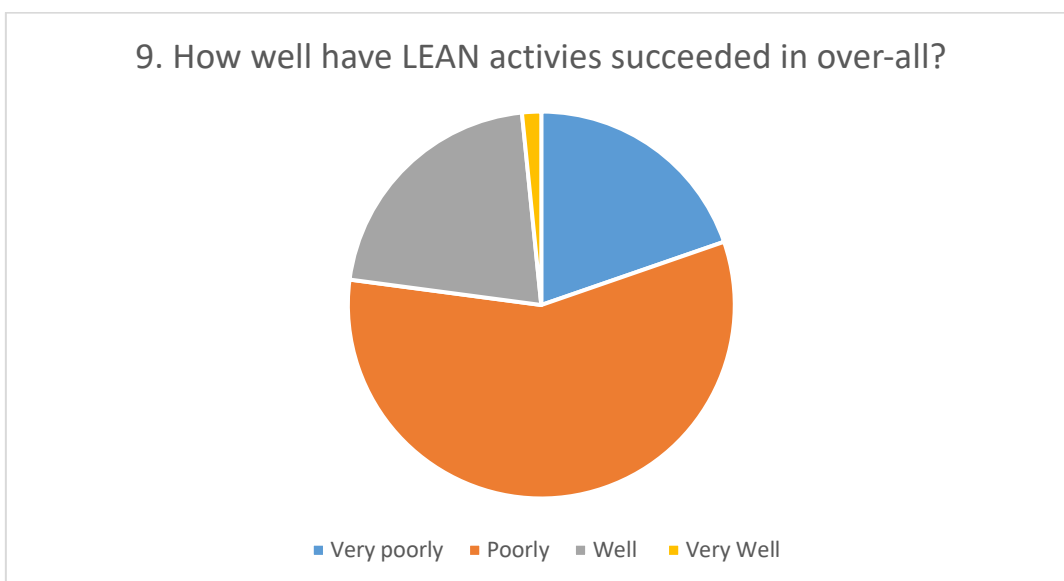


Figure 29. How well have LEAN activities succeeded in over-all?

Training was seen as most well executed and results show, what could be also seen from interviews, that supervisors and managers doesn't feel engaged to LEAN actions. Information is also something to develop further.

Last 4 questions that hold free text fields there had a quite a few answers. Question number 10 (What kind of expeptations you had towards LEAN training) was commented like:

"Same old"

"Nothing new"

"New kind of thinking"

"Didn't expect a lot, as project has been started earlier and they always stays in halfway"

Question number 11 (is there something that supervisors could have done differently) got answers like:

"Communication could have been better"

"LEAN is not in use on our department"

"Forget about LEAN and consenstrate on real work"

"They should be first engaged with LEAN activities, if they don't feel like it is thei business, things don't evolve."

Question number 12 (what factors or issues have post-poned possible LEAN activities) was commented like:

"Lack of time"

"Resistance to change"

"I haven't heard anything about LEAN since early 2021"

"No visible changes"

Final question 13 (Have this new approach been better than old ones) had comments:

"Same old, no changes"

"This time trainings were better"

"Separate LEAN team is a good idea, but resources should be guided better to achieve better results"

"No, this is a plywood mill, not Toyota factory"

Over-all there were a lot of negativity in the answers and only few could see some positive changes in LEAN implementation this time. Training was also executed better than in previous rounds and many commented on that with positive tone.

5.2 Problem space and findings

Research problem was to understand Koskisen Oy's Lean journey and what and why had gone wrong and how to develop the approach and engagement of people in the future. To avoid long lead-times and low production volumes related to market demand that plywood manufacturing had in 2021 it was crucial to find some tools or processes to help to get more value to customers.

Interviews and data analysis showed that over-all engagement in every level had been quite poor and Lean manufacturing had become something people did not want to have. There have been mistakes done in the past that caused these feelings to people.

First finding was that the start of 5S was implemented with commanding way and not listening to people. Second finding was that people felt that they had no opportunity to be a part of Lean and they were heavily guided from above. Third finding is perhaps a consequence from the previous ones and it is a lack of motivation and engagement from the management and operators. Fourth finding is that company's culture is concentrating to produce products and not develop processes and there for Lean activities have felt like something not for Koskisen Oy, this had led to lack of persistency. Lack of personnel in Lean is a fifth finding, people have felt that they are in a surviving mode, instead of developing their own work.

Also, when looking pictures from Koskisen databases it can be seen that topics from the first 5S tours weren't fixed and things at shopfloor looks the same way than back in 2010. There are rules for working, but still work method differs between different shifts. This has an effect to quality level and therefor also to material usage meaning sustainability. Faults in products also lead to rework and in worst case deliveries are postponed. Delivery accuracy is one of the main KPI's for companies.

Problem space in this research is how to engage people, how to get motivation for them and how to get results in Lean that lasts time. To get a new kind of culture of continuous improvement of all actions in plywood manufacturing. For the successful change in the culture everyone in every level of organization should be involved and heard and have the opportunity to contribute in Lean actions.

5.3 Solution space

Since current management of panel industry was experienced from LEAN manufacturing LEAN methods should be used. Activities in Lean had failed in previous attempts to create Lean culture and Koskisen had already understood this and focused slightly different this time. New kind of LEAN approach were needed.

To create solid foundation to Lean manufacturing 5S had to be restarted. To get a successful implementation people engagement is crucial. Also, there were no standardized way of executing 5S so first it had to be created. Colors for markings and area paintings need to be agreed and tools for execution purchased. Then pilot line chosen from different departments and then with support of Lean coach lead forward.

To have an impact to customer satisfaction SOP process needed to be created. To create customer value VSM for product needs to be checked. SOP's give best value in set ups, where typically wastes are biggest as machine is not running and producing products. SOP's can be also used in a smaller activities when trying to make value stream shorter and gain operational benefits in quality and get less process variation. New SOP process needed to be created with usable templates and guidance to whole organization.

SOP at Koskisen needs to be specific, visual, easy to understand and concentrate highly also to safety topics. SOP should also be easy to create and modify if needed and SOP's should be easily in hands and stored to safe, but accessible location.

With these actions it was aimed to create new open atmosphere and commitment from all levels of organization and engage operators and supervisors to use PDCA cycle to create SOP's. In a higher level of course idea of SOP's are to create customer value by reducing lead times, focusing on sustainability, bring higher material efficiency and reduce waste and these all have effect on product pricing which is not the last value for the customers. All these will have a positive effect to Koskisen Oy's profitability.

5.4 SOP process

By creating a simple SOP process for Koskisen Oy the impact to business will be better as there are bigger change that supervisors, managers and operators will use it. A workshop for SOP process took place in autumn 2021. The aim was to create simple steps to SOP process and create a templates for the SOP's. The idea of SOP was presented to

LEAN team and then ideas brainstormed together. Also, different templates were searched from internet and then started to create a template that would fit to Koskisen Oy.

It was decided that template should be in both vertical and horizontal way, but both of them would have exactly the same things in it. Also saving documents to M-files were thought carefully. We were standardizing the way that SOP should be done at Koskisen Oy. In top of the document will be a place where that specific SOP is created and link to M-files location. Below that, steps of SOP are defined and explained well enough. Time needed to execute that task works as KPI for that step. Needed PPE's are put with images and tools needed are described. Down of the SOP document are mentioned who have created it and who has approved it to production.

SOP process should be easy to understand and follow and it should follow plan do check act cycle. After reviewing different SOP processes, the steps were defined and put to plan, and it can be seen in figure 30.

SOP process, plywood 2022



SOP PROCESS, Koskisen OY

Phase	Step	Action
Plan	1	Define a process that need SOP
Plan	2	Check the current status of process and collect all related information
Plan	2.1	If the current protocol is well though and simple, then go to step 4.
Plan	3	Choose a tool for checking the current status to get a clearer view (VSM, SMED)
Do	4	Creation of SOP
Do	4.1	Use Koskisen template to create SOP either in horizontal or vertical form. Remember visibility, clear steps, needed PPE (personal protective equipment) and timing KPI for the tasks.
Do	5	Review the created SOP with production
Do	6	Approval of SOP by production managers
Do	7	Training of operators
Do	8	Implement SOP as a way of working
Check	9	Check that SOP is implemented and all operators are still working accordingly
Act	10	Start PDCA cycle again if needed

Figure 30. SOP process at Koskisen. (Koskisen Oy 2022)

First process owner needs to define a process that needs SOP. It can be a set-up, job changeover or one step from some larger process. It should be chosen so that the benefits from SOP would be high. After this the current status should be checked. All related information collected and reviewed. In case that process has already been reviewed and finetuned SOP can be created with less attention to process steps and wastes in them. If it has not been checked then correct tool for that should be defined. It can be for example SMED or VSM. With these people can more easily understand process steps and what is

internal action and what are external actions. After SMED or VSM is executed, team will gather all information and agree state of mind for the new way of doing those tasks.

After the plan phase described above comes do phase, where the SOP itself is being created. At this point people already knows how the process has been and how it should be done. Steps are clearly defined, and pictures taken to support visual management. The idea of explaining with pictures or drawings is global as everyone can see and interpret those without limitation of language spoken or understood. Also, personal protective equipment (PPE) is defined and carefully chosen for the tasks. Key performance indicators (KPI's) are also put to SOP to support efficiency of tasks.

When SOP is created it should be reviewed with operations and approved by managers. Training of all operators will follow, and it also needs to be carefully planned. People need to understand of new SOP and all of its steps and tasks. This implementation phase is followed by check phase where the SOP is checked that does it need some finetuning and are all operators still working accordingly. If some errors occur in check phase, then it is time to act and possibly start PDCA-cycle all over again.

First SOP was done together with LEAN team and production and it was chose that it would be done into one of the scarf-jointing machines. To keep it easy so that people will learn the use of new tool task was chosen in a way that it would be quite easy to describe and check. SOP was to adjust a piece that hold veneer in its place in a sawing machine. First SOP can be seen in figure 31.

Figure 31. First SOP at Koskisen Oy. (Koskisen Oy 2022)

After the first SOP was created it was reviewed with production and then printed and laminated and brought to the machine. Operators were trained and action followed. People had a good motivation, and they were keen to understand and learn this new way of doing production.

6 Results, reliability and validity of the research

LEAN activities have quite negative feeling across the organization, and it should be done in a different way. Information and engagement of foreman needs more attention. Also, perseverance need improvement, all actions need to be led with high intensity and with good energy. SOP process created to Koskisen will help people to execute their tasks in a LEAN manufacturing way which will decrease downtime and increase material efficiency. Guidance with SOP's are visual and well thought in advance which will also generate better safety to production.

As this study was executed with qualitative research, validity of it should be estimated. Qualitative validity defines how well and how accurate research have been completed. Reliability of the study is an indicator how research questions and outcome will be consistent towards other studies. (Creswell 2014, 251)

Questionnaire was created with simple questions and target group was employees of Koskisen Oy. Interviews were similar with all people interviewed and those people had a long experience at Koskisen and they have been heavily involved with LEAN activities. Because questionnaire question was guided towards employees of Koskisen they had the best estimation of LEAN activities executed at Koskisen. Questionnaire held similar questions that are typically used in surveys, and they were general so that answers would be as reliable as possible. Interview questions were also very general, and interviews were executed with a way that people could told their view of the LEAN activities in the past. If research would be executed in a similar way in 5 years, the answers received can be validated with this study. Theoretical part of this research was collected with reliable resources from internet Results of this study are reliable when compared to other research and research questions can be repeated in other research.

7 Conclusions

The purpose of this research was to understand current trends in markets and dig into LEAN manufacturing to understand how to increase customer value with using SOP's in production. One of main trends in markets are sustainability and LEAN can help companies to develop their sustainability. LEAN reduces wastes in the processes and therefor it has a positive effect to material usage (sustainability), lead times (better customer satisfaction) and product pricing when costs to manufacture the product is less than previously, this of course has also an impact to company's profitability.

Koskisen Oy had tried to start LEAN activities in history couple of times. There was a lack of personnel to do the tasks and engagement had been low in all steps of the organization. This had caused negative atmosphere to production operators, supervisors and managers. In future LEAN activities need to be done with high attention and follow-up must be constant and detailed.

LEAN manufacturing has a lot of different tools to use and in Koskisen Oy's plywood plant SOP was chosen to be a part of working in production machines. When operators are doing their daily or weekly task in a specific way described in SOP the wastes are less in a process.

Outcome of this research was a SOP process to create customer value by reducing wastes in production. First SOP is done and like all activities in LEAN manufacturing continuous improvement will be a part of it. Kaizen.

In future more research could be done related to LEAN manufacturing. SOP's are not only usable tool to reduce waste and creater customer value. Next steps could be to implement A3 project handling into all continuous improvement projects and extend production and maintenance actions into TPM to support better utilization of the machinery.

References

A brief history of LEAN, 2022. Retrieved on 12 February 2022. Available at: <https://www.lean.org/explore-lean/a-brief-history-of-lean/>

A3 problem-solving: fight the root cause. 2022. Retrieved on 19 February 2022. Available at: <https://kanbanize.com/lean-management/improvement/a3-problem-solving>

Anderson James C. and Narus James A. 1998. Business marketing: Understand What Customers Value. Retrieved on 3 February 2022. Available at: <https://hbr.org/1998/11/business-marketing-understand-what-customers-value>

Business library, W Edwards Deming. Retrieved on 5 February 2022. Available at: <https://www.bl.uk/people/w-edwards-deming>

Clark C. R. Plywood, its history, manufacture, and use in specific industrial arts areas. 1961. Retrieved on 13 March 2022. Available at: https://thekeep.eiu.edu/cgi/viewcontent.cgi?article=1224&context=plan_b

Creswell John W. 2014. Research design: Qualitative, quantitative and mixed methods. 4th edition.

Eight pillars of TPM. All about lean. 2022. Retrieved on 16 February 2022. Available at: <https://www.allaboutlean.com/tpm-pillars-overview/eight-pillars-of-tpm/>

Forest industry in Finland, available at: <https://mmm.fi/en/use-of-wood/forest-industry>

Forest resources in Finland. Retrieved on 6 February 2022. Available at: <https://mmm.fi/en/forests/forestry/forest-resources>

How the house of lean made me a better lean practitioner. 2022. Retrieved on 12 February 2022. Available at: <https://leanopedia.com/house-of-lean-better-practitioner/>

Ilmasto-opas 2022, Greenhouse emission development since 1060. Retrieved on 10 February 2022. Available at: <https://ilmasto-opas.fi/ilocms-portlet/article/42433dde-827f-485e-9fa9-45b49fbfa317/r/8f6fcd6d-39a1-4d01-8df8-a38632dfee1b/vanha-kuva1-iso-globaalit-paastot.png>

Juselius J. 2016. 50 vuotta vaneria. Koskisen vanerihistoriikki. Koskisen Oy

Järvi V. Lean expert. Koskisen Oy. Interview 14.1.2022

Koponen H. 2002. Puulevy tuotanto. Edita Prima Oy

Korpela S. Purchase manager. Koskisen Oy. Interview 15.1.2022

Koskisen tarina. Retrieved on 12 December 2021. Available at: <https://koskisen.fi/konserni/koskisen-tarina/>

Lean thinking and methods. 2022. Retrieved on 13 February 2022. Available at: <https://www.epa.gov/sustainability/lean-thinking-and-methods-5s>

Lehtinen M. Manager, thin plywood. Koskisen Oy. Interview 15.1.2022

Loane S. Webster C. M. D'Álessandro. 2014. Identifying consumer value co-created through social support within online health communities. Retrieved on 13 March 2022. Available at: https://www.researchgate.net/publication/262729017_Identifying_Consumer_Value_Co-created_through_Social_Support_within_Online_Health_Communities

Marr B. 2021. The 8 biggest consumer and customer experience trend in 2022. Retrieved on 6 February 2022. Available at: <https://www.forbes.com/sites/bernard-marr/2021/11/08/the-8-biggest-consumer-and-customer-experience-trends-in-2022/?sh=134d649a4cfe>

Melton T. 2005. The benefits of lean manufacturing. Retrieved on 11 February 2022. Available at: <http://mimesolutions.com/PDFs/WEB%20Trish%20Melton%20Lean%20Manufacturing%20July%202005.pdf>

Niwa, 2022. what is a carbon sink? Retrieved on 10 February 2022. Available at: <https://niwa.co.nz/atmosphere/faq/what-is-a-carbon-sink>

Picture. Forest industry production volumes since 1960. Retrieved on 9 February 2021. Available at: <https://www.metsateollisuus.fi/en-news/forest-industry-production-volumes>

Pro QC 2021. Definitions of Quality Picture. Retrieved on 3 February 2022. Available at: <https://proqc.com/blog/wp-content/uploads/2015/04/Definition-of-Quality.png>

Quality assurance & quality control. 2022. Retrieved on 5 February 2022. Available: <https://asq.org/quality-resources/quality-assurance-vs-control>

Single minute exchange of die (SMED). 2022. Retrieved on 19 February 2022. Available at: <https://www.mudamasters.com/en/lean-toolbox-lean-production/single-minute-exchange-dies-smed>

Skhmot N. 2017. What is lean? Retrieved on 12 February 2022. Available at: <https://the-leanway.net/what-is-lean>

SMED (Single-minute exchange of die). 2022. Retrieved on 19 February 2022. Available at: <https://www.leanproduction.com/smed/>

Standard operating procedure: the secret to a fail-proof SOP. 2022. Retrieved on 20 February 2022. Available at: <https://limblecmms.com/blog/standard-operating-procedure-sop/>

Svee E-O. Modelling business strategy: A consumer value perspective. 2017. Retrieved on 13 March 2022. Available at: <https://hal.inria.fr/hal-01572390/document>

Tarula M. Production development manager. Koskisen Oy. Interview 26.11.2021

Top 25 lean tools & techniques, 2022. Retrieved on 13 February 2022. Available at: <https://www.leanproduction.com/top-25-lean-tools/>

What is an ishikawa diagram? 2022. Retrieved on 13 March 2022. Available at: <https://www.consuunt.com/ishikawa-fishbone-diagram/>

What is SOP (Standard Operating Procedure)? 2022. Retrieved on 19 February 2022. Available at: <https://www.thinkleansixsigma.com/article/what-is-sop>

What is total productive maintenance (TPM)?, 2022. Retrieved on 13 February 2022. Available at: <https://leanfactories.com/tpm-pillars-eight-pillars-of-total-productive-maintenance/>

What is value stream mapping? Benefits and implementation. 2022. Retrieved on 16 February 2022. Available at: <https://kanbanize.com/lean-management/value-waste/value-stream-mapping>

Womack James P. Jones Daniel T. 2003. LEAN Thinking, banish waste and create wealth in your corporation. Simon & Schuster