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EVALUATION OF 5S LEAN PROJECT IN A CASE FACTORY

– Packing and dispatch area

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EVALUATION OF 5S LEAN PROJECT IN A CASE FACTORY - Packing and dispatch area

Main purpose of this thesis is to evaluate how 5S-project was executed and which were the final results on effectiveness in the case factory.

The core plan of 5S-project was how to increase effectiveness by using lean methods, mainly 5S-method and work analysis on Packing and dispatch area.

Other targets were to create new measuring tools to whole area, standardize working, make new layouts to work places, develop ergonomics and find other development solutions for the future. This low cost project aim was to increase effectiveness without extra costs by using mainly existing equipment. This continuing and ongoing turn around project started on 1.4.2016.

The results of the project were increased effectiveness which was the target of common 10-30% increase in these kind of projects, better employee satisfaction on work environment, increased willingness of employees on developing and on continuous improvements in their work place and low cost structure on the project.

KEYWORDS:

Development, Lean, 5S, production, logistics, evaluation, effectiveness

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LEAN 5S-PROJEKTIN ARVIOINTI ERÄÄSSÄ CASE-TEHTAASSA - Pakkaus- ja lähetysalue

Työn pääasiallinen tarkoitus on arvioida miten 5S-projekti toteutettiin ja mitkä olivat lopulliset tulokset tehokkuudessa case-tehtaassa.

5S-projektin toimintasuunnitelman ydin oli tehokkuuden kasvattaminen käyttämällä Lean-menetelmiä, pääsääntöisesti 5S-menetelmää ja työntutkimusta pakkaus- ja lähetysalueella.

Muita tavoitteita oli luoda uudet mittaustyökalut koko alueelle, standardisoida työn tekeminen, tehdä uudet pohjapiirustukset työpisteisiin, kehittää ergonomiaa ja etsiä muita kehittämisratkaisuja tulevaisuutta varten. Tämän matalan kulurakenteen projektin tavoite oli kasvattaa tehokkuutta ilman lisäkuluja käyttämällä pääsääntöisesti olemassa olevaa kalustoa. Tämä jatkuva ja käynnissä oleva muutos-projekti käynnistyi 1.4.2016.

Projektin tulokset olivat tehokkuuden kasvu, mikä oli tavoitteen mukainen 10–30% kasvu tämän tyylisissä projekteissa, parempi työntekijöiden tyytyväisyys työympäristössä, työntekijöiden kasvanut halukkuus työympäristön kehittämiseen ja jatkuvaan parantamiseen omassa työpaikassaan sekä matala kustannustaso projektissa.

ASIASANAT:

Kehittäminen, Lean, 5S, tuotanto, logistiikka, arviointi, tehokkuus

CONTENT

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1 INTRODUCTION

The company in this case is a manufacturing company. Later in this work I will use name Factory Oy of this company. Factory Oy is a subsidiary of a family-owned company which main industry is to manufacture and sell design furniture around the whole world. Parent company has collaborations with many famous designers and architects and it also has rights to manufacture many famous collections.

Factory Oy manufactures one these collections from sawn timber which has been drying outside for one year. This outside drying process keeps the lightness of wood which is one of the quality requirements in these furnitures. Factory Oy has also patented technology for wood bending techniques. Factory Oy has nowadays also automatized processes, but still the need of handcraft is huge. The quality of wood is never the same and quality requirements are high, which means that there will always be a need for expertized handcraft in all locations of production.

Factory Oy is manufacturing company but it also takes care of logistics services in Finland for the other subsidiary company. This other subsidiary company is a selling and marketing company which has retailers, private customers and two own stores in Finland.

In this work I will concentrate on packing and dispatch area which are owned by Factory Oy, but also few logistics services which Factory Oy is producing for the other company. These services are mainly combined with Factory Oy processes despite the fact that these are totally two separate companies.

1.1 Background of the case company

Factory Oy has a long history, it has been founded 1910. From the start to 2013 it operated under the original name until it was sold to the present owner. One of the special factors of this company and its processes is the life cycle of products. Many of these products are designed between1930-1950 and are still in production and are hopefully never-ending story.

This long life cycle, manufacture techniques and known shapes causes problems in production. Many items or components are still made by using original tools and methods. Because of the low volumes, automatizing would be too expensive to execute in all areas of production. Wood is also a material which has its own variance in quality and these variances needs handwork anyway.

Because of old methods, original and distinctive processes new owner started on spring 2016 Turn around-project in Factory Oy. The aim of this Turn around-project was to find out new ideas, processes and ways to increase effectiveness in production. The first step was to develop working by using lean methods and at the beginning the main method was to start Factory Oy 5S-project in the whole factory.

1.2 Targets and limits of the project

In Packing and dispatch area, as in the whole factory, working methods has been settled down to routines during the years. Almost all kind of analysis and development processes has been forgotten.

This 5s-project is a start for continuous improvements and it gives tools and methods to develop working and also start new learning on people behind it. Aim is to give tools to forget old habits and start to think working itself in a new way.

One of the targets is to create environment were people try to think everything in innovative ways and be a part of improvements and problem solving.

Factory Oy has four main departments: production, surface finishing, packing and dispatch area and logistics services. In this work I will concentrate on to packing and dispatch area and slightly to logistics services which are combined to or are part of packing and dispatch area.

Main target in this project is to develop working in next areas:

- 5S method
- ergonomic issues
- work analysis
- ABC-analysis - warehousing
- Visual control - method

1.3 Research aim and objectives

Research main aim is to evaluate 5s-project in Factory Oy. In this work I will study how to reach understanding of lean in theoretical way and create practical solutions for working by using chosen lean methods.

Firstly, the most important aim in this project is to create 5S standard to packing and dispatch area and start to execute it.

Secondly, create working environment for continuous improvements.

1.4 Research methods

Research method is qualitative. Mostly the information is collected from literature, but also using external interviews and professional knowledge in Factory Oy. Data collection is mainly from Factory Oy’s own database.

2 ACTION RESEARCH

In this study I will use Action Research-method in implementation of 5S-project at Factory Oy. Action Research (AR) is operational tool for development to find out solution for current situation and problems in that.

Action research can be defined as “an approach in which the action researcher and a client collaborate in the diagnosis of the problem and in the development of a solution based on the diagnosis”. In other words, one of the main characteristic traits of action research relates to collaboration between researcher and member of organisation in order to solve organizational problems. (Research Methodology, 20.10.2018)

Collaboration with employees is the most important function in AR. This function is also main requirement when implementing 5S-method in work place. I will discuss 5S-method later more in section 3.

Action research is a systematic approach to investigation that enables people to find effective solutions to problems they confront in their everyday lives. It uses continuing cycles of investigation designed to reveal effective solutions to issues and problems experienced in specific situations and localized settings, providing the means by which people may increase the effectiveness and efficiency of their work. (Stringer, E., p. 1).

Action research focuses on research *in* action, rather than research *about* action. The central idea is that AR uses a scientific approach to study the resolution of important social or organizational issues together with those who experience these issues directly. Action research works through a cyclical four step process of consciously and deliberately: planning; taking action; evaluating the action; leading to further planning, and so on. (Coghlan, D., p.3)

Between first three steps in AR researcher need to give feedback to organisation of all action made and how these changes have been succeeded. In next

figure Johnson Richard (Johnson, R., 2018) clarify steps and feedback between them:

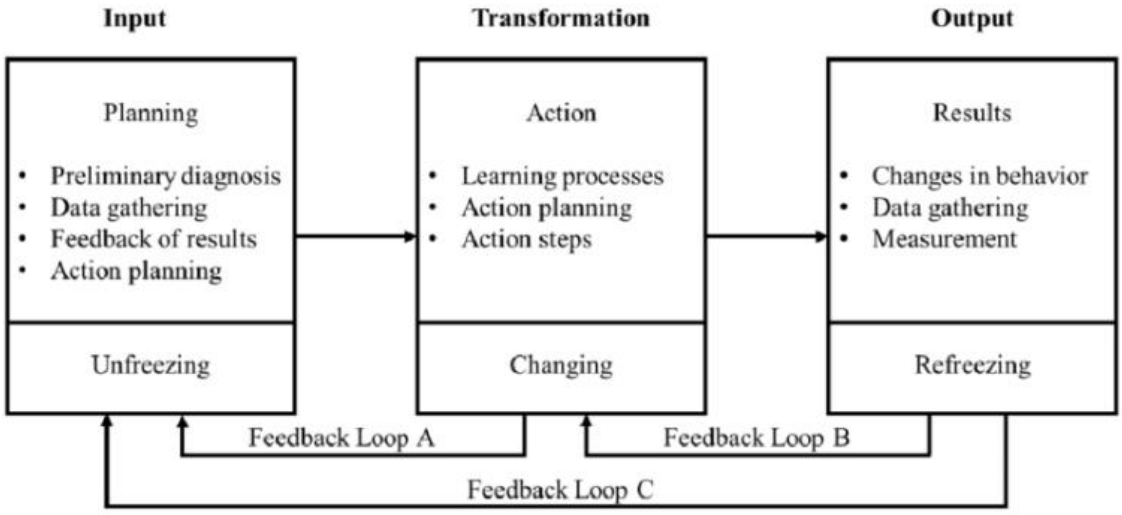

Figure 1: Systems Model of Action-Research Process (Johnson, R., 2018)

Learning processes during AR is necessary for continuous improvements. AR idea is not just to develop current situation only once, it is more life time process in a workplace but also employees need to have chance for learning new and that way to change their behavior in thinking.

Somekh Bridget describes in her book: All these settings are educational since education is a life-long process that incorporates the continuous development and learning of adults in their work places and communities. (Somekh, B., p. 31)

Action research is continuing process where processes are examined continuously. AR process can be defined shortly in four steps:

- determine current situation
- planning and implementation
- observing changes
- ensure new process continuance

The essential elements of these steps are that they are:

small – the idea being that the research is responsive to any findings that may occur, i.e don't carry out a second action before you've had a chance to reflect on your first

practicable – an incredible innovative plan is no good unless you can implement it simply, and its effects are open to observation (Warwick, 20.10.2018)

Next figure shows clearly these steps:

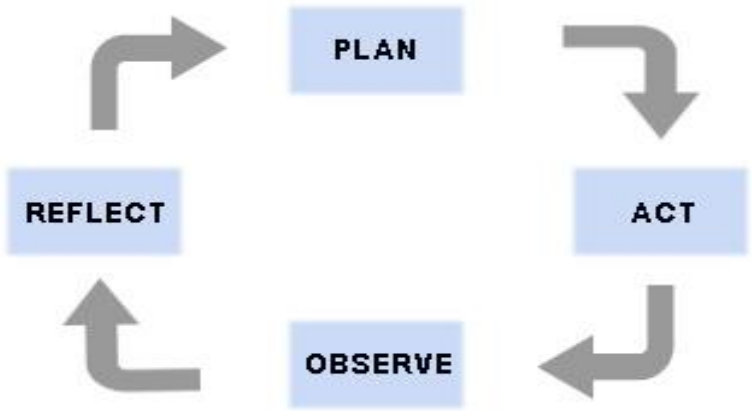

Figure 2: The Action Research Cycle (Warwick, 2018)

Fourth step in AR is to ensure new process continuity in organization. This is quite obvious if implementation has given effectiveness and organization is behind the new process. As Coughlan describes:

The client implements the planned action. This involves making the desired changes and following through in the plans in collaboration with relevant key members of the organization. (Coughlan, P. & al., p.233)

Action research is complementary model for 5S-model. These both are looking continuous improvements and also both models need the whole organization behind the execution. This means that employees willingness for learning and creating something new is the most critical point in success of execution.

3 WHAT IS LEAN?

The core idea of lean is to maximize customer value while minimizing waste. (Lean Enterprise Institute, 13.10.18) This core idea is one of the evaluation criteria how management can assess how developing has been actualized.

No single person, company, or country is singlehandedly responsible for what Lean is today. Some of the most basic elements each person listed are still fundamental cornerstones of Lean. They all took an idea, understood it and then took it to another level. Clearly, there are many other people in the past, present and future who have and will continue to shape what Lean is and will be. (MAMTC, 13.10.2018)

One of the best resources for understanding “what is lean” is the book Lean Thinking by James P. Womack and Daniel T. Jones. They recommend that managers and executives should think three fundamental business issues which should guide the transformation of the entire organization: Purpose, Process and People. (Lean Enterprise Institute, 13.10.18)

These three fundamental issues can be defined as follows (Lean Enterprise Institute, 13.10.18):

- *Purpose:* What customer problems will the enterprise solve to achieve its own purpose of prospering?
- *Process:* How will the organization assess each major value stream to make sure each step is valuable, capable, available, adequate, flexible, and that all the steps are linked by flow, pull, and leveling?
- *People:* How can the organization ensure that every important process has someone responsible for continually evaluating that value stream in terms of business purpose and lean process? How can everyone touching the value stream be actively engaged in operating it correctly and continually improving it?

Lean includes different methods which can be used individual or in any combination which is needed. For this case I chose few methods which were most useful in area on this project. Next I will shortly explain all methods we used in this project.

3.1 5S Method

5S is a simple tool for organizing your workplace in a clean, efficient and safe manner to enhance your productivity, visual management and to ensure the introduction of standardized working.(Lean Manufacturing Tools, 14.10.18)

This tool is a great platform for developing Factory Oy's existing actions which has been without this kind of improvements last years. One of the most critical point of this project is to get employees behind this project. This point and reasons are introduced more closely in section 4. Employee's knowledge, their skills and their ability for developing is one of the key factors for successful results when executing 5S-project.

5S is a team run process and should be conducted by the people who work within the area in which the principles of 5S are being applied, *it is not a tool that can be applied by an outsider onto an area without the knowledge and co-operation of the people within it.* (Lean Manufacturing tools, 14.10.18)

One target of 5S-project in Factory Oy is to develop Packing and dispatch areas by using existing equipment's and keep cost structure low. Cost structure of developing is one of the evaluation criteria in this work how 5S-project was implemented.

It is clear that the adoption of 5S is well suited to applications within production firms as it provides a platform that, with little effort, allows the organisation to satisfy various international standards with minimal costs. (Gapp R., p.576)

5S means 5 principles: Sort, set in order, shine, standardize and sustain.

3.1.1 Sort

Separate required tools, materials, and instructions from those that are not needed. Remove everything that is not necessary from the work area. (Kanbanize, 10.11.2018)

5S-project starts from the checking of everything. Unnecessary tools, components, boxes and other items which have been stored for later use, and forgotten there years ago, should been removed. Also everything which has been stored because of the value of the item should be evaluated again.

3.1.2 Set in order

Sort and organize all tools, equipment, files, data, material, and resources for quick, easy location, and use. Label all storage locations, tools, and equipment. (Kanbanize, 10.11.2018)

This step includes also planning of the layouts in working area. When working area is reorganized in new way, it is recommendable to use also other tools for developing, for example: visual control system, abc-analysis and work-analysis. These methods analyze different actions and that way support 5S steps; how ergonomics is taken care of, how inventory is located close to working place and how everything is marked in visual way.

3.1.3 Shine

Set standards for cleanliness. Clean and remove all trash, grease, and dirt. Cleanliness provides a safe workplace and makes potential problems noticeable (e.g., equipment leaks, loose parts, loose paperwork, or materials). (Kanbanize, 10.11.2018)

Third step of 5S is cleaning. This is easy after the first two steps, but it also demands the possibilities for workers to keep their area clean. This means that

employees need to have enough cleaning equipment's, recycling bins and other needed tools for cleanliness.

3.1.4 Standardize

Engage the workforce to systematically perform steps 1, 2, and 3 above daily, to maintain the workplace in perfect condition as a standard process. Establish schedules and set expectations for adherence. (Kanbanize, 10.11.2018)

Standardizing work environment means that everyone in workplace is aware of how to do in different actions of work and that way they are not influencing extra work for the others.

3.1.5 Sustain

Build organizational commitment so that 5S becomes one of your organizational values so that everyone can turn it into a habit. (Kanbanize, 10.11.2018)

This last step is the most critical step. It is quite easy to say how we should do than change habits and attitudes. Sustain means that management needs to sustain continuously and long enough to get results. Cultural changes are always long period changes and it doesn't matter is it the culture of people or environment.

3.2 Ergonomics

Physical ergonomics is concerned with human anatomical, anthropometric, physiological and biomechanical characteristics as they relate to physical activity. Relevant topics include working postures, materials handling, repetitive movements, work related musculoskeletal disorders, workplace layout, safety and health (IEA, 4.11.18).

Ergonomics in working environment is nowadays one of the main development areas in companies. Ergonomic issues influence to employees performance and well-being and are that way valuable improvement factor for companies.

Human factors/ergonomics (HFE) has great potential to contribute to the design of all kinds of systems with people (work systems, product/service systems). HFE has a unique combination of three fundamental characteristics: (1) it takes a systems approach (2) it is design driven and (3) it focuses on two closely related outcomes: performance and well-being.(Dul, J., 2012, p.377)

In this case Factory I will focus mainly to workplace layouts and working postures in working areas.

3.3 Work analysis

Work analysis, also known Job analysis, is useful process when developing workplace layouts: Job analysis is the process of collecting, analyzing and setting out information about jobs in order to provide the basis for a job description and data for recruitment, training, job evaluation and performance management. Job analysis concentrates on what job holders do and achieve. It identifies the tasks that job holders undertake and the outcomes and outputs they are expected to produce. (Armstrong, M., 2014, p. 604)

Work analysis process helps to make improvements in workplace at same time with lean processes. 5S-method, ergonomics values and work analysis together will create better work performance and working environment for employees.

3.4 ABC- analysis

ABC analysis is a method of classifying items, according to their relative importance. This analysis aims to define groups of items which have varying levels of significance and must therefore be processed or controlled differently to each other. This analysis is based on the Pareto principle (also known as the

80–20 rule). It states that, for many events, roughly 80% of the effects come from 20% of the causes. (Leanlab, 5.11.2018)

Leanlab determines that inventory items can be classified into these categories:

- A-items are goods which usage value is highest
- B-items are the interclass items, with a medium usage value
- C-items are items with the lowest usage value

Category	Percentage of items	Percentage of overall value
Class A-items	5-25%	40-80%
Class B-items	20-40%	15-40%
Class C-items	40-75%	5-20%

Figure 3: ABC-analysis (Leanlab, 12.11.2018)

ABC-analysis, also know Pareto analysis, is useful to find out information for improvements. Noticeable is to understand that Pareto analysis is not the solution: Pareto analysis does not report what the problems are, only where they seem to occur. It is important to select the categories carefully. If the locations of failures were recorded rather than the type of failure, the results would be quite different and perhaps not significant. (Arnold, T., 2014, p.33)

3.5 Visual management

Visual management is a way to visualize workplace and its actions to be easier and faster to understand how to act in different operational situations: Visual management aims to make the situation easily understood merely by looking at it. The goal is to get as much information as possible with as little observation or time as possible. (Allaboutlean, 8.11.2018)

Visual management and visual control systems can be executed in any kind of formats. The main idea is to help employees to find out for example; tools, work instructions and pallet or component places.

Visual control execution in workplaces can be implemented in many ways, for example; using colours in work instructions, floors and shelves. These colored markings can be paint, tape or using other visual items like colored papers. Also colored tools, boxes and other accessories in work environment give the visible view for employees and also to outsiders.

4 CURRENT SITUATION – 1.4.2016

The start of 5S-project was difficult. Packing areas looked messy and all working was some kind of mix of hassle and hurry. Also former management had caused frustration for workers.

Idea management is a structured process for the collection, handling, selection and distribution of ideas. It may include support for gathering, storing, improving, evaluating and prioritizing ideas be providing methods and tools, such as templates and guidelines (Karlsson, M., 01/2010 p.8).

Idea management and knowledge sharing is a part of both existing processes and cultural change in work environments. It is used mostly in new innovations, but at the same time it can be used as guidance for management in lean processes. And in this case, cultural change in work environment was remarkable.

First I tried to find out what was going on by making questions: why items were placed as they were, why you do this, why you do that etc. Mostly answers were placed that they don't know and this is how we have done this all the time. After few meetings with workers I realized that they wanted to change their work, working environment and really they wanted to do they work without any hassle and hurry. Karlsson also mention that essential ideas come from employees inside the organization and it is a good idea to start managing ideas internally to learn and get some experience (Karlsson, M., 01/2010, p11).

Employees were frustrated because of the former management and culture of improvements needed to be changed. Working environment was literally negative for new ideas and attitude for management at least reserved. Teresa Amabile from Harvard Business School studied affect and creativity at work: When positive affect increases, the scope of attention broadens and cognitive flexibility increases, increasing the probability that diverse cognitive elements will be associated (Amabile, M., 2002). This means that management should first engage employees to continuous improvements for better results.

Overview of packing and dispatch area was effective, people were doing their work well and they gave everything what they could. But in big picture, they made enormously unproductive work. Employees were waiting work instructions from management and when they got it, they started to find components and tools from stock where wasn't exact shelf places for all items. These caused huge waste of time.

In next subtitles I will shortly elaborate existing problems what we had at the start of 5S-project.

4.1 Packing area 1- CA-products

This packing area consists of smaller items like stools and chairs which are delivered to customer unassembled. This area handles yearly more than 300 000 components and pack more than 80 000 product.

Main problems were:

- ergonomics, no electric tables, bad work posture
- no places for all different components
- no places for packing material
- nonspecific work instruction between workers

Problems above are an example of miserable management. All kind of discipline and improvements were disappeared during the years. The main problem which has caused this was increased amount of new different kind of components. Employees in that area haven't had possibilities and resources to develop their working environment or work itself.

This area is the most important area on this case. This packing area had the biggest inventory of components in the whole factory and it handles almost 80% of all components which has been produced.

4.2 Packing area 2 - Assembling

This area consists of bigger furnitures: armchairs, tea trolleys etc. These items need to be assembled before delivering it to customers. Mainly all products are assembled by using different specific tools and fittings. This area assembles approximately 6000 products yearly, which is much less than in Packing area 1. But even so, different and specific tools, fittings and assembling in different products caused problems in working effectiveness. This was seen immediately at the start of 5S-project.

Main problems were:

- no tools and too much unneeded tools
- no place for components
- no place and marked fittings
- no assembling instructions

Main problems in this area were mostly possible to improve by using 5S-model methods Sort and Set in order. The largest work is to create assembling instructions to all products. Also the number of different kind of fittings to all products caused inventory location and worktime problems in assembling.

4.3 Packing area 3 – Table package

Packing area 3 finishes table tops and table legs from production. Special feature in this area is table tops which are mostly quite heavy, more than 30 kg. Despite of low yearly volume, the weight of table tops causes difficulties on handling and that way to effectiveness. Finishing of tops can be made by one employee, but lifting of tops needs 2 employees. In this area employees take care also of the final surface finishing.

Main problems were:

- ergonomics, heavy table tops needed to lift by hands
- no places for components -> totally mixed around the area
- packing material was picked from outer warehouse only for need at that point -> several times every day

Problems in this area consisted mostly of ergonomics and discipline of product locations.

4.4 Inbound-outbound – Internal logistics services

Logistics services in Factory Oy are complicated: production, warehousing services for other company, outsourcing items and shipments to customers. These all causes the following actions:

- internal inbound and outbound between production and warehouse
- external inbound to production
- external inbound and outbound for client company
- external inbound of outsourced products to warehouse
- external and internal outbound for client company and to customer

Factory Oy has only two customers, one inside the warehouse for domestic needs and one export customer. Logistic also books all inbound and outbound actions to IT-systems for all three companies, which means that employees need to handle three different systems: Jeeves, Sap and Navision.

Main problems were:

- Four workers and only one computer and printer, and everyone need computer on their work -> waiting time in front of printer
- no access to all systems -> three companies, three different systems

- not allowed to do all work in all companies -> limited access to systems
- no definite places for internal logistic pallets

Improvement needs in this area consisted mainly from IT-systems.

4.5 Inventory

Inventory consists from three different parts: client company's inventory, Factory Oy's inventory of components and Factory Oy's inventory of ready products. Total inventory area is 2700 m2 which includes also packing areas and dispatch area.

Main problems were:

- no rooms for goods -> also lanes were full
- no markings in pallets
- lot of old and useless items in inventory
- wrong or insufficient item explanations in system
- ineffective use of heights in shelves

The biggest problem in inventory was the lack of space. All shelves and lanes were many times full of pallets which cause huge difficulties when collecting orders and when receiving inbound orders from suppliers.

Secondly, new layout on shelves, relocating items by using ABC-analysis and better item marking on pallets and in system need to be improved.

5 IMPLEMENTATION

“Now we start this!!” This kind of statement is not a realistic start to any project. Projects need always a team which is allowed and able to do improvements. Team consists of professionals and collaborators; both external and internal, employees and the most important member on team is leader of the team.

It’s quite easy to say what we want and what we want to be, but execute the project and achieve the target without explicit plan is almost impossible or at least improbable. *In this case, resources for full time project management were limited. Team manager was also a foreman and he needed to execute the project with employees with the same time their own daily work. This caused that preparation for project, planning, scheduling and reporting was made insufficient.*

Unforeseen uncertainty makes contingency planning more difficult because the project team cannot anticipate everything. Because it is impossible to create a complete contingency plan, the plan must evolve as the project progresses. When enough new information arises, they must be willing to learn and then formulate new solutions. (De Meyer, A., 2002, p. 2)

On the other hand, if the task is a challenge -- i.e., the path to the target condition is unclear and has to be discovered via iterative learning -- then managing by results and extrinsic carrot and stick motivators does not compete so well. In that case, how people go about striving for their target conditions becomes important. (Liker, J., 30.10.18, p.3)

Liker and De Meyer emphasize that without complete planning, the meaning of the team arises and team members willingness to strive the target is important. In this case, the meaning of employee’s willingness to achieve the target arose significantly.

5.1 Start 1.4.2016 - Meeting with employees

The first action concerning 5S project was to meet all employees and show what 5S is and clarify the target to achieve. I invite employees to meeting room and I showed presentation of 5S and proposal how we should continue with this project. This meeting connected people to this project and also gave understanding how they should discuss with each other to find out solutions how to go forward.

The whole team should be trained in the vision and objectives of the company and given a clear understanding of what the company is trying to achieve through them and their 5S program implementation. They needed to have a clear understanding of the seven wastes of lean and an overview of basic lean principles. With this knowledge they will be ready to undertake their 5S implementation (Lean manufacturing tools, 14.10.2018).

5.1.1 Different way of thinking and working in a team

Noticeable observation was how team was thinking problems and solutions. Too often they started to think small areas without vision what will happen if we do this. When we break things down into smaller and smaller components, we tend to lose sight of the interactions between them. (Bartlett, G., 2001)

Bartlett describes differences between Systematic-, Systems- and Systemic Thinking. Differences between these are how different actions in work place are combined together and then broken smaller parts for analyzing needs. In next figure is described these differences:

Systematic Thinking	Systems Thinking	Systemic Thinking
Thinking methodically.	Thinking about how things interact with one another.	A simple technique for finding system-wide focus.

Figure 4: Systematic-, Systems- and Systemic Thinking (Bartlett, G., 2001, p. 2)

Systemic thinking lists as many elements as possible (to ensure that the theme is as representative as possible), while analytical thinking lists only a handful of elements (to make the workload manageable). Systemic thinking finds and focuses on the theme across the elements, while analytical thinking selects and focuses on the most attractive or promising element. (Bartlett, G., 2001, p. 7)

On next figure is seen clearly what kind of difference is between Systemic thinking and analytical thinking:

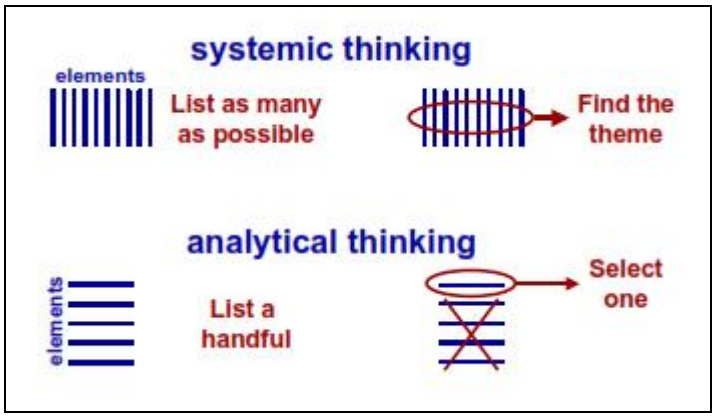

Figure 5. Systemic vs. Analytical thinking (Bartelett, G., 2001, p. 7)

In this case Systemic thinking is more useful because it focuses more to identify similarities than differences. This means that it is easier to find out similarities in actions and find out how these actions work together.

Only the way of thinking is not enough, team needs to be led and coached right. Richard Hackman from Harvard University describes a theory of team coaching in his journal as follows: Team leaders engage in many different kinds of behaviors intended to foster team effectiveness, including structuring the team and establishing its purposes, arranging for the resources a team needs for its work and removing organizational roadblocks that impede the work, helping individual members strengthen their personal contributions to the team, and working with the team as a whole to help members use their collective resources well in pursuing team purposes. (Hackman, R., 2005, p.269)

Both, Bartlett and Hackman are defining what kind of team should be and how lead it to right direction. In this case was seen that at the beginning employees

tried to think too narrow area and they couldn't see the Big picture. After few discussions with the team this changed rapidly. Also employees were ready to open their minds also to "stupid" ideas, which are many times those missing parts of a puzzle. But mostly it told to us that we had created an environment were all people were allowed to suggest ideas without being afraid of critical or mean response from others.

5.2 Packing area 1- CA-products

First and the most important improvements needed to do in this packing area. This area handles almost 80% of components from production, so this area is the most critical point in the whole factory.

At the beginning of 5S-project we decided to keep meetings when necessary, if needed then daily or even hourly. As in the start of this research, *the most important issue is to involve people behind the project. This means information giving and idea collecting and sharing with all employees.*

During the first days we listed all needs for improvements and started the first 5S improvements in packing area by sorting out all unnecessary tools, components and other goods which were left there during the years.

NEW LAYOUT – New layout was necessary for creating better environment for employees. *The new layout was created to existing working area by minimizing the need of unnecessary moves from shelves of component and back to working place. This meant also the change of shelves locations. At the same time we developed new packing units for packaging*. This change made working easier when package unit was planned to be as a packing cell where everything needed were located close for worker. New package units and location of shelves decreased unnecessary need for moves enormously. For example we located cardboard boxes inside the working unit or at least really close of it. When all the boxes were located to same places, *the Visual control for the amount of boxes was clearly seen quickly and it helped to order more boxes from warehouse to packing unit.*

SHELVES – the whole area was filled with pallets of different kind of components and shelves were full. The solution for this was to change the heights of the shelves. ABC-analysis gave answers how to fit all components to the shelves. There were more than 40% of components which needed less space than others. *Solution was to change heights of the shelves so we had a change to increase the amount of component places more than 40%. Also using ABC-analysis we had a chance to locate mostly needed components closer the packing units.*

ERGONOMICS – *one clear improvement was to purchase new adjustable tables to packing units.* This was the most preferable renewal for employees and to their working environment. It is impossible to determine the benefits of ergonomic issues, but *in this case at least the investment payback time will be short because of the satisfaction of employees.*

WORK LIST – before this project employees got their work instructions from the foreman and usually only one work at the time. This caused problems when foreman was busy. There was times when employees didn't know what do next and they needed to wait. This kind of way prevents also possibilities of employees to influence to their own work.

Because of the ordering and production times, *we had a chance to create working list for employees where is all orders which need to be done on that week.* After this *employees got their working list on Monday morning* and they could *plan their own work for that week*. This increased working satisfaction remarkable and satisfaction will increase effectiveness.

IT-TRAINING – IT-training for workers was also necessary for releasing foreman to do beforehand work for the need of the next week. On previous years employees were not allowed to go company's systems, so *we needed to make training for workers how to use system*. After the training all employees were able to print all needed documents and labels and also they had skills to check inventory, incoming orders etc. This increased the knowledge of their working area and engaged them better to take care of their own work.

5.3 Packing area 2 - Assembling

Packing area 2 was interesting area because of its specific tools and fittings. One main problem was how to solve assembling that way that employee has all needed clearly available.

NEW LAYOUT – The first action was to design new layout which consist of three different topics: fittings and tools, components and assembling place. ABC-analysis gave few answers, but in this case practical knowledge of employees was the best factor of developing. One main factor of layout was the size of components and also needed assembling space. These two caused collision between knowledge and ABC-analysis. *We decided to reorganize components firstly by using size of them and secondly using ABC-analysis*. This solution gave better space for moving pallets of component to this area and also location in shelves was planned considering moves of pallets. Mostly all heavy and big size components were located to floor place which is also ergonomically the best solution.

Another totally new idea was to build new shelves for the cardboard boxes. This was executed by using pallets and board. Previous way was to storage boxes in pallets, which took a lot of floor place. In these new shelves we lifted boxes to upright position, marked all locations with item number and planned enough space for individual items. This gave visual scene for ordering more boxes from the warehouse, but it also released space for assembling.

Space for assembling increased because of the reorganizing components and cardboard boxes approximately 30-40%. Assembling needs space because of the size of items and now we had a chance to create another assembling unit to same previous place. This second unit enables two employees to work at the same time when it is necessary of production. Previous way was to make overtime work which costs are higher.

FITTINGS – Fittings in this area was a problem which needed to solve in appropriate way. There were screws, specific fittings and other fittings more than

200 pieces. Many of them were used in more than one product and employees needed to find many times a day correct fittings from shelves. One way to solve this kind of situation is to create two-box system for all fittings. But in this case we needed to also create an assembling cart for all products which were assembled in this area. Because same fittings were used in many products, the space was limited and also it would be problematic for ordering more fittings when there would be many locations of the same fitting. This problem was solved by *creating and innovating two-location system. In this new idea assembling cart included all needed tools and fittings for one product and reserve stock was located in different place.* When all fittings were used from the assembling cart, employee could easily get more from the reserve stock just by checking from the cart the number of the fitting and get more from reserve stock were all fittings were numbered with the same number than in a cart. From reserve stock is easy to take an inventory and order more from supplier when needed. It also gave visual control for fittings.

ERGONOMICS – Ergonomic issues in this case were mainly solved by using adjustable tables in assembling and location of components were heavy items were located on the floor. Part of ergonomic improvements came from new tools and locations of tools and fittings which were now closer the assembling table.

INSTRUCTIONS – In this assembling area one of the most critical development need was product assembling instructions. There were no previous instructions; all assembling know-how was learned by other employees. This caused problems when permanent worker was in sickness day or in a vacation. Quite often in that situation employees tried to find out correct fittings and in problem situation they tried to find a person who knew how to solve assembling problems. This meant huge loss in working effectiveness. Solutions for this were to create assembling instructions for all individual products were was all assembling stages detailedly descripted with enough pictures of those actions. Assembling instructions included also all needed screws and fittings with item numbers. These instructions decreased unnecessary inquiries between workers.

OTHER – In this area was also a need for IT-training and for new working list. These improvements were copied from solutions of Packing area 1.

5.4 Packing area 3 – Table packaging

Table packaging area needed a lot of planning in locations of table tops and also ergonomic issues in this area needed updating. Employees had an adjusting table in use, but it is not a solution for lifting. Table tops are quite heavy, approximately 20 - 40 kg and sizes from 100cm to 220cm.

LAYOUT – First step was new layout for table tops and also for packaging and for the final surface finishing. Existing layout was made for more of taken care of packaging area, but not taken care of pallet places on the shelves. Of course the situation had been changed in previous years and now there were approximately more than 50% more items and quantities in the whole area. It was clear that we needed to add more places to shelves. Because there were a lot of new items, we decided to decrease packing area, build new shelves and make existing shelf places lower. Existing height of shelf places was 120cm, but approximately need was only 70cm. This way we could increase shelf locations more than 40% and also new shelf gave 40% more places.

ERGONOMICS – The next step was the most costly investment during this project; new vacuum lifter for table tops. Previous way was to lift heaviest tops by two employees, so influence for effectiveness increased, but the most important improvement was unquestionably ergonomic development.

EFFECTIVENESS – Increase of effectiveness in this area was remarkable. New vacuum lifter released one employee to the other place on the factory. Another effective improvement was achieved from increased shelf places, which gave possibilities to build place for cardboard boxes. This decreased the picking need of packing material from outer warehouse. Previous need was several times a day and now we could decrease this need only to one time a week. Because there was no anymore need for two employees, much smaller packing area was enough for work load.

OTHER – As in other areas, in this area was need for IT-training and new working list, which were solved in the same way than in other areas. New places for packing material gave better visual control and planned locations for components and table tops were mostly created by using the size of table tops, but also ABC-analysis support these decisions.

5.5 Inbound-outbound – Internal logistics services

Internal logistics services were taken a shape after changes when logistics of subsidiary company was brought together to the same building where was Factory Oy's production few years ago. Despite of the earlier planning, the layout was insufficient for the need.

LOGISTICS - We planned a new layout for internal logistics considering the new layout of Packing area 1, which was at same space with logistics. Principles for the layout came from lean thinking that everything should move forward. We created new area between packing area and logistic area for the internal inbound pallets. After this change production had a clear place where to move ready items from packing area and logistic people had a clear visual scene of pallets which need to be handled forward.

After this internal inbound area we created new layout for the external inbound and outbound pallets. These areas were located close to internal logistic area and also beside the loading dock. These improvements decreased distances between actions and gave better visual scene to whole logistic area.

IT-SYSTEM - Next improvement we needed to solve was IT-problems and time waste in that. Firstly we add two computers and printers, one for the packing area for the need of item labels and packing lists and one for the handling for inbound and outbound needs. Both IT-units were located in that way that employee could stand in front of computer and there was enough space around it. This was really important improvement in actions of inbound and outbound processes, because now employee had a chance to bring pallet close to computer and make easily inbound and outbound checking and needed entries to IT-

systems. This change was also ergonomic improvement, before this there was a distance between computer and pallets, so employee needed to walk back and forth from pallet to computer and sit there.

Second improvement was to allow access to all three systems in all three computers. This decreased unnecessary actions when employee had a chance to make all entries to all three systems at the same computer.

5.6 Inventory

Inventory in Factory Oy consist of three different parts: client company's inventory, Factory Oy's inventory of components and Factory Oy's inventory of ready products. The biggest problem was the lack of space. For this reason we analyzed all bigger actions in inbound and outbound processes and we found out few processes which caused the biggest need of space in inventory. In these processes were two processes we had a chance to change.

First we negotiated with our client company of straight deliveries from supplier to the customers place. There was one customer who had almost weekly full trailer deliveries from one supplier and we managed to change these loads to go straight from supplier to customers place. This change caused a lot of space savings in our inventory, time savings in logistics and it is also environmental issue when unnecessary transport was eliminated.

Second remarkable change was to stop double warehousing in Factory Oy's building. This double warehousing in a client inventory and in a Factory Oy's inventory was formed because of long delivery times from Factory Oy's inventory to the client's inventory. We changed ordering systems and shortened delivery times so our client company didn't had a need for own inventory of the same products what was in Factory Oy's inventory.

The third change was to analyze the contents of inventories. This analyze showed that there was old and useless items in all three inventories and many items were marked wrongly also in shelves and in IT-systems. After these were

handled we had a chance to make Abc-analysis and locate all items in new places.

These three changes gave a lot of space to all three inventories. Despite the fact that the rate of inventories are still more than capacity, it is anyway better situation now when comparing to the previous situation. Still the lack of space is distinct; all the shelves are filled all the time. Because both companies are increasing their sales yearly, the next step must be planned in the near future.

5.7 General overview – improvements in the whole area

In general: the whole scene in all areas changed. The most visible improvement was floor markings in all new layouts. All lanes, floor pallet places and logistic areas were marked with tapes by using different colours. We used green tapes to mark lanes for internal logistics and also to be safe lanes for outsiders. All floor pallet places and working units were marked with yellow tapes. These marking created better discipline and visual control to all actions; there were no anymore individual pallets all around inventory, there was clear places where the pallets needed to locate and it clarified all packing and logistic units.

Also 5S-method gave better understanding how to clarify working units and in general in all places. We started to use better labelling in working units for example for tools and accessories, in shelves for items and also in inbound and outbound pallets.

One of the most important improvements was to improve information needs between the company and employees. Previous way for all information was limited and employees didn’t have a clear picture of targets and achievements. To clarify this we started weekly information meetings with employees given by foreman. This weekly meeting was a good idea, but quite soon we realized that once a week was not enough when 5S-project was going on. This weekly meetings evolved from weekly to daily individual meetings. Short few minutes individual meetings in work places was better for employee and it was also rapid way to share information between employees. One information improvement

was information boards in all areas. Information boards, movable or not, is a practical way to inform daily or weekly achievements. For example previous week results in effectiveness, daily performance or quality issues.

IT-training in packing and dispatch area was one of the critical parts in the whole project. Employees didn't have an access to IT-systems in time of former owner and now we started practically from the basic elements. Employees took this training really well and they were satisfied because now they had a chance to increase their own knowledge and expand their skills in their own work. This training caused increase in employee's responsibility of their work and that way also engaged employees to learn new skills and develop new improvements.

In work management area we improved different kinds of instructions to the work places: work lists, assembling instructions, quality definitions and instructions for the use of tools and machines. We also listed components, fittings and cardboard boxes to be useful lists for employees. These instructions and lists decreased the need for unnecessary searching of the correct item and unclear instruction for example in assembling.

6 RESULTS – EFFECTIVENESS AND DEVELOPMENT 2016 -2017

The benefits of 5S for Lean were significant, it is suggested that efficiency gains of the order of 10% to 30% can be achieved, and certainly within my experience of handling many 5S program implementations these levels of success have always been achieved, even in companies that already claim to have implemented 5S (Lean manufacturing tools,14.10.2018) .

Before the 5S-project started on 1.4.2016 there wasn't any kind of measuring tools for current effectiveness. The first operation was to find out someway earlier existing numbers, but it was practically impossible to get reliable information from previous years. This is the reason why numbers for measuring tools was able to look only 3 months backward. For this reason research time period for effectiveness decided to settle to period 1.1.2016 – 31.12.2017. *Because this research and 5S-project started 1.4.2016 and previous data wasn't able to use, this evaluation is compared from 2016 results to 2017 results.*

6.1 Evaluation

Evaluation criteria of this case were settled at the start of this research. Main research area is packing and dispatch area and slightly logistic services. Evaluation of the success of this project can be compartmentalized to next categories:

- low cost structure of the project
- increase of effectiveness
- development of measuring systems
- employee satisfaction
- 5S compatible working environment

6.1.1 Low cost structure of the project

Low cost structure in this project was one of the targets. Target was to increase effectiveness without extra costs by using mainly existing equipment. Mainly all needed supplies and materials were accepted from management in the start of this project, only distinctly costly purchases needed to get an approval from management.

Costs in this project were followed in detail level on purchases, but meeting costs with employees needed to be evaluated approximately because during the project we started daily individual meetings.

Cost structure in this project consists of three different categories:

- supplies and materials
- acquisition of high cost equipment
- human resource expenses

Supplies and materials

Supplies and materials include floor and shelf markings, office accessories like plastic pigeon holes, plastic boxes for fittings and all kind of similar items for visual control and discipline on tools and equipment in work units.

Acquisition of high cost equipment

This category includes high cost equipment which were in this project new vacuum lifter for table packing unit and new assembling carts to assembling area.

Human resource expenses

These expenses consist mainly of meetings with employees, both group meetings and mainly individual meetings. These costs were not followed precisely, mostly because these meetings came rapidly when employee had something questions or ideas. Mainly these situations were only few minutes and mainly at

the same time with other management issues. Group meetings were held only few times during this 21 month period. With these limits it is possible to evaluate that meeting costs were approximately 10 minutes/employee/day. This means 50 minutes in every week with individual worker and it is at same level than what is the own perception of used time. There was approximately 7,6 employees in this area during the 21 month period. Counting for meeting costs will be next: 50 minutes/week x 4 weeks/month x 21 months x 7,6 employees. This counting makes total 532 hours. For the cost of meetings the cost of working hour need to be defined. In this case we could use productivity or real salaries. Because total hours are the value which is useful when comparing cost and results, it is not necessary to give any exact cost of working hours. In this calculation I will use approximately 25,00€ cost per working hour.

Summary of cost structure

Summary of costs structure is following:

- supplies and materials 850,00€
- high cost equipment
    - o vacuum lifter 8 000,00€
    - o assembling carts (5 x 850,00€) 4 250,00€
- meeting costs (532 hrs x 25,00€) 13 300,00€

Total 26 400,00€

Costs of 5S-project were total 26 400,00€, but it consist mainly of high cost equipment and personnel costs. For the 5S discipline supplies and materials cost were only 850,00€ which is in every scale really low. Personnel cost were 70 hours/employee in this 21 month period which is 2,08% of yearly working hours.

6.1.2 Increase of effectiveness – Packing area

Effectiveness in production of packing area was measured by using three different measure tools:

- Packed and collected rows
- Collected rows vs working hours
- Effectiveness eur/hours

On the next chart is shown increase of packed and collected rows on production on research time period:

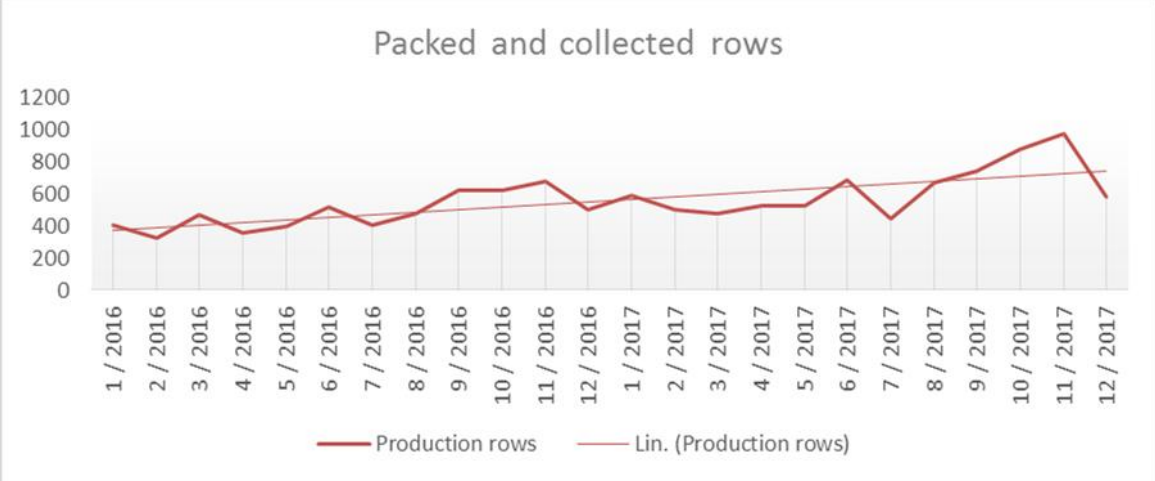

Figure 6. Packed and collected rows in production

During the research period total quantities of rows increased from the year 2016 packed 5770 rows to the year 2017 packed 7576 rows -> increase 31%. This increase of rows caused more work in packaging area when employees needed to start new order more often than previous years.

On the next chart is compared increase of collected rows and working hours:

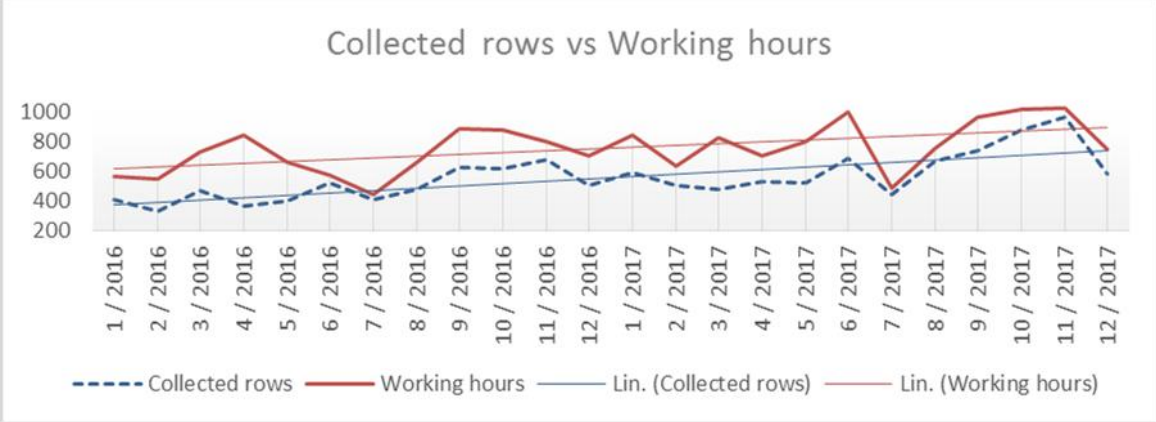

Figure 7. Collected rows vs working hours

This chart shows that increase of collected rows was faster than increase of used working hours. Total increase of working hours was from 8278 hours (2016) to 9816 hours (2017). This increase is 19% which is less than 31% increase in collected rows. This value doesn't merely show the real increase of effectiveness. With these values management need to compare also the value of collected rows which is shown on next chart:

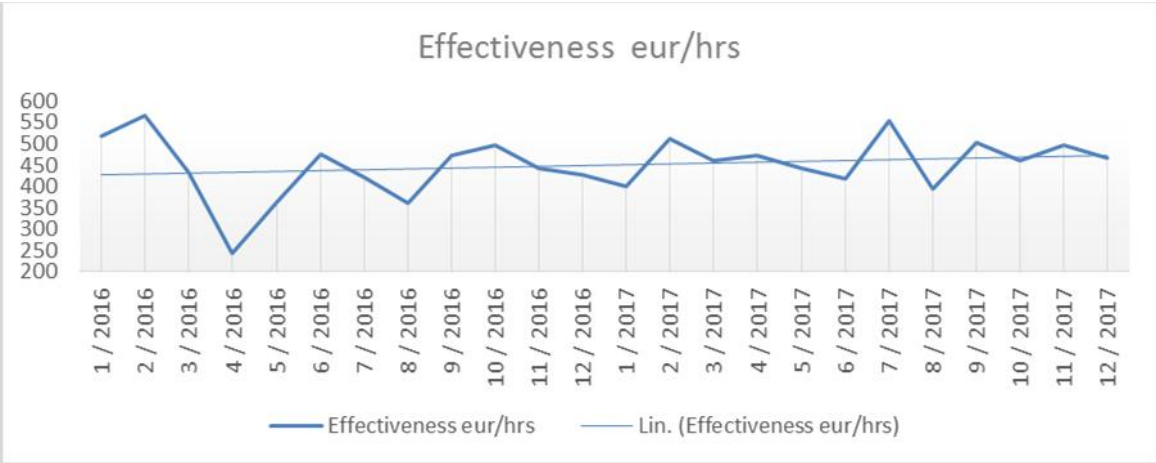

Figure 8. Effectiveness eur/hrs

This calculatory value is determined by using value of the products and specially defined value of product value increase on production. So this doesn't show direct which is the employees productivity in packing area, but it can be used

when evaluating effectiveness if employees. This calculatory value increased 27% from the year 2016 value to 2017 value.

SUMMARY

Effectiveness in production of packing area can be summarized by using three charts above:

- increase of collected rows 31%
- increase of calculatory value 27%
- increase of working hours 19%

These results show that increase of working hours was much lower than increase of collected rows, which also increased work productivity. With these numbers it is possible to evaluate that increase of effectiveness was compatible of the 10-30% target of increase.

6.1.3 Increase of effectiveness – Logistic services

Effectiveness in logistic area was measured also by using working hours and collected rows. The most development was achieved by using ABC-analysis, new layout and using changes in procedures.

On the next chart is compared working hours, delivered and received rows:

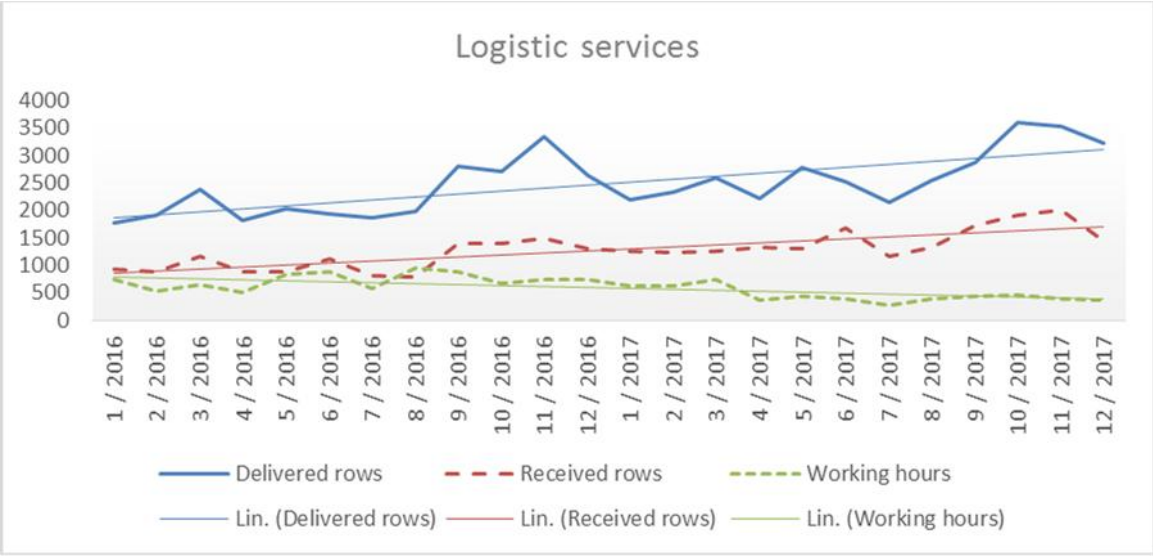

Figure 9. Logistic services

This chart shows how inbound and outbound has been increased during the years 2016-2017. Quantities of outbound rows increased from 27169 rows (2016) to 32511 rows (2017), which was almost 20%. At the same time inbound increased from 13031 rows (2016) to 17586 rows (2017) where increase was 35%. This kind of increase of workload causes normally increase of working hours, but in this case development processes were already almost done, so effect of workload didn't influenced to daily work. Working hours decreased from 8640 hours (2016) to 5477 hours (2017), which means 42% decrease in total working hours.

SUMMARY

All made development processes supported the target of decreasing the lack of space in warehouse. It is quite obvious that enough space in warehouse is the only key for effectiveness. Full shelves and aisles cause enormous need for useless and unnecessary transfers and relocating inside the warehouse.

6.1.4 Development of measuring systems

Development of measuring systems was at the same easy and difficult because there wasn't any kind of existing measuring tools. During the project we tried many different kinds of measuring, but most of them were not useful. The most of the tools were not on line of quality and that way those were unequal for comparing employees and their effectiveness. *Quality issues are the most important definition on Factory Oy which is against effectiveness. It is obvious that when increasing handwork speed, probably quality will decrease.*

For this reason *we created measuring tools to whole area which consist of calculatory value of productivity, number of packed pieces and working hours. This is equal for all workers and it increases the willingness to help other workers in same area because the target is collective.*

6.1.5 Employee satisfaction

One of the evaluation criteria of this project was also employee's satisfaction. This is possible to measure with questionnaire, but this wasn't done when this project started. Afterwards it is impossible to get reliable results, so satisfaction in this case needs to evaluate in different way.

One good measure tool for satisfaction is sick leave days. In this area previous sick leave days were 3-5% yearly. During this project sick leave days has been decreased under 3% level.

Another observation is the willingness to do over work when workload needs it. On previous time foreman needed to follow workload and ask people to make over work. Many times this was made during the same day. In this new situation employees follow individually daily how workload influences to weekly target and they decide itself is there need for over work. This means that they have possibilities to decide the day which is the best for example to their families and still they can achieve weekly targets.

One criteria in measuring satisfaction is also the willingness to learn new skills and make new ideas for productivity. This willingness has been increased enormously. Before this project employees had ideas, but they were not excited to improve actions. After this project is seen that when employees notice some kind of need for improvements, they don't just say it, they rather require it. This kind of change tells that employees are interested and engaged for developing their own work and they have willingness for continuous improvements which was one of the targets of this project.

6.1.6 5S compatible working environment

5S compatible working environment means different actions in work place. These actions are different in every company. In this case main improvements concerning this 5S-project are following:

- daily information meetings with employees
- changes in measuring
- changes in employees thinking for continuous improvements
- willingness to develop own work
- working area and environment is clear and employees take care of it
- effectiveness has increased without increase of workload -> no unnecessary moves and so on
- relaxed atmosphere on working area

This list shows how working environment has changed to be more informative, more innovative and in my opinion the relaxed atmosphere on working area is the main achievement in this project. To get better environment, at the same time when effectiveness has increased 25%, is really an achievement.

7 CONCLUSIONS

Within 21 month effectiveness improved 15-45% during the Lean 5S-project and in the whole area 25%.

One good example was employee's willingness to develop their own work. From the start of the project the most common questions were: Why to change, we have always made this way. This changed during the process to the questions: Why don't we do this way, why can't we change this? Employees have a huge potential to develop their own work if they have possibilities to do so. One of the most important rules for developing lean systems is to focus on people inside the organization and really involve all employees to be behind of projects to get successful results. This was shown in our project clearly.

EVALUATION OF 5S PROJECT

Entirety of 5S project in this case was success. Increase of effectiveness was on the same level which was the target of common 10-30% increase in these kinds of projects. Cost structure of the project was low, only the lifter to table top packing area got over the estimate, but the benefits of ergonomic issues were needed in this case. Broadly however, budget for these kind of development projects can be and can be managed to be low and that way especially 5S project are really useful and effective way to increase productivity also in small enterprises.

At the end of this action research project it was wonderful to see how development continues without even specified project plan and notice how especially employees in area of this research and the whole organization grew in their thinking of continuous development. This research and project of this case was for me remarkably educational to see how even small changes in work environment can change the whole organization and inspire people inside the work and also help them to increase their own potential of thinking outside the box to find out new solutions.

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