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Minimizing the Impact of Stock and SAP Conflict on the Production Line

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Abstract <p>This thesis was done the case company which challenges with their bookkeeping so that the real stock and ERP stock has mismatch. The objective for this thesis was to study this mismatch.</p> <p>The research was implemented firstly by collection the needed data for understand the potential source for the mismatch. Data was collected for the company's ERP system with comparing the usage of one product's components with different size orders. The root reasons were also thought with the help of fishbone diagram.</p> <p>The theoretical part of thesis is focusing on Kanban and Lean six sigma which are in crucial part of the empirical study as well. The collected data was used for improvements which were done by using the theories of DMAIC as well as Kanban board. The implementation of the improvement ideas is left to the case company.</p>		
Keywords Lean Six Sigma, DMAIC, Kanban, bookkeeping, eliminating the mismatch		

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1 INTRODUCTION

Companies can have issues with their actual stock which they have in storage and the stock which they have marked to their ERP system. This kind of error can bring many different consequences which are bringing challenges to the company's operation. The aim of this thesis is to research these errors.

The thesis starts with the case company's overview and the explanation of mismatch in their case. The study begins with data collection and root reason searching with the help of fishbone diagram. When required background is collected, the tools of Kanban and Lean six sigma are used for improvement ideas. Those ideas are presented at the end of the thesis.

2 CASE COMPANY DESCRIPTION (CONFIDENTIAL)

3 OBJECTIVES, PROBLEMS, AND IMPLEMENTATION OF STUDY

3.1 The purpose and the objectives of the thesis

The primary objective of this thesis is to ensure the alignment of raw material quantities between the actual stock and SAP. The study will focus on one of the fundamental products used in production, tracing their journey from raw materials to finished goods. Initially, the process will be observed and documented, including all the steps involved. Subsequently, based on the collected data, improvements to the

process will be proposed and implemented. The discussion will encompass various process stages, such as receiving, warehousing, and entering the products into the ERP system.

3.1.1 ERP System

ERP is an abbreviation from words enterprise resource planning. It is referring to software that companies are using for managing daily business activities like accounting, risk management and supply chain operations. ERP systems are crucial for many companies because the software ties together company's various processes and enables the data flow in between. Enterprise resource planning systems are integrated platforms which can be either on the spot or on the cloud. (Website of Oracle, 2023.) Case company uses SAP which is the market leader in ERP systems (Website of SAP, 2023).

3.1.2 Bookkeeping

Processes, methods, and systems which are used for account and manage company's stock are referring to stock bookkeeping. In bookkeeping context, stock refers to items in inventory which can be any of following three stages: ready goods, goods in production or raw materials. Inventory bookkeeping is crucial for company to efficient operation, smart decision-making, and financial reporting. Bookkeeping can be done either continuously or at the end of agreed period like for example every month. Physical inventory counting is crucial for ensure that real inventory matches with system's accounting. Differences in real stock and system can be due theft, spoilage, loss or human errors. (Website of Superfast CPA, 2023.)

3.2 Boundaries of the project

There are numerous complex product lines with significant variations in their process flows. Attempting to analyze all product lines would be impractical and prevent an in-depth examination. Therefore, the focus will be on one of the main products. For

instance, products such as dangerous goods and special batch productions, which are ordered once a year, will not be included in this thesis.

The reason the boundaries are set this way because comparing many products will bring challenges. Also, each product group has its unique and complex processes, which could complicate the project.

3.3 Research problem and sub problems

The research questions for this thesis;

Research question 1: What are challenges in warehouse stock keeping when the stock and the ERP bookkeeping do not match and how to minimize or eliminate the problem?

Research question 2: Why ERP bookkeeping and actual stock are having mismatch?

Research question 3: Can Lean tools like Kanban or six sigma be used beneficially with ERP bookkeeping?

Research question 4: What improvements and challenges used tools are bringing?

3.4 Conceptual framework

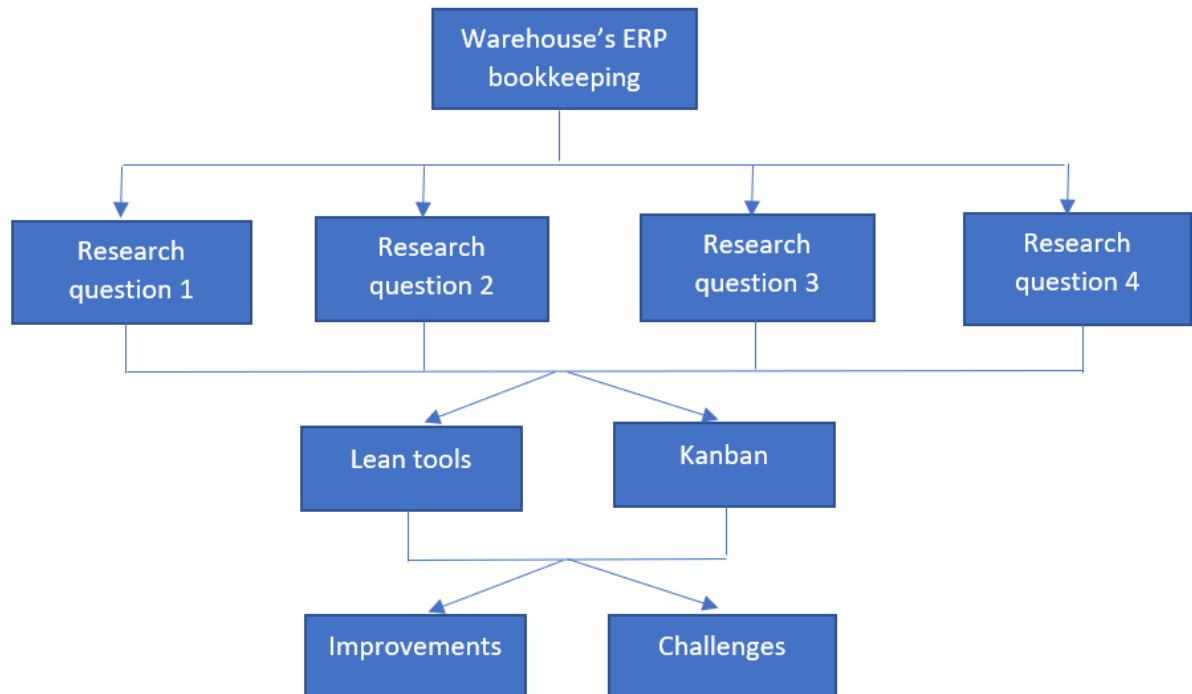


Figure 1. Conceptual framework

From the figure 1, can see the conceptual framework. On the top is the ERP bookkeeping which leads to four research questions. Those research questions are analyzed with the help of theory of lean and kanban. Outcomes are improvements and challenges.

3.5 Research methods

3.5.1 Qualitative and quantitative research

The used research method is partly qualitative and partly quantitative research. The fishbone is a sample of qualitative research where focus is on exploring the ideas and formulating theories. Method is also suitable for this case because this case is about trying the understand the reason for mismatch (Streefkerk, 2019). Quantitative method is used when data is collected from company's ERP system. Quantitative research is

dealing with numbers and graphics which makes it suitable for ERP's data collection (Streefkerk, 2019).

3.5.2 Inductive approach

In inductive research relevant data for the case is collected and then viewed. When data is viewed, researcher is trying to develop the theory of occurred patterns. (Principles of Sociological Inquiry: Qualitative and Quantitative Methods, 2012.) Inductive approach is good for this thesis because work in this case starts from data collecting and the received data is analyzed with the help of theory.

3.5.3 Data collecting

Data will be collected in few ways; with observing and by using the information from ERP system. The inventory stocks can be compared to SAP's data which will bring much information. In observation time, also the usage of unmarked items is needed to be followed. Data will be collected and the analyzed the help of theories.

4 KANBAN

The word Kanban comes from Japanese, and it can be translated as signboard (Gross, J. & McInnis, K. 2003). It is Lean workflow management method which can be used for defining, managing, and improving services which are bringing knowledge work (Website of Kanbanize, 2023). The process as well as the work which is passing the process are being visualized which helps to identify possible bottlenecks (Bhaskar, 2023).

Kanban roots are in 1940s and 1950s when it was used in the production system of car manufacturer company's Toyota (Gross, J. & McInnis, K. 2003). It was developed by Toyota's industrial engineer Taiichi Ohno for compete better with American car

manufacturers. With the help of Kanban, Toyota reduced the costs of their inventory while on the same time created flexible and just-in-time production system which made their productivity higher. (Bhaskar, 2023.) It is known as synonym of demand scheduling. In the early days Kanban was developed for reduce the costs for example by minimizing the work in progress between processes and by reducing the inventory holding costs but these days it can be used for various purposes. (Gross, J. & McInnis, K. 2003.)

4.1 Principles of Kanban

Kanban can be separated to six core principles from which the first one is to start with the currently known facts for understand the present workflows and processes. Another key principle is to accept the small changes rather than wait for everything will be changed at once. Kanban also encourages the employees at every level to suggest improvement ideas. The fourth principle is to keep focus on the needs and expectations of customer. The work instead of employees should be managed by respecting the team member's roles and responsibilities. Lastly, the network of services should be reviewed on a regular basis for keep up with quality levels. (Website of Kanbanize, 2023.)

4.2 Practices of Kanban

Kanban has also six practices. Firstly, the bottlenecks can be identified by visualizing the workflow. Next, the current work in progress -tasks should be minimized by focusing to complete one task at time. The third practice of Kanban is to manage the flow of work. Also, the process policies should be clear for every member of team for minimize the misunderstandings. In Kanban is important to know the areas which are needing improvements so fifth practice is to implement feedback loops. Lastly, the collaboration should be also improved. (Website of Kanbanize, 2023.)

4.3 Kanban board

Kanban board is work management tool, which is helping to visualize the work, understand the process and finally, make improvements (What is Kanban board, 2023). It was founded when David Anderson in year 2007 developed the idea of Kanban method to little bit further (Website of Kanbanize, 2023).

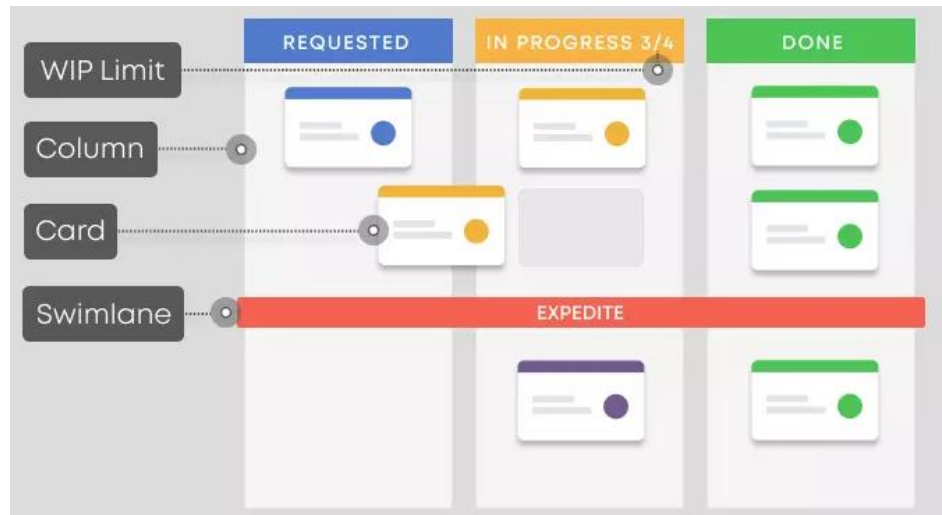


Figure 2. Template of Kanban board (Website of Kanbanize, 2023).

Kanban board has six components; columns, swimlanes, kanban cards, commitment points, WIP limits and delivery points, which can be seen on above on figure 2. Board is separated on up to the columns which are presenting the activities of the work process and together columns are making the workflow. Kanban cards are the tasks, and the details of the task are written on the card. The cards are moving on the board from left to right depending on their status of the progress and completed task are exiting the board.

Commitment and delivery points can be added to tasks for add value to the customer and give better understanding of workflow to the employees. Commitment point is agreement that certain request is delivered to the customer while delivery point has been completed when final item is handed to the customer.

By adding work in process-limits (WIP limits) to the board, it helps with keeping correct amount of work on going so that work is effective. WIP limits, also courage the complete the unfinished tasks. Swimlanes can be used for organizing the tasks.

Work can be organized for example by employees, types of tasks or by teams. When Kanban board is created and process is being understood, it helps with understanding the lead time. (What is Kanban board, 2023.)

5 LEAN

Lean which is also known as The Toyota Production system (TPS) was developed between 1948 and 1975 by Toyota's industrial engineers Taiichi Ohno and Eiji Toyoda (Website of Creative Safety Supply 2023). The idea is to minimize the stocks by eliminating the waste which will increase the cash flow and reduce the needs of physical space (Website of Lean Six Sigma Definition 2023). Lean is illuminating the hidden waste by providing philosophy, techniques, and tools for thinking, organizing, and performing the work. When the waste is detected, organization can find the solutions for reduce or eliminate the waste. (Gygi, 2018.)

Lean method has seven unnecessary wastes which should be avoided for minimization of problems. First of avoided waste is overproduction. Then organization should minimize the waiting time. Thirdly, the inventory should be kept small. Also, defects and rework should be avoided. Company should keep the process simple and eliminate overprocessing. In addition, also the transportation waste should be avoided. Lastly, all movements should be well planned and unnecessary motion needs to be eliminated. The eighth waste which can be added to the list is the waste of people's skills which should be used in beneficial way to the company. These wastes should be avoided and focus on the customer's satisfaction. (Website of Mevisio, 2021.)

5.1 Lean six sigma

Lean six sigma is an improvement method where Lean refers to waste of time while Six Sigma refers to the waste of material. Lean six sigma method is used for improving the capability of processes and systems. (Website of Six sigma 2023.) Its target is to

eliminate the waste of physical resources, effort, and time by on the same time keeping quality of production and other organizational processes on the high level. Lean six sigma has its roots in the 1990's when manufacturers in United States of America tried to compete with Japanese products. In comparison to Six Sigma, Lean Six Sigma is improving the flow of work and creating value to the customers by minimizing or even eliminating resources' waste. (Kenton, 2023.)

5.1.1 Benefits of Lean Six Sigma

With the help of Lean Six Sigma, companies can build the loyalty both inside and outside of the company by increasing the performance of their important processes which can improve the working experience for their workers and at the same time make customer satisfied. When company's processes are simplified, they are easier to control, and company is more able to jump to new opportunities faster. At the same time, company's sales as well as revenue can increase, and costs can decrease which is leading to more sustainable business. In Lean Six Sigma method, it is also beneficial for enterprise to involve employees to the process which can improve workers' skills and growth possibilities. By taking employees to the process, it is also making them more committed to the company. (Kenton, 2023.)

5.1.2 DMAIC

DMAIC is quality strategy idea behind the lean six sigma which is used for process improvement. The process has five steps; define, measure, analyze, improve and control as can be seen from figure 3.

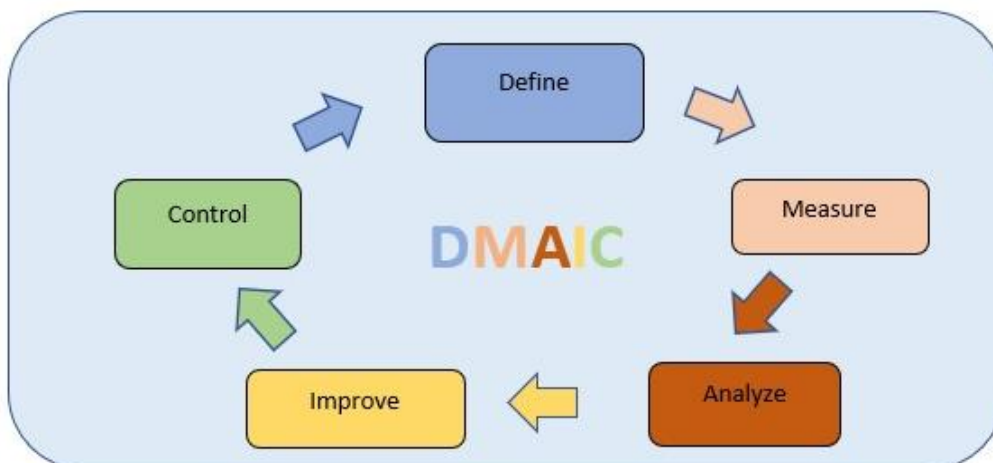


Figure 3. Phases of DMAIC (Sarigül, 2023).

On the first, define phase the issue has been defined. The chosen problem should be the one which solution will improve the customer satisfaction. The measurement phase is critical since the measurements are showing the current situation of the process. The measurements can have different focus for example lead time or quality. (Website of Go Lean six sigma, 2023.) On the analyze step, the cause of an issue is being identified by analyzing the effects of different quality or quantity inputs to outcome are evaluated (Allen, 2006). On the improvement phase the analyzed solutions are tested and measured (Website of Go Lean six sigma, 2023). On the last, control phase learned lessons are documented and plans for future follow up are made (Allen, 2006).

Although DMAIC is quite laborious, it is having many benefits. DMAIC is demanding much data collection for understand what contributes to the problem or issue. Since the quantitative is emphasized, it is also bringing more effective way for assumptions testing and offsetting the biases which makes the results more difficult to be criticized. The results which are coming from DMAIC cycle are quite trustful since the phases requires attention and they cannot be skipped to avoid wrong results.

With DMAIC the root causes can be identified which is the key factor for make the correct improvements. To ensure the suitability of the outcome, it is important to conduct the test for revised process. (Kliem, 2016.)

5.1.3 PDCA

The PDCA (plan, do, check, act) cycle is a popular tool used for quality improvements, mostly due to its simplicity. The first step, plan, is determining the issue which is needed to be resolved and then building the map for resolve it. On the do part, the plan is executed. After that, check is for measure the performance and determine if the progress is meeting the set expectations. Act is analyzing and making the needed improvements. The cycle keeps turning until the results are satisfying. (Kliem, 2016.)

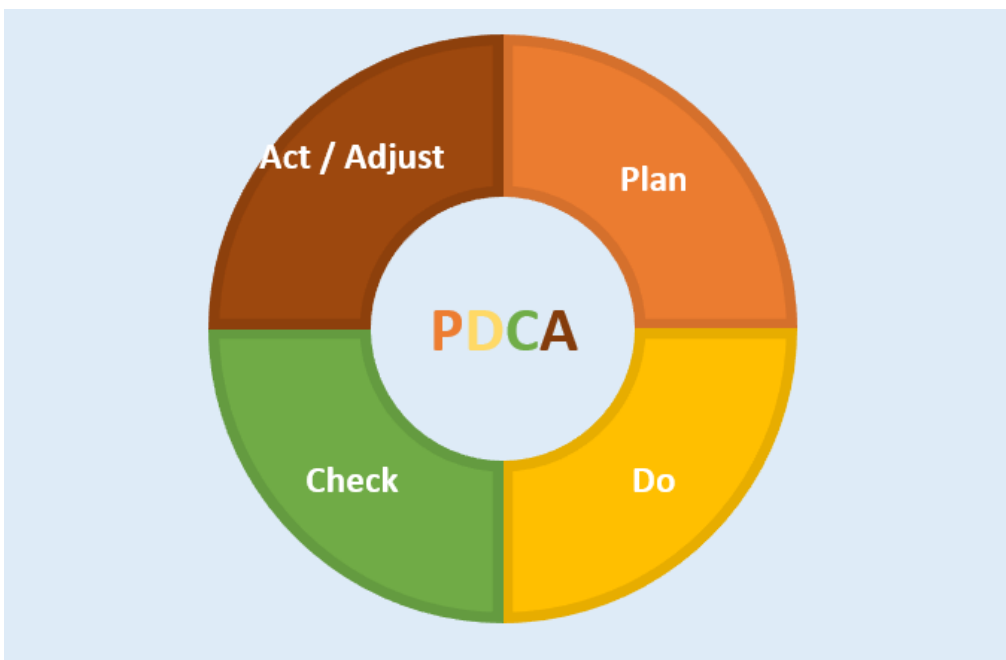


Figure 4. Phases of PDCA cycle (Sarigül, 2023).

PDCA is iterative so the stepwise refinements can be made during the process and the cycle is adaptable. PDCA is not requiring much mathematics, with this method meaningful results can be achieved with little or even no mathematics.

For the get the best outcome of PDCA cycle, it is needed usually to be used at least few times for the follow up. Since the projects are often short, the PDCA is not the best fit for projects because for ensure the success, the project needs to have planned several iterations.

Since the PDCA is not requiring much mathematics, it is needing to keep attention of not letting the bias affecting to the result. When using this tool, it is important to realize

that bias might be present and find the tools and techniques for offset it. Since the PDCA is quite simple to use giving the opportunity to avoid data and facts collection which leads to preliminary or cursory review to determining the solution for the issue. Similar challenge is that people will take shortcuts by not thoroughly completing the phase or even skipping some of them by making assumptions. (Kliem, 2016.)

PDCA has several benefits for be used in Lean projects. In comparison to DMAIC cycle, PDCA is easier and faster since DMAIC is real combination of Six Sigma and Lean which makes it more difficult and harder to handle. DMAIC is suitable for issues which are needing deep investigation rather than PDCA is more suitable for issues where speed is necessary. PDCA is also better and more widespread known than DMAIC which is making the use of PDCA easier than more research demanding DMAIC cycle. PDCA has more situations where it can be used since it is applicability to different industries while DMAIC is mostly suitable for manufacturing environments. (Kliem, 2016.)

6 QUALITY TOOLS

6.1 Fishbone diagram

Fishbone diagram is suitable for be used in cases where the causes for effect or problem needs to be identified. The diagram is simple to do, it does not need more than pen and some whiteboard where team members can brainstorm their ideas. (Website of ASQ, 2023.)

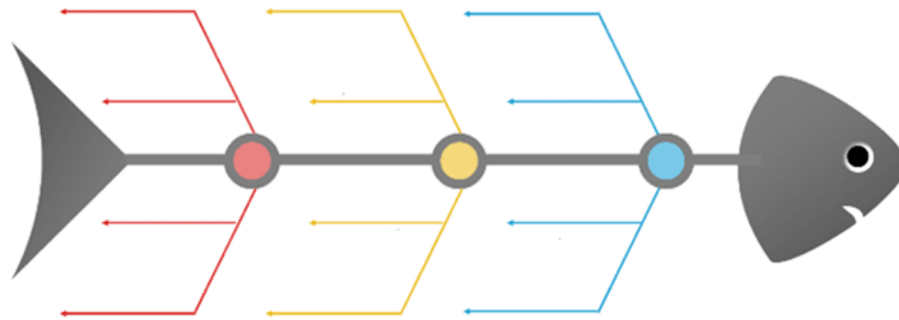


Figure 5. Template of Fishbone diagram (Website of Six Sigma Study Guide, 2023).

6.1.1 Procedures of fishbone diagram

Fishbone diagram has five procedures which needs to be followed. Firstly, the problem statement needs to be agreed and written on the center of right side on the whiteboard. Next, the major issues which are causing the agreed problem to need to be thought and written on the board. Then the team can brainstorm the possible causes behind the problem by asking the question “Why does it happen” and then adding the answer to the whiteboard. The same question needs to be repeated to get the deeper levels of the causes. Lastly, when team is running out of ideas, keep the focus on the section where the ideas are less. (Website of ASQ, 2023.)

7 RESEARCH PROJECT

7.1 Case

It is understood that case company is having mismatch of real warehouse stock and the stock which is written on their ERP system. Firstly, for solve this challenge, the data is needed to be collected. The root reason for the mismatch is analyzed from the

collected data and with the help of fishbone method. Then, it is needed to be thought the solutions and actions for future improvement.

7.2 The challenges caused by mismatch

This issue of mismatch in real stock and ERP bookkeeping is bringing several challenges. For the production line the challenge is that products cannot be manufactured if components are missing. This kind of situation occurs when ERP bookkeeping is not matching with the warehouse. If production cannot operate on the schedule, it is bringing delays to the end customer's deliveries and making customer unsatisfied. Also, for logistics team it is hard to give correct lead time to the customer when they cannot trust to the ERP's stock. When lead time is getting longer than expected, unsatisfied customers are calling or sending email which increases the workload in logistics team.

7.3 Possible reasons for the mismatch of real stock and ERP bookkeeping

The differences in the real stock and ERP bookkeeping can have various background reasons. One of the reasons may be the inventory counting which has not been done properly or not enough often. When inventory is counted often on regular basis, the mismatch can be found enough early for minimize the possible future issues. Also, the mistakes on the receiving time are causing the mismatch. In this company, also mismatch is due to employees on the production line who does not have access to the ERP system so they cannot mark all the items which are for some reason going to waste or they do not inform the manager for enter the quantity to ERP system.

7.4 Data collecting (Confidential)

7.4.1 Analyzing the collected data

The collected data is showing that over usage is not increasing with higher quantity orders and these differences can have various reasons why they occur. Difference can be due for instance that those components were expiring or for some other reason on unusable condition on the production time. Also, the components can be used for some other purpose on that same time when making an order, so the usage percent is increasing. Such a high difference like with component E, can be caused for human error so that there are mistakes or oblivion when entering the usage to the ERP system. For understand the real root reason, it would require deeper investigation and longer observation.

7.5 Finding the root reasons with fishbone diagram

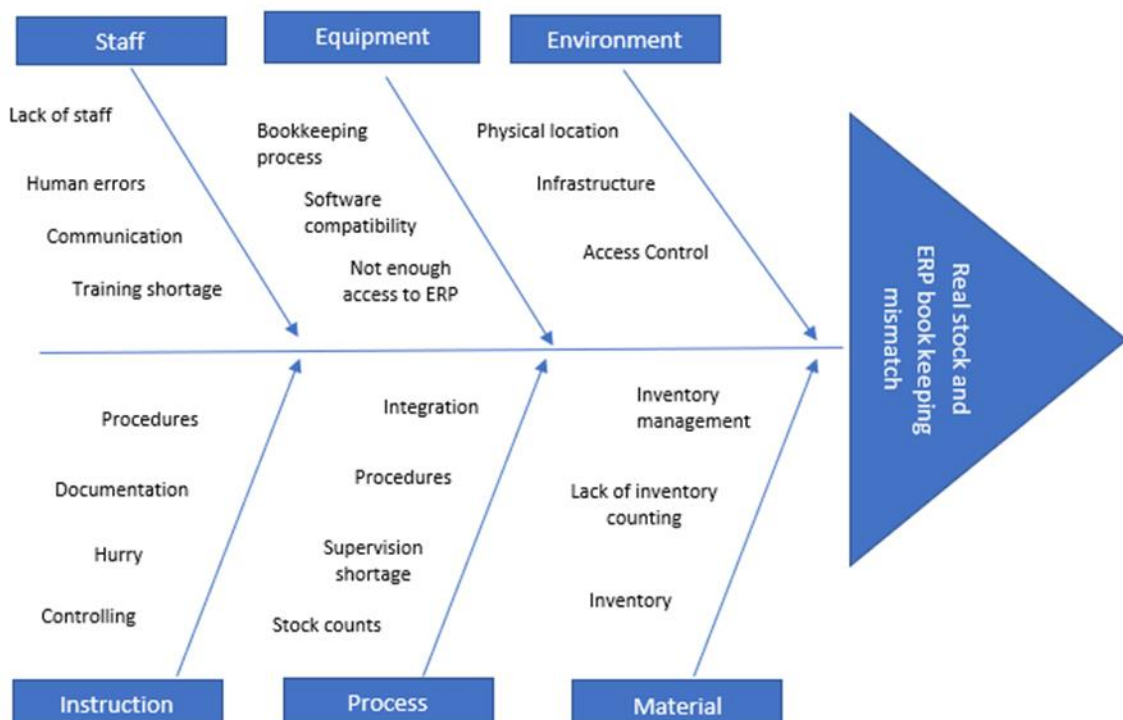


Figure 6. Fishbone diagram for the case (Sarigül, 2023).

On figure 6 which is presented on the above can be seen the fishbone diagram for this case. On the right to the head of fish is marked the research problem which is the

mismatch of real stock and ERP system's bookkeeping. On the body of fish is brainstormed the possible reasons for the mismatch in six categories: staff, equipment, environment, instruction, process, and material. The lines between categories are blurred and they can be linked to each other.

7.5.1 Staff

From staff section human errors like forgetfulness and lack of communication can lead to that all the used components are not marked to the ERP system. In the production area only, few people have access to the SAP so if those staff member are forgetting to mark the components or others are forgetting to mention unusable components errors occur. Lack of staff is bringing rush which helps with the occurrence of errors. The education of new employees is also lacking so for example workers may not know that they need to report unused products so that those can be marked to system as wastage.

7.5.2 Equipment

In this section, we can consider the personnel who have access to the products but cannot enter the used or wasted raw materials into the system. It may be a painful process for everyone in the production line and packaging area to use the ERP system or to be trained but in the long run, it would be important way to minimize errors.

7.5.3 Environment

The environment in which the process or task takes place can also have an impact in this area, including factors such as temperature, lighting, or other external influences. In other words, working conditions are having great importance at this point.

7.5.4 Instruction

This category relates to procedures, guidelines or instructions given to staff on how to fulfil the process or task. It is necessary to give the staff a good description of their task and to specify the processes correctly and clearly. It is also very important to follow the process continuously.

7.5.5 Process

It specifies the steps necessary for the process to start, progress and reach its conclusion. There can be many different steps in these processes and processes such as training, follow-up and control come first.

7.5.6 Material

Refers to raw materials, materials or inputs used in the process that may contribute to the problem. This means problems with raw materials. In general, errors in counting or that it's not being done often enough. The quantities used are not fed into the system on time or correctly.

7.6 Improving the process with Kanban board

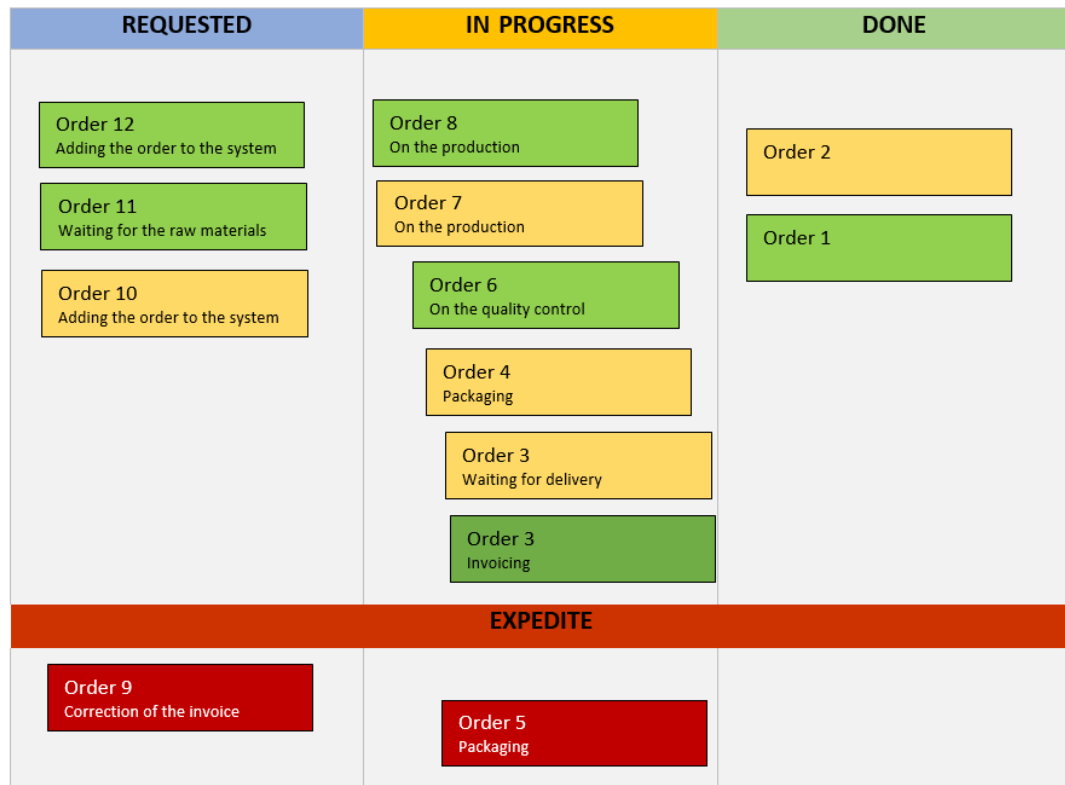


Figure 7. Current situation of the process with Kanban board (Sarigül, 2023).

On the figure 7 can be seen the current situation of the process. Currently, the tasks which are on the process are much so the kanban board is very much simplified. Low importance tasks are marked on the figure with green and higher importance tasks with yellow. The urgent tasks which need to be completed quickly are marked with red on expedite.

The kanban board which is on figure 7 is done from logistics department point of view and for example steps of production are not mentioned. Currently, when new order request is coming from customer, the whole logistics team is available to answer to customer and register the order to the system. The time which each order is staying on the progress are varying a lot since some products are faster to manufacture. Also, some orders are staying on the work in progress list very long for instance due to lack of required raw materials. Some products are needing special checking and, in the

company, only few people can sign the releasing of those products so it can delay the process.

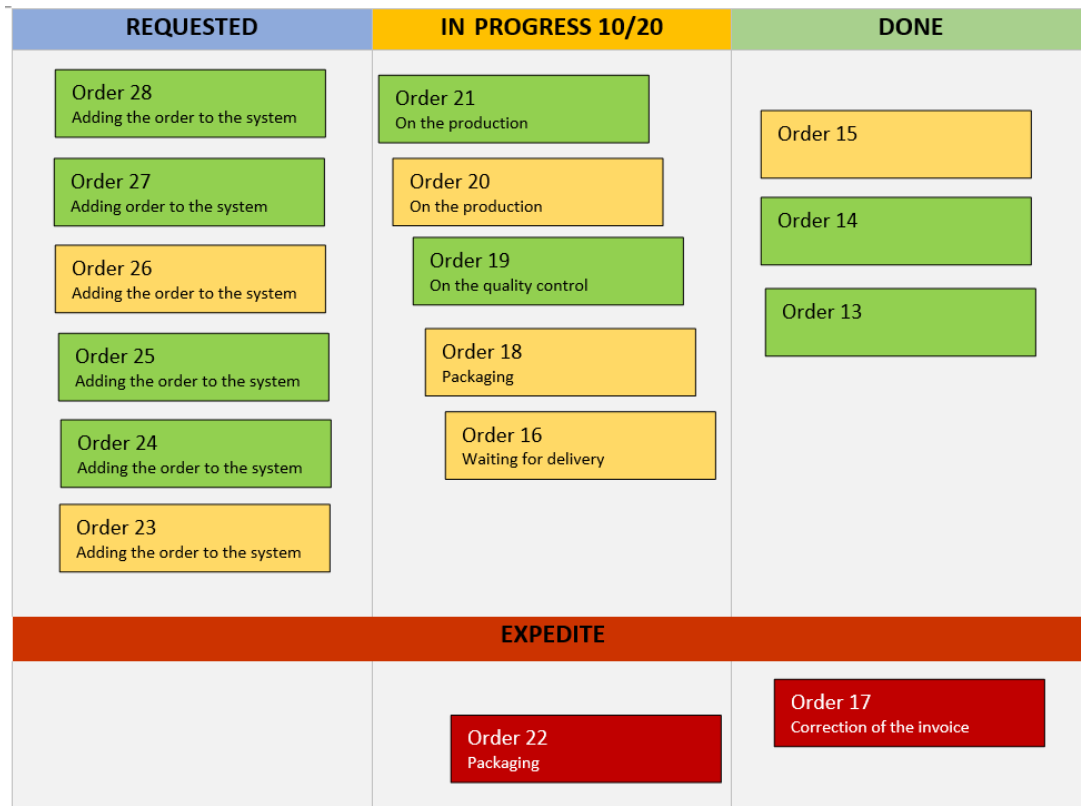


Figure 8. Improved Kanban board (Sarigül, 2023).

7.6.1 Improvements with Kanban board

Current situation can have many improvements and on the figure 8 can be seen on the improved kanban board. Work in progress should be limited for speed up the process and increase the customer satisfaction. However, there are challenges with WIP limits because of production can take long so naturally company has many orders on the kanban board at the same time. Currently, orders which are on the process can be about fifty so if those could be reduced to twenty the work would be more efficient. When focus is on the limited orders, logistics team could follow the production process and prepare the invoice and the delivery in advance. The urgent cases could be also handled faster without those affecting hugely to the other orders.

For this case, kanban board can be very beneficial because it can visualize the process and help with finding the bottlenecks. As mentioned earlier, some tasks are handled

by only few people, so it is slowing the process down for instance if those critical people are away from the work. When following the kanban board in longer run, the similarity of problem cases can be spotted. For example, if same product is always lacking the raw materials, company can pay attention to it and improve the process. Also, similarities with human errors can be spotted so company can reach to it and give for instance more education to the staff.

7.6.2 Challenges with Kanban board

Although, Kanban board can be very useful for this case, it is naturally having also challenges. Kanban board can be challenging to handle because the process is multilayered and same task can be handled with multiple people. During the process for instance with logistics team the person who is answering to the customer can change so it is making the tracking more complicated. Due to lack of education, many tasks can get stuck because of an employee needs to ask help or permission from other employee or supervisor before continuing the task. It would be challenging to keep WIP limits on the effective level when the tasks can have various and very long-lasting reasons for pause on the board.

7.7 DMAIC

DMAIC can be used for this case for find the correct improvement ideas. DMAIC is more suitable for this case than PDCA because DMAIC is more suitable for deeper investigation. PDCA is also needing to be repeated several times which is not option in case with limited timetable.

7.7.1 Define

As mentioned earlier for the case problem is the mismatch in real stock and ERP bookkeeping. When thinking this issue, it's improvements will have significant effects to the customer satisfaction because it can help the company follow up their schedule and even shorten their lead time.

7.7.2 Measure

The measurements are done earlier on this chapter on part 7.4 where can be seen the collected data.

7.7.3 Analyze (Confidential)

7.7.4 Improve

To earlier mentioned issues can be improved with various ways, below can be found the ideas and their analyzes.

Inventory counting

Currently, inventory is counted only when needed so there is not any regular basis for the counting. Inventory should be counted more often, in the best-case scenario monthly for follow up the usage. By this way mistakes with either on the receiving time or on the production time could be spotted earlier.

Training

New employees should have more comprehensive education to the company's procedures as well as their own responsibilities. All the staff member who are in touch with the raw material should know where and how they should mark the receiving or usage. Naturally training is costing to company, but it will be beneficial in the future when mistakes are decreasing.

Software

If more staff members have access to the ERP system, all the usage could be faster marked to the system with less middleman. Of course, educating the staff is costly and here is the risk of mistakes to occur if the person does not know how to use the system.

Controlling

The level of controlling should be increased. Supervision during the whole process would help with the spotting the mistakes and those could be handled faster.

7.7.5 Control

Author leaves the controlling step which includes the following to the case company. Earlier mentioned improvements are just ideas, which management can implement if they wish so. Due to improvements are not yet in use, the control is left out from this thesis.

7.7.6 Improvements with DMAIC

DMAIC is very beneficial for this case and with the help of it, the process can be improved with various ways as mentioned earlier. DMAIC is more suitable for this case than PDCA because DMAIC is more suitable for deeper investigation. PDCA is also needing to be repeated several times which is not option in case with limited timetable. For get the best possible utility from DMAIC it would require more measurements for find the correct reason behind the mismatch. Also, the follow up should be with longer-term, which is not possible with the limited timetable.

7.7.7 Challenges with DMAIC

The risk with DMAIC in this case is that the improvements are done based on assumptions. The measurements should be done properly and investigate the case until finding the real root reason for mismatch. This would be time consuming, and it would cause challenges in relatively small company where employees are already having a lot of tasks and responsibilities. But the outcome from DMAIC would be worth of the spend time.

8 CONCLUSIONS AND RECOMMENDATIONS

The founded outcomes are bringing multiple recommendation ideas for the company's future. Due to limited amount of time and other kind of setbacks, there was not time for implement the findings.

For improve the process and increase the efficiency, the kanban board should be utilized in the company. Kanban board could help management to visualize the employees' tasks and the responsibilities could be separated more easily. Time management would improve when the focus is on correct and urgent tasks.

DMAIC is bringing a lot of useful information to this case, both from data collection view as well as improvement's perspective. Company should pay high attention to the findings of DMAIC and test the improvement proposals. The changes could minimize the mismatch which would have significant impact on the customer satisfaction.

9 FINAL WORDS

For author's perspective this thesis case was very instructive and at the same time very eye opening. The used theory was challenging to internalize but as the process proceed, the theory was easier to utilize and use on beneficial way. Afterwards, new follow-up questions are coming to mind.

The goal was to implement the findings and improvements, but the schedule did not give up on that. The original timetable was late for about four months, so some parts where needed to leave out. When the process prolonged, it was challenging to keep the common thread in mind. Summertime is challenging for thesis project because the set due dates are easily postponed due to summer vacations and other reasons.

Overall, the collected data and provided outcome with the help of theories are bringing very useful tips which case company could utilize in the future. The completed study has many possibilities for continue the research as well.

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