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Understanding Performance Variation at a Goods Reception

A Six Sigma Project at a Retail DIY Company

Master's thesis in Quality and Operations Management

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SUMMARY

This study aims to investigate what factors that affect performance variation at a goods reception through the application of Six Sigma‘s DMAIC methodology. The study adopts a comparative case study design where the main site has been compared to a benchmarked site, operating under largely the same conditions.

This has been done by conducting a gemba walk to gain a better understanding of what quantitative data then needed to be collected. The quantitative data consisted of the case company’s own data. The data was then summarized and visualized using exploratory data analysis (EDA) tools, to gain a comprehensive understanding of what differed between the two sites. To explain the findings from the quantitative data, qualitative data was collected through semi structured interviews. From triangulating the quantitative and qualitative data, several root causes to why the main site performed worse than the benchmarked site were identified.

Based on identified root causes the study proposes several improvement initiatives, with the purpose of contributing to a better and mitigated performance variation. To ensure successful implementation, the study adopted a change management methodology, where the chosen tool is the Kotter's 8-step change model.

Keywords: Six sigma, DMAIC, change management, goods reception, quantity inspection, internal delivery, external delivery, in-store transporter, exploratory data analysis (EDA), gemba walk

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Sincerely,

Alex Larsson & Isak Nilsson

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Terms and Definitions

This chapter presents different terms and definitions and what they mean.

Abbreviations

DMAIC = Define, Measure, Analyze, Improve, Control

FIFO = First-in-First-out

Definitions

Quantity inspection types

- Type A: Predetermined to be quantity inspected and has been quantity inspected.
- Type B: Predetermined to not be quantity inspected and has also not been quantity inspected.
- Type C: Predetermined to be quantity inspected, but has not been quantity inspected.
- Type D: Predetermined to not be quantity inspected, but has been quantity inspected.

In-store transporter = Line-feeder

Out-store transporter = THM

Occupation board = Shows status on available and occupied spots in the store

Booking = A delivery from one supplier

Positions = Number of different article-numbers within the booking

1. Background

Recent research highlights that supply chain performance increasingly depends on efficient inbound logistics. Poor coordination and lack of visibility in inbound flows have been shown to negatively affect cost, delivery reliability and operational stability (Kalaiarasan et al., 2022). One way of identifying inefficiencies in warehouse and inbound logistics processes is the application of Lean Six Sigma methodologies, which have been shown to be effective in reducing waste and improving processes performance (Adeodu et al., 2023).

1.1 About the Case Company: Hornbach

Hornbach is a German retail company founded by Michael Hornbach in 1877 in Landau, Germany (Hornbach, n.d.-a.). At that time, Hornbach was a roofing supply warehouse. However, in 1900, Michael's son Wilhelm Hornbach expanded his father's business and transformed it into a construction materials trading business (HORNBACH Holding AG & Co. KGaA, n.d.). In 1968, Hornbach's business model was transformed again with the opening of a new store that combined a do-it-yourself (DIY) store with a gardening center, thus turning it into what it is today.

Throughout the later part of the 20th century, Hornbach started to expand its presence in Germany by opening up several new stores and being listed on the stock market (Hornbach, n.d.-a.). In 1996 the first warehouse outside Germany was opened in Austria and today, Hornbach is active in 9 different countries throughout Europe. This has resulted in the Hornbach concern becoming one of the largest actors in Europe within its chosen market, as well as being the only do-it-yourself (DIY) company that is family owned and listed on the stock market (Hornbach, n.d.-c.).

Hornbach's market strategy is to target project customers by offering their customers high quality products, large sales areas and a constant low price, across around 150 different stores around Europe (Hornbach, n.d.-b.). These stores are around 20 000 square meters big and have around 60 000 different articles, making them market leaders among this kind of store.

1.2 Problem Definition

The warehouse was previously characterized by a high level of operational performance, supported by continuous improvement initiatives and performance management practices. However, over time the organization appears to have moved away from these approaches, with reduced emphasis on follow-up activities, analytical work, and the systematic maintenance of performance standards.

At the same time, other sites within the same organization continue to operate at a high level of performance under largely similar conditions. This contrast suggests that differences in internal practices may play a significant role. Therefore, a benchmarking approach is considered relevant, as examining a high-performing site can provide insights into the factors and practices that support sustained operational performance.

The past few years of development have contributed to several operational challenges, where there are indications of inefficiency and decreased performance. The goal of the goods receptions is to be as fluent as possible and be able to inspect every incoming goods that are not damaged or any quantity faults. This suggests the importance of an analysis of the current state by identifying factors contributing to inefficiency and the decrease in performance as well as providing a guideline on how the goods reception can be changed in the best way possible.

1.3 Purpose

The purpose of the research is to investigate what factors affect performance variation at the goods reception. Additionally, the research also aims to provide an implementation plan to ensure employee buy-in, contributing to a sustainable change over time.

1.4 Scope

The organization has several warehouses, however, only one main site and one benchmarked site will be analyzed due to time constraints. The research will primarily look at how factors within and outside the goods reception contribute to its performance variation. However, only factors related to the on-site goods reception process will be investigated.

1.5 Research Questions

To fulfill the purpose of the study, two research questions have been developed, each one focusing on one specific part of it. As the initial part of the purpose is to investigate what factors affect the performance variation at a goods reception. The following research question was developed:

RQ1: What factors affect performance variation at the goods reception?

However, as the study also aims to provide the reader with an action plan describing how the causes that affect the performance variation can be mitigated, while at the same time ensures employee buy-in and thereby contributing to making the improvement suggestions sustainable over time, the following second research question was developed:

RQ2: What actions can be taken to mitigate the causes of performance variation?

1.6 Disposition

This chapter will present and give a quick overview of the disposition of the report. The disposition is shown in Figure 1.

Figure 1: Disposition of the report

In chapter one, the background to the study is presented. It will cover topics such as information about the case company, the purpose and the scope of the report. Furthermore, this chapter also includes the research questions.

In chapter two, the theoretical background of which the study is based upon is presented. This chapter included relevant topics such as Six Sigma, DMAIC, gemba walk, Exploratory Data Analysis and Change Management.

In chapter three, the methodology of the report is introduced. It provides an outline of how the report has been conducted and shows how the research quality has been attained. This chapter

also presents critical aspects such as how the report has been conducted in an ethical way, and to what extent AI has been used.

In chapter four, the results from the qualitative and quantitative data collection processes are presented and analyzed. Additionally, the chapter ends with the presentation and its analysis of the identified root causes affect/influence performance variation at the goods reception.

In chapter five, results and analysis are discussed in the form of the DMAIC cycle and connected to each phase. The chapter ends with the final causes that affect performance variation at the goods reception as well as what actions can be taken to mitigate these causes that are discussed with respect to the theoretical framework.

In chapter six, the conclusion of the study is presented. In this chapter, the research questions are answered and the theoretical and managerial implications are discussed. Additionally, the researcher's own reflections are presented and further studies suggested. The chapter then ends with a discussion regarding the study's contribution to existing research.

2. Theoretical Framework

In this chapter, the theoretical framework based on relevant literature and previous research is presented. The chapter introduces the theories, concepts, and methodologies applied throughout the study.

2.1 Inbound Logistics

According to Smith and Srinivas (2019), a typical inbound logistic flow usually consists of a structured sequence of processes in a number of steps. The first one being the truck's arrival at the gate followed by the truck being administratively processed. Here relevant information such as arrival time and shipment number is recorded. The final stage of the inbound logistic process is unloading. The performance of these processes is usually measured in processing time, truck waiting time, unloading time and number of gates available for the truck to be unloaded at. The facility has to manage these processes for a variety of deliveries, as the trucks will vary in both sizes as well as ownership.

Another aspect that Smith and Srinivas (2019) highlight as an important area to take into consideration is the type of unloading process that is performed. Depending on what type of processes it is, it will require different amounts of time and will therefore impact the performance measure. They further emphasize that one of the reasons why companies want to minimize the inbound processing time is that they only have a set amount of time to unload the trucks. This time is called “free time” and is negotiated with the trucking company beforehand. If the company were to exceed the free time, the trucking company may demand an extra fee, called “detention fee”, since their trucks have been standing at the company too long.

When managing and finding ways to improve inbound logistics, Baller et al. (2022) mentions multiple existing constraints and are therefore important to take into consideration. These constraints are linked to both inbound logistics and also the goods reception, where they mentions “the available number of storage places, capacity of goods reception, delivery profile and transportation pattern constraints, truck utilization, demand satisfaction, and the reverse flow of empty load carriers” as important factors and changes in these have an impact on total logistics cost.

2.1.1 Lean Logistics

The main purpose of lean logistics is to think of the perspective of what creates value for the customer (Jones et al., 1997). Otherwise, it may be seen as waste since it is seen as a cost but no value. According to Jones et al. (1997) there are "... seven common forms of waste, activities that add cost but no value: production of goods not yet ordered; waiting; rectification of mistakes; excess processing; excess movement; excess transport; and excess stock." (s. 154). Instead of analyzing individual departments it is important to consider the whole value chain. By focusing on the whole chain it is possible to avoid improving single units or departments which often result in longer lead times.

2.1.2 Logistic Flow

Oliveira et al. (2022) describes the importance of a goods reception process to make the flow more agile and reduce throughput times resulting in reduced costs. However, an inefficient warehouse system could prevent products being smoothly transferred to customers. Oliveira et al. (2022) states that "Therefore, maintaining an efficient flow of the inventory from the warehouse is a crucial task and efficient management of the warehouse system chain" (s. 3).

2.2 Warehouse Management

According to Oliveira et al. (2022) warehousing is an important part of the supply chain, where it makes it easier for organizations to control fluctuations in market demand better. Warehouses are described as a great solution for usage of storage and recovering products to redistribute to other customers. Although these are beneficial strategies of utilizing warehouses, the main function is to receive and put away into storage.

According to Guimarães et al. (2022), "The sustainability of industries depends on the performance of its supply chain and a balance between responsive and efficient warehouse operation" (p. 64). The authors further emphasize that logistical processes rely on efficient information flows, highlighting the importance of integrating information systems that provide accurate, real-time data. This information availability is important for coordinating goods receiving and other internal material handling processes, where poor information flow may lead towards inefficiencies and increased operational costs.

2.2.1 Training Flexibility

Workforce flexibility enables organizations to adapt to resource allocation depending on operational demand (Hopp & Oyen, 2004). However, Hopp and Oyen (2004) explains that employee flexibility is limited by competence requirements and cost. They further describe that cost of skill acquisition, including training time and resources, lower the level of cross-training. As a result, organizations risk being dependent on specific employees with specialized competencies.

2.2.2 The Goods Reception Process

The goods reception process is a crucial operation since this process ensures the right product has been delivered (Richards, 2017). This process also controls the quality of the product as well as making sure the right amount has been delivered. He further argues that once the goods have been delivered to the goods reception, little can be done to correct a problem if one has occurred.

The results of Baller et al. (2022) show that limitations in the good reception process have a significant impact on total logistics costs, which motivates further research in this area. They further indicate that adjustments in goods reception capacity can lead to substantial cost changes and highlight the importance of aligning delivery patterns with goods reception capacity to avoid inefficiency and increased costs. Richard (2017) emphasizes that 48-60% of a warehouse total cost comes from labour cost, and that the in-handling process alone represents 20% of the total labour cost.

Richard (2017) states that 80% of a company's inbound problems are caused by only 20% of its suppliers. Because of this, he states that it is important to constantly monitor the performance and develop mechanisms that detect if suppliers start to deviate from agreed upon quality standards. He further argues that no company wants to deliberately underperform, therefore it is more beneficial to work with the supplier to fix the problem, since they probably aren't unaware of how their actions affect the company's operation. In addition to this, there are no universal rules for what type of pallet that should be used, meaning it is hard to optimize the storage of pallets inside the warehouse.

2.2.3 First-In-First-Out

The study by Smith and Srinivas (2019) presents that most studies adopt a FIFO queuing system after accepting the goods. Smith and Srinivas further emphasize that this strategy might not be optimal to decrease long turnaround times, due to variation in service time across different loading or unloading procedures.

2.3 Six Sigma

According to Schroeder et al. (2008), Six Sigma is a methodology developed by Motorola in 1987, that helps organizations to control improvement process initiatives by only allowing for 3.4 ppm defects. They further define six sigma as "... an organized, parallel-meso structure to reduce variation in organizational processes by using improvement specialists, a structured method, and performance metrics with the aim of achieving strategic objectives" (p. 540).

Additionally, they argue that the Six Sigma methodology enables organizational ambidexterity by providing the organization with a structural framework that allows them to balance exploratory activities with control in improvement initiatives. Furthermore, Harry and Schroeder (2000) describe Six Sigma as a "business process that allows companies to drastically improve their bottom line by designing and monitoring everyday business activities in ways that minimize waste and resources while increasing customer satisfaction" (p. vii). Blakeslee (1999) described Six Sigma as a "high-performance, data-driven approach to analyzing the root causes of business problems and solving them" (p. 78), while Uluskan (2016) defines it as "Six Sigma is an advanced self-control process that aims to produce or deliver near-perfect products and services" (p. 406).

Uluskan further emphasizes that Six sigma can be seen as a tool box and that the application of specific tools and techniques are a key ingredient to achieving a successful result. He further mentions that some of the most used tools are control chart, histogram, cause-and-effect, flow chart, relationship diagram and Pareto diagram, whereas some of the most common techniques are design of experiment (DOE), statistical process control and failure mode and effects analysis (FMEA).

2.3.1 DMAIC

Many organizations strive towards improving process performance and product quality in order to achieve financial and strategic goals, as well as increased market shares, competitiveness and profitability (Wang et al., 2025). According to Schroeder et al. (2008) six sigma uses the DMAIC method containing five stages: define, measure, analyze, improve, and control. Wang et al. (2025) further describe the DMAIC as a method that has been examined in several different industries and organizations. They state that, "DMAIC identified and resolved quality concerns, reduced process cycle time, increased productivity, and improved operational efficiency" (p. 539).

The first phase of the DMAIC methodology is the Define phase, which according to Tsarouhas and Sidiropoulou (2024) is regarded as the most critical phase. During this phase, the scope of the improvement project is established by identifying the key problem that needs to be addressed, as well as the customer needs.

The second phase of the DMAIC methodology is the Measure phase, in which the current performance of the process is measured in order to establish a reference point (Tsarouhas & Sidiropoulou, 2024). During this phase, the process under investigation is translated into measurable terms in order to be able to analyze it.

This phase is followed by the Analyze phase, which purpose is to identify and verify the underlying root causes behind the problems within the selected process (Tsarouhas and Sidiropoulou, 2024).

The penultimate phase of the DMAIC methodology is the Improve phase, which aims to improve the process by addressing the problem (Tsarouhas & Sidiropoulou, 2024). This by developing and implementing appropriate solutions that target the root causes causing the problem, ultimately leading to an improved process performance.

The last phase of the DMAIC methodology is the Control phase, which according to Tsarouhas & Sidiropoulou (2024) aims to sustain the improvements achieved in the Improve phase by stabilizing the improved process and embedding it within the organization. This to ensure that the increased process performance is maintained over time. However, sustaining these improvements over an extended period of time can be difficult, as organizational factors such as employee turn over can cause problems.

2.4 Control Chart

Control charts are a central tool within the DMAIC methodology, particularly in the Analyze and Control phases, as they allow for continuous evaluation of the process (Montgomery, 2009). Control charts are designed to detect uncommon activity. As demand for high quality processes increases has led towards a growing interest in their application and further development (Novin et al., 2025). This has become a useful tool for measuring the time between events (TBE) when analyzing rare events.

One main purpose of control charts is to determine whether variation in a process is natural or caused by a specific problem. Some variation is caused randomly that are known as common cause variation and others are from identifiable factors. Control charts help distinguish between these variations. According to Novin et al. (2025), TBE control charts require two key components to be defined: the concept of time and the definition of event. Time can be measured either discreetly or continuously, while events may be classified as positive or negative depending on what the target values are.

2.4.1 Different Control Charts & Patterns

There are different control charts depending on what factors need to be assessed and evaluated (Montgomery, 2009). Firstly, there is the R chart which illustrates within what range the process operates, by highlighting how the process fluctuates over time. Then there is the s chart, which similar to the R chart can be used to illustrate the process variation over time, by assessing the standard deviation of the process. Lastly, there is the $\bar{x}$-chart that evaluates the process average value. By combining these charts, it provides a comprehensive and structured way of evaluating the performance of the process and determining if the process is stable or not.

In addition to these three common control charts, there are also two other types of control charts that often are used together (when subgrouping is not possible) called Individuals and Moving range control charts (Montgomery, 2009). The Individuals control chart is used to monitor the process mean, meaning that a change in the mean would alter the data point or points so that they may fall outside the control limits. A typical behavior for the Individuals and Moving range control charts is that if there is a data point located outside the control limits, often caused by a high mean value, the Moving range control chart will typically also show it. However, this typically does not mean that the process variation is unstable, but rather that the mean is.

By analyzing the different control charts and finding different patterns, information regarding the process performance and stability could be obtained, and used to improve it (Montgomery, 2009). However, firstly before analyzing the $\bar{x}$-chart, it is necessary to analyze its corresponding R chart in order to see if the process is stable. If the R chart appears to be unstable, the $\bar{x}$-chart should not be analyzed. Instead, the assignable causes that show up for both charts should be removed from the R chart, since it typically removes the nonrandom pattern from the $\bar{x}$-chart.

Once the R chart has been analyzed and it has been determined that the process is stable, further analysis of where patterns are identified can take place, where some of the patterns that could be found are trends, stratification, cyclic patterns, mixture and shift in process level (Montgomery, 2009).

2.4.2 Control Limits

A control chart is usually used in statistical process control (SPC) and shows the average value of samples collected from the process over time, allowing monitoring of process stability (Montgomery, 2009). The control chart contains a center line (CL), upper and lower control limits (UCL and LCL) seen in Figure 2. Where the center line represents the typical value of the process when it operates under normal conditions without unusual variation and control limits are calculated by using statistical methods. When unusual sources of variability occur, values will be shown outside the control limits. This indicates that there needs to be research about the event to correct and remove the unusual source of variability.

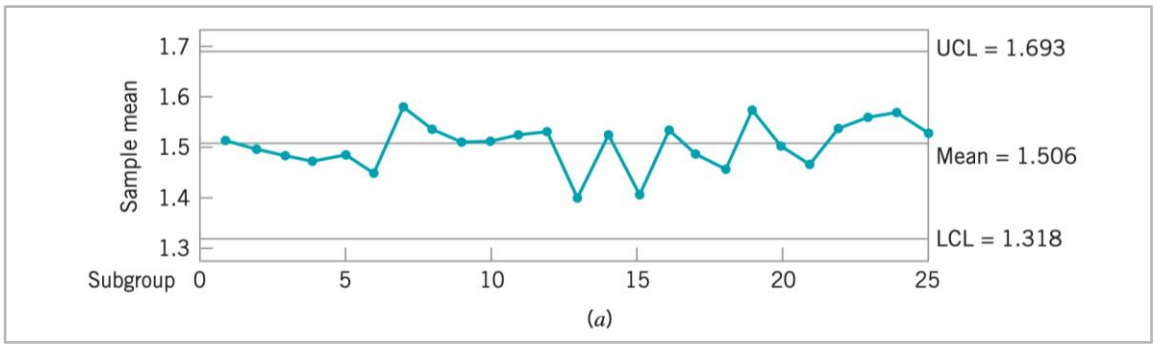

Figure 2: Visualization of a control chart (Montgomery, 2009, Fig 6.4, p.236)

2.4.3 Specification Limits

According to Montgomery. (2009) "Quality characteristics are often evaluated relative to specifications" (p. 8). The measurement value that represents the deserted level of a quality characteristic is referred to as the nominal or target value. These target values are often

surrounded by an acceptable range of values that are considered close enough to the desired level and will not be considered to impact performance negatively if it lies within that range. The two acceptable characteristics are called upper specification limit (USL) and lower specification limit (LSL). However, some quality characteristics consist of specification limits on one side of the target.

2.5 Gemba Walk

Gemba is a concept explained by Liebengood et al. (2013) as the place where value-added activities happen. The gemba walk is a method used by management to see this themselves to identify problems and fully understand the issues. Liebengood et al. (2013) further emphasizes gemba walk as an approach that has been proven to be a successful management tool. In contrast to single observation this concept also allows management to understand the value stream, discover waste and identify problems.

2.6 Exploratory Data Analysis

Exploratory Data Analysis (EDA) is used to evaluate a data set to understand its structure, quality and main features before using a formal statistical model (Chatfield, 1986). An example of understanding the data set, Chatfield mentions graphs such as histogram, scatter plots, stem-and-leaf plot, box plot and time plot. According to Chatfield (1986) "...in broad outline it includes checks on data quality, the calculation of summary statistics, the plotting of appropriate graphs, and perhaps the use of more complicated data-analytic techniques such as principal component analysis" (p. 5-6).

Furthermore, Chatfield (1986) explains EDA as something that should be integrated into the overall statistical analysis and model building process. Meaning, EDA is not something that is conducted and then forgotten, it should guide and support the choice and validation of the statistical model. Lastly, the graphs and tables that are generated to present the results should be clear and easy to understand. This means that they should include clear titles and labels, as well as use an appropriate number of digits.

According to Chatfield (1986), EDA contains of two purposes, data description and model formulation. Data description is used to summarize the data and identify the main features to understand its key characteristics before doing further analysis and model formulation means

generating hypotheses, deciding what kind of model to use and choosing a fitting statistical procedure. However, in some cases Chatfield says, describing and summarizing the data is enough. Especially when the data is too poor for formal testing or population data is completed so statistical inference is not necessary.

2.7 Ishikawa Diagram

According to Liliana (2016), the Ishikawa diagram is used in many organizations to analyze problems and take practical actions by identifying the root cause. As a result of this tool management and leaders are able to improve quality within their operations. This is a diagram-based technique used to systematically identify causes of problems and support thorough analysis by structuring the investigations into four main steps: Identifying the problem, determining the major factors involved, identifying possible causes and analyzing the completed diagram. Causes are often further categorized into different groups such as people, methods, machines, materials, measurements and environment, which helps identify different sources of variation of a process.

2.8 Theory of Constraints (TOC)

Pegels & Watrous (2005) highlights the purpose of theory of constraints (TOC) to identify the weak link at an organization and being able to improve it until it isn't a limited factor anymore. Pegels & Watrous (2005) further states "...no matter how strong the chain has become, it will always have at least one link that is not quite as strong as the others." (s. 303). TOC could therefore be seen as a continuous improvement process, since after an improvement initiative is made there will always be another factor being the weakest link.

2.8.1 Bottleneck

A Bottleneck is an operation that is not capable of performing at the required level of the throughput time (Pegels & Watrous, 2005). As a consequence, these operations often contain work-in-process (WIP) inventory. According to Pegels and Watrous (2005), these situations specifically occur during "busy periods".

2.9 Change Management

According to Kotter (2007), companies go through a series of change processes which takes a considerable long time to go through while conducting their change initiative. He emphasizes that skipping a step or making crucial mistakes in them, only create the illusion of gaining time and can have a considerable bad effect on the ending result and ultimately slow down the change initiative.

2.9.1 Kotter's 8 Step Model:

To address these challenges, Kotter (2007) proposes an eight-step model containing a sequential process that helps guide the company through the change initiative in order to ensure a successful change initiative. The sequential model includes Establishing a sense of urgency, forming a powerful guiding coalition, creating a vision, Communicating the vision, Empowering others to act on the vision, planning for and creating short term wins, Consolidating improvements and producing still more changes and lastly Institutionalizing new approaches.

Step 1: Establishing a Sense of Urgency

Kotter (2007) further emphasizes that, although the first step sounds straightforward compared to the others, more than half of the change initiatives fail at this initial step. Furthermore, he argues that in some of the most successful cases, a crisis has been deliberately engineered. Kotter provides examples of how CEOs deliberately have engineered accounting losses or sent out customer surveys, knowing they will receive negative results. This to ensure that a critical mass of the company's management recognizes that the current way of operating the business is unsustainable and requires a change, which he believes is 75 %. Butt et al. (2016) emphasizes the importance of including stakeholders in the beginning of the first stage.

Step 2: Forming a Powerful Guiding Coalition

The second step is according to Kotter (2007) forming a powerful guiding coalition. This process usually starts small with only one to two people but needs to expand early in the change initiative to gain sufficient influence and reach a critical mass in order to build the necessary momentum to sustain the change initiative. For larger organizations the initiative needs to grow

up to 20-50 people, with senior management making up the core, but other big stakeholders can also be found.

Kotter further emphasizes that successful change initiative requires an active and involved top management. Meaning that the chairman, the president or the division general manager needs to come together with another 5-50 people in order to establish a shared commitment to the change initiative. Although it is common that not all senior management will buy in at first, the coalition usually consists of employees with powerful titles, expertise, credibility and powerful connections. While it is possible to make progress even without a strong coalition, these efforts are rarely sustainable, due to the fact that the people opposing the change manage to undermine the initiative.

Additionally, a strong sense of urgency among the senior management can help create the coalition. However, this is usually not enough and additional effort is needed to form the coalition and help its members to align behind the change initiative, like an off-site retreat.

A common reason why this stage fails is that companies underestimate how hard it is to drive change initiative through and thereby do not create a powerful enough coalition. Sometimes companies even delegate the responsibility to lead the coalitions to staff executives rather than a key line manager. This limits the coalition's effectiveness since its leaders lack the necessary authority and influence.

Step 3: Creating a Vision

Kotter (2007) emphasizes that in successful change initiatives it's important to have a clear and compelling vision. This vision helps show in what direction the organization needs to move in order to evolve and is developed by the guiding coalition to attract positive attention from all stakeholders.

Additionally, the first draft of the vision is usually created by a single individual with vague details but refined over time by the guiding coalition to create a concrete vision and a way for reaching it. Unlike the company’s normal planning document, the vision goes beyond numerical targets and instead focuses on aligning the organization so that the different departments don’t pull the change initiative in different directions and thereby don’t align or produce the intended result.

Furthermore, Kotter emphasizes that it is really important that the vision is simple and easy to communicate with the employees in order to engage their support and interest. He states that there needs to be a clear statement of where the change initiative is heading, not just stating all the procedures, goals, methods and deadlines. Lastly Kotter (2007) states "A useful rule of thumb: If you can't communicate the vision to someone in five minutes or less and get a reaction that signifies both understanding and interest, you are not yet done with this phase of the transformation process." (p. 99-100).

Step 4: Communicating the Vision

According to Kotter (2007), a common reason why change initiatives fail is that the vision is often under communicated by a factor of ten. Without effective communication, the employees will never truly engage in the change initiative. As he states, "Transformation is impossible unless hundreds or thousands of people are willing to help, often to the point of making short-term sacrifices." (p. 100). Effective communication is critical, as it ensures that the right information reaches the right stakeholder at the appropriate time, while ensuring a clear understanding of the project's outcomes (Butt et al., 2016). Kotter (2007) further emphasizes that even though the employees are dissatisfied with the current situation, it is still a challenge to encourage them to make these commitments unless the employees believe that meaningful change is achievable, especially if the change initiative involves consequences such as downsizing.

To avoid the mistake of under communicating the vision, Kotter (2007) suggests an approach where leaders should make extensive use of all the existing communication channels to communicate the vision to the employees. These communication efforts can range from integrating the vision into their daily activities, clarifying how the employees' actions either encourage or undermine the vision and explicitly communicating how the proposed solution aligns with organizational goals to transform company newsletters into dynamic articles that promote the vision, turn quarterly meetings to engaging and interactive discussions centered around the change initiative. However, Kotter emphasizes the most important factor is that the leader should lead by example, since he believes actions often are more powerful than words.

Step 5: Empowering Others to Act on the Vision

As the process is progressing it is important to involve people where they will be encouraged to take action to try new approaches, develop new ideas and show signs of leadership, this will

indicate towards a successful transformation (Kotter. 2007). Kotter further explains simple communication can result in a guiding coalition that empowers others into taking actions. However, communication itself will not be enough, it will also require removing obstacles which may arise.

Kotter mentions there too often are employees understanding the vision and want to make it happen, but obstacles are there preventing it from happening. Obstacles could be in the organizational structure, where narrow job categories can affect productivity negatively or make it difficult to have a customer focus mindset. Furthermore, if rewards and evaluations are not aligned with the new strategy, employees might choose what helps them personally and ignore the vision.

At last, Kotter. (2007) mentions that "In the first half of a transformation, no organization has the momentum, power, or time to get rid of obstacles. But the big ones must be confronted." (p. 102). Whether the obstacle is a person it is important to treat the person fairly and consistent with the vision. However, Kotter also mentions that action is crucial, to both support people and maintain credibility of the change initiative.

Step 6: Planning for and Creating Short-Term Wins

Real transformation takes time, therefore it is important to introduce short-term goals, otherwise there is a risk of losing momentum due to the lack of limited evidence of progress. Kotter explains there is a higher risk of conceding or joining the resistant force without introducing short term goals into a change initiative. In indication when a meaningful organizational change has happened is when quality, profit, market share, productivity or customer satisfaction has improved, which also provide numeric proof.

Kotter. (2007) mentions in his article "In a successful transformation, managers actively look for ways to obtain clear performance improvements, establish goals in the yearly planning system, achieve the objectives, and reward people involved with recognition, promotions, and even money." (p. 102). According to him, managers have a negative attitude about being forced to produce short-term wins, however he states that it can be useful in order to make a change. Furthermore, Urgency level can drop when people realize major changes take time, short term will be enough to keep the right urgency level and create analytical thinking.

Step 7: Consolidating Improvements and Producing Still More Changes

The second to last step is according to Kotter (2007) to not declare the change initiative as completed as soon as the first performance improvement is achieved. This is because it can take between five and ten years for the changes to become embedded within the organization's culture. Kotter emphasizes that new approaches are prone to revert to old practices, meaning that declaring the change initiative as completed too soon can have devastating effects. Additionally, declaring it completed too soon can destroy the momentum of the change initiative and cause organizations to fall back into old routines.

Kotter (2007) further emphasizes that declaring the change initiative as completed too soon is usually caused by both supporters and opponents to the change, as supporters want to celebrate the improved performance, which the opponents see as an opportunity to stop the change, by declaring the increase in performance as that the change initiative has been completed. Causing the individuals driving the initiative to relax, resulting in a declining momentum and thereby the change initiative comes to a stop.

According to Kotter (2007), leaders that have driven successful change initiatives use the credibility that the short-term wins have awarded them to go after even bigger problems than the initial ones. Furthermore, these successful leaders understand that change initiatives take years and Kotter illustrates this by giving an example where the most significant change occurred several years after the first visible success occurred.

Step 8: Institutionalizing New Approaches.

The final step in Kotter's (2007) model is institutionalizing new approaches. This is achieved by anchoring the new change initiative so far into the organization that it becomes the new norm for how to operate within the organization. In order to achieve this, Kotter suggests that the organization must focus on the following two factors.

Firstly, the organization has to explicitly highlight how improved performance connects with the change initiative and thereby prevent employees from drawing the wrong conclusion Kotter's (2007). Kotter highlights the importance of communication in this step and ways of doing this could be by showing it in the company newsletter or discussing it in meetings.

Secondly, the organization needs to be very careful with how they conduct the leadership succession, since according to Kotter (2007) “One bad succession decision at the top of an organization can undermine a decade of hard work.” (p.103). Therefore, the new succession of leaders must truly believe in and embody the change, otherwise there is a high risk that the change initiative never truly takes its roots in the organization and therefore reverts to the old ways.

3. Methodology

During this chapter, the research design, the data collection process, the research quality and the sampling strategy used will be introduced and presented.

3.1 Literature Search Strategy

During the literature search strategy, the PRISMA model has been used as a framework to decide which articles to include. According to Moher et al. (2010) does this method contain an identification, screening, eligibility and included stage. At the beginning of the identification phase, a systematic literature search was conducted in Google scholar, ScienceDirect and Chalmers Library using keywords (such as Six Sigma, inbound logistics, warehouse and so on) and Boolean operators. In addition, a manual review of the reference lists of the included studies was conducted, resulting in identifying two additional relevant sources.

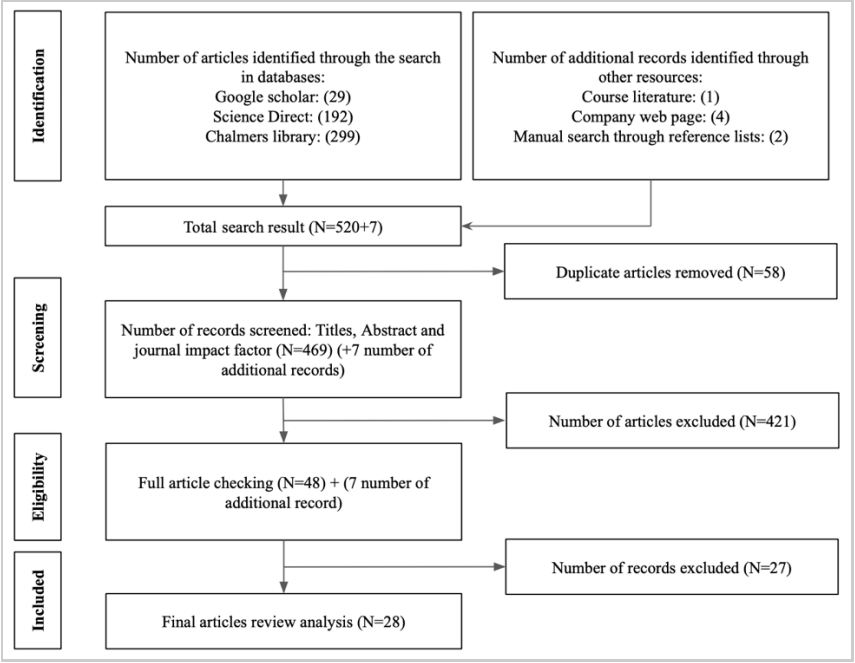

Figure 3: PRISMA Chart

The search was limited to peer-reviewed articles and literature. During the screening phase, titles and abstracts were screened for relevance to the research. Articles that were unrelated to the research were excluded at this stage. In this phase, the journal in which the articles were published were checked for its impact factor and screened based language. If the impact factor

was below 1.5, the article was excluded. Moving forward to assessing full-text articles for eligibility.

Studies that resulted in not addressing the research or lacked sufficient theoretical detail were excluded. A total number of 28 articles met the inclusion criteria and were therefore included in the research. This methodology has been chosen to increase the quality of the gathered knowledge, which the results and discussion later on will be based upon. This since it allows for a thorough screening of articles, screening out irrelevant, low quality and duplicate articles, resulting in a greater number of higher quality papers. Additionally, previous course literature from relevant courses such as change management has also been used.

3.2 Research Design

In the literature by Bell et al. (2022), research design is referred to as a framework for the collection and analysis of data. Choosing a research design involves deciding about the primary aims and priorities of the study. Common types of research design include experimental design, cross-sectional or social survey design, longitudinal design, case study design, and comparative design.

This study adopts a comparative case study design which according to Bell et al. (2022) is an add-on to the case study design, which lets the researcher compare two or more cases against one another to find factors that are either common or differentiate them from each other. Bell et al. (2022) further emphasizes that this variant of research design can be both of the quantitative and qualitative nature.

3.2.1 Chosen Research Method

According to Bell et al. (2022) there are three different approaches to how a data collection process can be conducted, either through a quantitative, qualitative or mixed methods approach. This study adopts a mixed method approach, which Bell et al. (2022) describe as an approach that combines qualitative and quantitative research strategies. They argue that a mixed methods approach enables triangulation between the two research methods, whereby one method could be used to explain the findings generated by the other research strategy.

They further emphasize that there are four different approaches to how the methods can be combined, where two of them are Exploratory sequential design and Explanatory sequential

design. The first one being the Exploratory sequential design which is when qualitative data collection precedes the quantitative data collection. This approach can be used to increase the generalizability of the qualitative findings, generate and validate hypotheses as well as develop data collection tools. In contrast, Explanatory sequential design is where firstly, quantitative data are collected and analyzed and followed by the collection and analysis of qualitative data to explain the findings from the quantitative data.

Furthermore, this study adopts a combination of the Exploratory- and the Explanatory sequential design, as qualitative methods were initially utilized to get a better understanding regarding how the goods reception operated and acted like preparation for the quantitative data collection process. Following this, the traditional Explanatory sequential design was utilized, where quantitative data first was gathered and analyzed, followed by the collection and analysis of qualitative data to explain the findings from the quantitative data.

3.2.2 Abductive Approach

Since the study adopts both an Exploratory and Explanatory sequential design, the study includes both inductive and deductive elements. As the research aims to explain the quantitative data by utilizing qualitative data to find the patterns and the reasons why the quantitative data looks as it does, the study constantly moves between theory generating and theory testing, resulting in the research is of the abductive nature.

3.2.3 Tools

Additionally, as the study aims to understand performance variation at a goods reception, the study has adopted the Six Sigma methodology, as Schroder et al. (2008) argues that this methodology is aimed at reducing variation. Especially the DMAIC approach was utilized as it allows the research to be split into the different phases within the DMAIC cycle.

The study therefore begins with defining the problem, followed by measuring the defined problem at both sites to get a better understanding of the current situation. The collected data are thereafter analyzed, before improvement suggestions are generated and an implementation plan crafted, to ensure a stable process and that the improvement suggestions are embedded into the organization. To ensure the last phase of the DMAIC cycle, the control phase will take

a change management approach, where Kotter's 8 step model will be applied to devise the implementation plan.

3.3 Data Collection

Bell et al. (2022) argues that there are three different approaches to how data can be collected, either through a quantitative, qualitative or mixed methods approach where the two other approaches are combined.

As this study adopts a mixed methods approach, both quantitative and qualitative data were collected, where the quantitative data consisted of the organization's own data records, containing the performance of each site, whereas the qualitative data collection process consisted of observation, unstructured interviews and semi structured interviews.

3.3.1 Quantitative Method

Bell et al. (2022) emphasizes that a quantitative approach focuses on collecting numerical data that could be analyzed statistically and used in a deductive way to test the study's hypotheses or answer its research question. This approach is usually standardized in the way that data is collected consistently across all cases, to ensure that there are minimized errors caused by differences between researchers and respondents.

Quantitative data collection plays a crucial role in the measure phase of the DMAIC cycle, as relevant numerical data regarding the performance of the goods reception at the two sites needs to be gathered in order to provide valuable insight into how much better the benchmarked site performs than the main site. Relevant data regarding the performance included received volume, lead times, worked hours and the rate of which quantity inspections are adjusted. Additionally, quantitative data provides the foundation for comparing the sites and is the basis for which the analysis is based upon to identify similarities and differences between the sites.

A quantitative tool that will be used to visualize and analyze the collected data is Exploratory Data Analysis (EDA). The utilization of EDA tools will provide the study with a deeper understanding of the characteristics and the quality of the collected data. Additionally, it will be used to determine what other types of statistical tests could be done with the data collected, but also what aspects of the collected data that were of too bad quality/or missing and therefore needed to be recollected. The EDA process will begin with the generation of tables and graphs,

highlighting and comparing the current state of two different sites and the important KPIs for this thesis. Followed by the generation of graphs such as control charts and histogram to highlight the differences between the sites, their performance variations and how close they are to their targets.

3.3.2 Qualitative Method

Qualitative research design places a lot more emphasis on words rather than on numbers compared to a quantitative approach (Bell et al., 2022). This approach tries to understand how people interpret and experience the world and is therefore by nature more inductive than deductive, since the theory evolved through the gathered data and not tested against it. This method will be used in order to find the root causes to why the benchmarked site performs better than the main site.

According to Liebengood et al. (2013), gemba walks are a useful method to gain a better understanding of what the problem is. The qualitative data collection process therefore began at its earliest stage of the project in the Define phase of the DMAIC cycle with three days of gemba walk at the main site. Here information regarding how the goods reception operated was gathered through observation and unstructured interviews with the employees. The employees ranged from front line employees to the group leader and even head of department. After the gemba walk, the collected information was analyzed and a problem definition was formulated. Additionally, a mapping was constructed by the authors to gain an overview at the goods reception and was developed to provide a comprehensive overview of its layout. However, it was excluded from the report due to confidentiality.

This was followed by a one day visit to the benchmarked site, in order to get a better understanding of how their goods reception operated and what differentiated them from the main site. During the gemba walk, unstructured interviews were conducted to get their perspective of why their goods reception operates at the performance it does.

Bell et al. (2022) emphasize that semi-structured interviews can be utilized to allow theories to emerge from the collected data, as it enables the researcher to remain open to new insights. Therefore, to gain a better understanding of the differences between the sites, to validate the findings from the gemba walk and the quantitative data analysis, and to further identify more

root causes regarding why the main site's performance, in comparison to the benchmarked site, semi structured interviews were conducted.

The interviews included employees working at the main site and ranged from front line employees working at the goods reception to the head of department (see Table 1, for more information regarding the interviews). Additionally, as the study adopts a change management approach, the employees' attitude towards change was also examined to identify a possible and suitable change agent to be in charge of the implementations of the findings of this report.

Interviewee	Interview 1	Interview 2	Interview 3	Interview 4	Interview 5	Interview 6
Date	12/3-2026	4/5-2026	5/6-2026	7/5-2026	7/5-2026	12/5-2026
Duration	25 min	48 min	27 min	58 min	27 min	25 min

Table 1: Summary of interview statistics

3.4 Research Quality

According to Bell et al. (2022), there are three main areas that need to be taken into consideration when evaluating a study. These three main areas are Replicability, Validity and Reliability. However, they also emphasize that other areas are important as well, such as trustworthiness and ethical aspects.

3.4.1 Validity

Bell et al. (2022) describe validity as a measure of how true and accurate the conclusions of the research are, in relation to what the research has actually found. Furthermore, they emphasize that validity is one of the most essential quality criteria.

They further point out that there are four different types of validity with the first being measurement validity. This factor describes if the research actually captures what it is intended to measure. They also emphasize that a measure of an unreliable process cannot be valid, making it closely related to another quality criterion, reliability (Bell et al., 2022).

The second factor is internal validity and is concerned with the causal relationship between two variables, and whether one variable actually is responsible for the causes of variations or deviations observed in the other variable. The third factor, external validity, relates to what degree the study is applicable to other contexts than what the study was conducted in. Because of this, representative samples are considered important quantitative research.

The final factor is ecological validity and refers to how well the gathered information reflects the real-world setting being studied. If the information is gathered in a way that is unnatural for the studied group, the study's ecological validity is reduced.

To ensure a valid result, every part of the data collection process has thoughtfully been planned, in order to increase the validity of the study. To ensure a high measurement validity, the studies research questions have been taken into consideration in every part of the process.

Additionally, to increase the internal validity of the study, gemba walks were initially conducted to gain a better understanding of how the different processes were interrelated. This was followed by quantitative data analysis, which highlighted the differences between the sites and provided some potential explanations for these differences. The following interviews were conducted to identify further explanations, as well as to explore and verify the potential explanations from the quantitative data analysis. As a result, all the collected data was triangulated with one another.

During the qualitative data collection process, employees with different experience, competencies and roles were interviewed to better capture different perspectives and thereby generate more representative findings, strengthening the external validity of the study. Furthermore, as the goods receptions are largely the same between the different sites within the organization, the generalizability of the findings may further be enhanced, especially within the organization.

By observing the studied group in their natural environment during several occasions, their actual working behavior was captured, leading to an increased ecological validity. On the contrary, something that may have contributed to a lower ecological validity were that the interviews were held in a separate room, and thereby not the studied groups natural environment. However, this was intentionally and necessary in order to ensure confidentiality and allow the participants the possibility to share their feelings and thoughts freely.

3.4.2 Reliability

Reliability refers to how consistent the research findings are. It examines whether a study would obtain similar results if it were conducted again under the same conditions (Bell et al., 2022). Because of this, they emphasize that reliability is particularly important when conducting quantitative research, since if the same measurement shows different results each time, the results would not be considered trustworthy and the measure would therefore be regarded as unreliable. They further emphasize that there are three different factors that determine how reliable the measure is. The first factor is Stability, which measures how many fluctuations there are between two identical tests, taken at two separate times. If there is little variation between two identical tests, the measure is considered to be stable. The second factor is Internal-reliability, which examines how well the measurements regarding the same topic correspond to one another. This means that it assesses how well answers to different questions but within the same topic correlate with each other. If the answers correlate to a high degree, the internal-reliability is considered to be high. The last factor is Inter-rater reliability, which refers to how consistently different people interpret, categorize or observe the same data. For example, if two researchers interpret the same open-ended response in two different ways, the inter-rater reliability is considered low.

To ensure a high level of reliability, the authors have taken these factors into consideration throughout the designing and execution of the study. Firstly, all the quantitative data that has been used during this study has been collected from the organization's database and originates from a time period that has already occurred. As the dataset was provided by the organization, the authors did not generate or modify any datasets, ensuring that it reflects the organization's actual process. This means that other researchers can analyze the same dataset and draw comparable conclusions, which increases the stability factor within reliability.

Secondly, all the interviews were analyzed to assess the consistency of each interviewee's answers across different questions within the same topic, in order to evaluate internal reliability. Lastly, in order to ensure high inter-rater reliability, all interpretive aspects of the collected and generated data were discussed among the researchers to create a shared understanding and agreement regarding how the data should be interpreted.

3.4.3 Replicability

To provide other researchers with the opportunity to verify the study, Bell et al (2022) emphasizes that the study must be replicable. They further emphasize that in order for the study to be replicable, the authors of the study must have documented how the research has been conducted, as otherwise it would not be possible.

To ensure that other researchers have the possibility to replicate the study, all the procedures, techniques and tools that have been used to conduct the study have been documented in the thesis. Additionally, the number of observations as well as number of interviews and its corresponding questions are included, as well as how the articles on which the theoretical background is based upon, have been found and chosen, in order to further increase the possibility to replicate the study.

3.4.4 Trustworthiness

Bell et al. (2022), argues that researchers need to evaluate qualitative findings differently compared to quantitative findings. They argue that a suitable quality criteria that can be used to evaluate the findings of the qualitative data is Trustworthiness, as it has its own four different sub criteria's, which are Credibility, Transferability, Dependability and Confirmability.

To ensure trustworthy results, the qualitative findings have been presented and discussed with the supervisors from the case company, enhancing the credibility. Further on, all the generated qualitative data have been triangulated with each other, in order to validate that the findings are coherent, thereby further enhancing the credibility. Additionally, the study has been peer reviewed twice, one in the middle of the work and one at the end, to ensure that the study followed proper procedure, thereby strengthening its dependability. To increase the confirmability of the research, the qualitative data collection processes and analysis procedures were documented in a transparent manner to reduce the risk of the author's personal values influencing the result and to instead increase the objectivity of the study.

3.4.5 Ethical Aspect

According to Bell et al. (2022), "Research ethics refers to any situation where moral considerations related to the appropriateness, fairness, and reasonableness of a study arise" (p. 443). They further state that there are four different areas that researchers have to keep in mind

and adhere to, in order to ensure integrity of the study. These four areas are avoidance of harm, informed consent, protection of privacy through confidentiality and lastly prevention of deception.

In order to comply with these areas, the study will be conducted according to ethical research principles. Participation will be voluntary and all the interviewees will be provided with information about the purpose of the study, this involves the right to be anonymous as well as have the ability to withdraw their contribution to the study at any given point without any negative fallouts. Before all the interviews, the interviewee will be asked for their constant and informed about how their answers will contribute to the study.

3.5 Sampling Strategy

Key concepts regarding sampling are first defining the units within a population (Bell et al. 2022). The population refers to the entire group of interest, while the sample is the smaller group chosen to investigate. Sampling can be conducted either by probability or non-probability sampling, depending on the research design.

A key objective in sampling is to choose a sample that reflects similarly to the characteristics of the targeted population (Bell et al. 2022). However, issues such as sampling biases, sampling errors and non-responses potentially affect the quality and accuracy of the result. Determining a suitable sampling strategy is important for the study in order to gather high quality reliable data to ensure the best sample possible.

While conducting the research, several actions have been taken to ensure a good sampling strategy that results in the collection of reliable high quality data that ensures a representative result.

3.5.1 Qualitative Data Collection:

When conducting the qualitative data collection, purposive sampling was utilized, as Bell et al. (2022) argues that it lets the researcher choose which participants that are relevant to the research questions. When choosing the participants, it was important that the sampled participants varied in task knowledge and different roles, as those were seen as important to the research questions, which Bell et al. (2022) argues is a common approach.

3.5.2 Quantitative Data Collection

While collecting the quantitative data, no sampling strategy was used, and instead the entire population was collected to eliminate the risk of sampling bias or sampling errors. Additionally, the chosen time period was in the past, meaning that the author's presence at the goods reception and the employee’s knowledge that they were being studied did not affect the way the employees worked, thereby eliminating the risk that the author's presence affected the result.

3.5.3 Selection of Benchmarked Site

To establish a baseline against which the performance of the main site can be compared and evaluated against, a suitable comparison site was needed to be found. To select a suitable site, purposive sampling was conducted. While finding a suitable benchmarking site to compare against the main site, several aspects were taken into consideration such as that the both sites operated largely under the same conditions, received roughly the same volume, had the same internal layout and available operational space and that the benchmarked site was the best performance site with regards to lead time and adjusted quantity inspection rate.

3.6 Usage of AI

During the writing of this study, generative AI has been used, but only for the sole purpose of enhancing the grammar and flow of the text. All interpretations, ideas and discussions are the author's own.

4. Results & Analysis

This chapter presents and analyses the findings from the study. The chapter covers the first phases of the DMAIC cycle, Define, Measure and Analyze and forms the basis for the later improvement proposals. Both qualitative and quantitative methods were used to examine the current state of the goods reception process at the main site. In addition, a high-performing site was studied as a benchmark in order to identify practices associated with superior performance. The empirical material was collected through gemba walks, interviews, flowchart mapping, exploratory data analysis (EDA) and control charts.

4.1 Historical Ways of Working

At the beginning of the study the authors were given information of the organization's standardized ways of working, which present the guidelines of the correct ways of working. By examining this and conducting unstructured interviews it was possible to draw the conclusion that the warehouse demonstrated a high level of operational performance in 2012, characterized by continuous improvement initiatives and flexible knowledge among employees. However, over time, the organization has departed from these practices, with a noticeable decline in follow-up activities, analytical work, and the maintenance of established performance standards, which could be confirmed by conducting gemba walks.

4.2 Current State

This subchapter presents the current state and the tools applied to obtain the results. gemba walks were conducted to observe and gain an understanding of the goods reception process. Furthermore, unstructured and semi-structured interviews were carried out to collect information and confirm accuracy of the understanding.

4.2.1 Go to Gemba - Main Site

Three gemba walks were conducted at the beginning of this study to develop thorough understanding of the goods reception process, as well as other operational processes at the warehouse. These observations provided an overview of warehouse operations, clarified how these processes are connected and at the same time unstructured interviews were conducted to ensure the correct understanding. This has been part of the "Define phase" where information about the current state was gathered to also determine the width of the scope.

The first gemba walk consisted of reviewing the structure and tasks associated with the goods reception process. This provided a great amount of insights, where the initial factors identified was the high degree of manual work involved and how much these processes depend on human resources.

The second gemba walk focused on understanding the line-feeder process which is part of the goods receiving department. However, the line-feeder has constant work and is assisting others at the warehouse that doesn't add any value to the goods reception. Most of the time there is only one person working as an in-store transporter.

The third day consisted of going through general processes of the warehouse, which were not directly linked to the goods reception department. However, it provided a holistic view of the entire warehouse and how everything is connected.

Observations conducted during the gemba walks, combined with interactions with employees, resulted in several insights of the goods reception, where four different process stages were identified as follows:

External delivery

One of these processes involves processing the goods in the First-in, First-out system, where these rules were strictly followed during low demanding periods, which only included the third party deliveries. This meant that pallets arriving from suppliers, were processed in the same order it came and registered manually into the computer system. The purpose of this was because of the quantity inspection process, where the employees have to count the content that arrives from third party deliveries to make sure nothing is missing. Figure 4 shows an illustration on the FIFO system and quantity inspection zone.

However, During high demanding periods the flow would be too high to follow FIFO, resulting in distance from it. To have this system organized, queues are established for these pallets and bookings are later registered into a digital system. This enabled employees to see they were available in store. From the overall process the external deliveries were seen as a potential bottleneck, since it was observed to be longer processing time than the internal deliveries arriving at the goods reception.

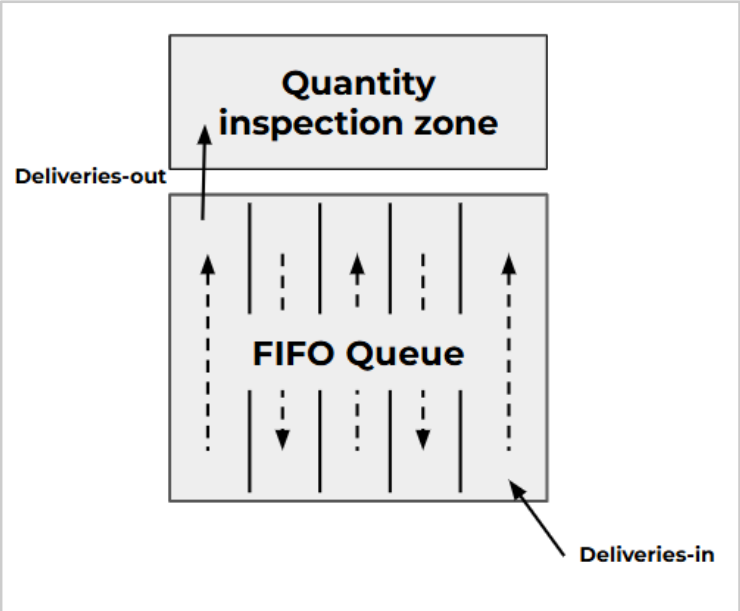

Figure 4: Illustration of the FIFO queue and quantity inspection zone

Internal delivery

In contrast to the external deliveries, the internal deliveries are received and placed ready to the in-store transporter. Since it is sent directly from an internal warehouse, they are more confident there is the right amount in the delivery. However, there are some intermediate steps between unloading the internal delivery goods and preparing them for the in-store transporter, such as scanning the pallets, examining documents and sorting the items. It is confirmed from interviews that an internal delivery can be processed between 1-2 hours.

In-store transporter

The third process is called the “Line Feeder”, which is referred to as the “in-store transporter” and will be further on in the report. The in-store transporter receives both internal and external deliveries from the goods reception and transports them into the warehouse. The pallets are later retrieved by the in-store transporter to the goods reception once the goods have been picked by the warehouse workers.

The in-store transporter uses a manual dashboard, referred to as an occupation board, to navigate pallets to the correct locations. This enables the transporter to identify available spots for pallet placement. The guideline is to avoid placing more than one pallet in these areas, as they are located in aisles used by customers. Doing so increases the risk of technical stock-outs, meaning pallets are in the way of the customer to reach the products.

The in-transporter also has additional tasks, supporting other departments. These tasks include delivering return of goods and misplaced items to their designated departments. This means that the in-store transporter must retrieve the goods from the reclamation desk and deliver them one by one to the right department as well as to drive the misplaced item from one department to another.

Out-store transporter

The out-store transporter is responsible for managing deliveries arriving at goods reception that need to be transported outside the warehouse. This role requires a specific type of forklift capable of handling heavier goods. In certain situations, the transporter may also assist with tasks inside the warehouse that require this equipment. Additionally, the role includes responsibility for handling empty pallets, organizing them outside the warehouse, and loading them onto arriving trucks. However, since this process is outside the goods reception area, this will not be analyzed.

4.2.2 Go to Gemba - Benchmarked Site

The following subchapter presents the chosen benchmarked site, which includes factors differentiated from the main site. Observations are therefore gathered during a gemba walk to present and provide a basis for comparison with the main site.

Utilization of space and division of work tasks

The benchmarked site was observed to have a structured operation at the goods reception area. Their goods reception did not contain any other activities than processing goods and handling reclamation at the workspace and equipment such as trolleys and materials were organized along the walls, allowing more space to work at. Activities such as tagging goods with alarms were assigned to the checkout function rather than the goods reception. Additionally, the handling of returns and reclamations was allocated to other responsible roles instead of the in-store transporter, as it was stated that it was a time-consuming activity, and that the in-store transporter already had a high workload.

Prioritization system

A deviation from standard practice was observed in relation to the FIFO system. Instead of following FIFO, the benchmarked site prioritized pallets intended for immediate transport to

the warehouse. The workflow was guided by an occupancy board, where employees identified available positions before selecting pallets for processing. When a high volume of goods was processed at goods reception, the group leader communicated with other departments to confirm available space. Communication between departments was observed during replenishment activities, and pallets were dispatched once space became available.

Prioritization system

Pallets were sorted at the beginning of the process into different queues based on complexity. For example, pallets requiring comprehensive counting were placed in one queue, while simpler pallets were placed in another. In some cases, certain process steps were bypassed for packages and smaller deliveries. This included skipping the printing and attaching of labels for FIFO storage, with items instead scanned directly and prepared for the in-store transporter. Pallets were also observed to be distributed into queues that required extensive counting.

Cross-functionality

According to the group leader, employees perform multiple roles within the department where they have integrated a role flexibility structure. This means there are job rotations during each week, allowing employees to handle a variety of tasks at goods reception consequently. The group leader also stated that deviations from standard procedures are addressed by management when necessary. Furthermore, it was mentioned that employees capable of performing physically demanding work are assigned to relevant tasks.

4.2.3 Mapping

From the information gathered from the gemba walk, a mapping of the goods reception was constructed to gain an overview of the operational layout and also highlight differences between the sites (see figure 5). By highlighting the differences, it was possible to identify constraints within the main site that potentially negatively affected the outcome of operational performance.

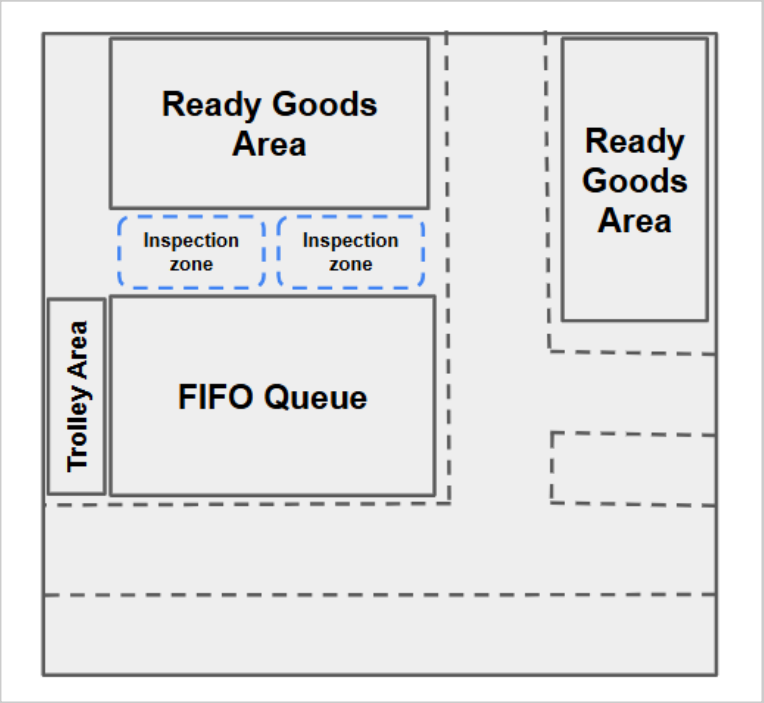

Figure 5: Illustration of the goods reception area

4.2.4 Comparability of Sites: Volumes & Capacity

In order to make sure that the two sites were comparable, quantitative data was gathered from the case company's data servers regarding the volumes that the goods reception received and the hours worked during the time period. The data were then visualized using different graphs.

To establish if the different goods reception receives the same amount of volume, the delivered positions were chosen as the examined factor, as bookings can include several positions, making positions more representative of the number of goods they actually received. Additionally, the internal deliveries can include several bookings, but are not representative to the pallets delivered, whereas positions are, as each pallet is one position in that case. Figure 6 shows the relationship between the sites and shows that during the time interval, the main site had received 9,9 % more positions than the benchmarked site. It further illustrates that they had received 10,53 % more internal positions and 9,42 % more external ones.

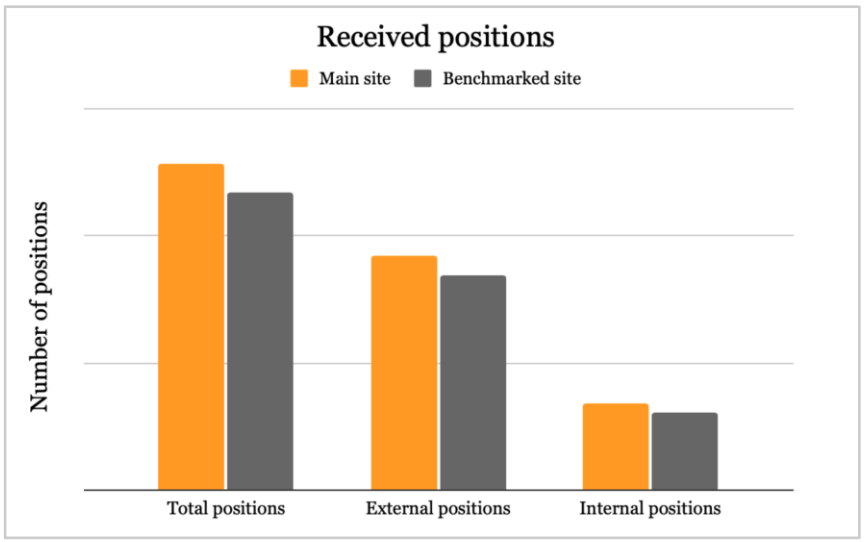

Figure 6: Total number of positions

This indicates that the main site receives a significant amount of more interval deliveries compared to the benchmarked site. To get a better understanding regarding if the sites are comparable and if the added volume is the source behind the lower performance level, the worked hours at each goods reception were gathered and illustrated. Figure 7 highlights that the main site works 6 % more hours than the benchmarked site.

Figure 7:Total number of hours worked

To see if the additional volume corresponds to the additional worked hours, both sites total positions and each delivery type independent from each other were divided by the sites total amount of worked hours at the goods reception. The results highlighted that the main site only receives 3,61 % more total positions per hour, which corresponds to approximately half a

position per hour. By examining the other delivery types, similar results were found as they indicated as the main site receives 3,2% more external deliveries and 4,2% more internal deliveries when compared to the total hours that both sites work. As the sites received approximately the same volume when compared to its working hours, the two sites were deemed comparable and confirmed further analysis into other factors causing performance variation.

4.2.5 Processing Types

From the quantitative data analysis, it was found that internal deliveries arrive from the organization's central warehouse and therefore comes pre-inspected, meaning that they don't have to undergo the quantity inspection process. However, this is not the case for the external deliveries, meaning that they are required to pass through the quantity inspection process. Because of this, the volume that passes through it for both sites has been compared and analyzed.

By examining the quantity inspection process, two categories were initially identified, firstly deliveries that must be counted (Type A) and secondly deliveries that don't have to be counted (Type B). However, during the qualitative data collection, it was found that the warehouses had the ability to alter these categories, resulting in the generation of two additional ones, namely deliveries that should have been inspected but have not been (Type C) and vice versa (Type D).

From this finding, the relationship between the different processing types were analyzed for both sites in order to see potential differences and possible patterns. Figure 8 illustrates the relationship between the different quantity inspection types for both sites under the chosen time period. The figure further highlights that the main site processed 85 % of their total number of positions according to their predetermined quantity inspection type (Type A and Type B), where Type A represented 45,6% % and Type B 39,4%. The benchmarked site, on the other hand, processed an even higher share of positions according to their predetermined quantity inspection type where Type A represented 47,1% and Type B 43,7%, resulting in 90,8% combined.

Figure 8 further illustrates that the main site alters the quantity inspection process for 14,19 % of the total positions to become Type C delivers, whereas the benchmarked site only does it for

8,19 %. Furthermore, the figure shows that the main site alters 0,8 % to become Type D deliveries whereas the benchmarked site alters 2,11 %.

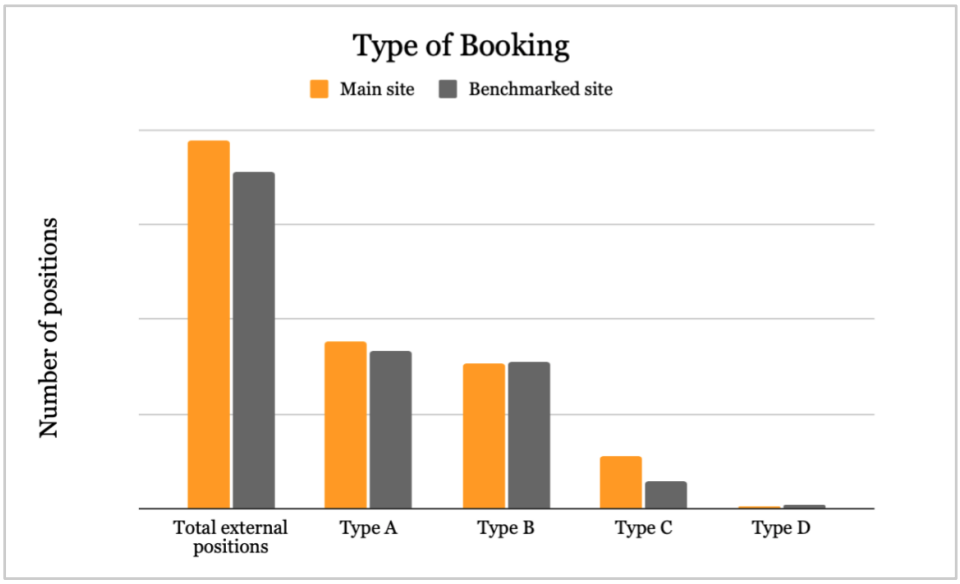

Figure 8: The relationship between each quantity inspection type for externally delivered positions

This indicates that the main site alters a significant amount of more positions to not pass through quantity inspection, even though they need to than the benchmarked site, resulting in a lower performance level. Additionally, as Type D deliveries are inspected even though they did not need to be, they are seen as a positive factor and the fact that the benchmarked site has more of these deliveries further enhances their performance level.

4.3 Numerical Data Variations

Quantitative data was collected from the case company's servers to be examined to gain a deeper understanding of the variation between the current states, analyzing similarities and differences between the sites, as well as identifying performance levels and confirming bottlenecks at the main site. Relevant raw data from a set time interval regarding Workforce variation, Lead times, Capacity and Missed quality inspections was gathered. With the help of EDA tools, the data was processed and evaluated, as well as generating relevant graphs and tables. This was also conducted to allow for a detailed comparison between them.

4.3.1 Workforce Variation

Figure 9 illustrates the hours worked at each site and how they have fluctuated throughout the chosen period. The figure further highlights that both sites have a large fluctuation between the

months, where the main site ranges approximately 36,8% between month four (highest) and month eleven (lowest). The benchmarked site ranges between approximately 135,1% between month one (lowest) and month seven (highest). This has resulted in the Benchmarked site having a 121,35% bigger standard deviation compared to the main site.

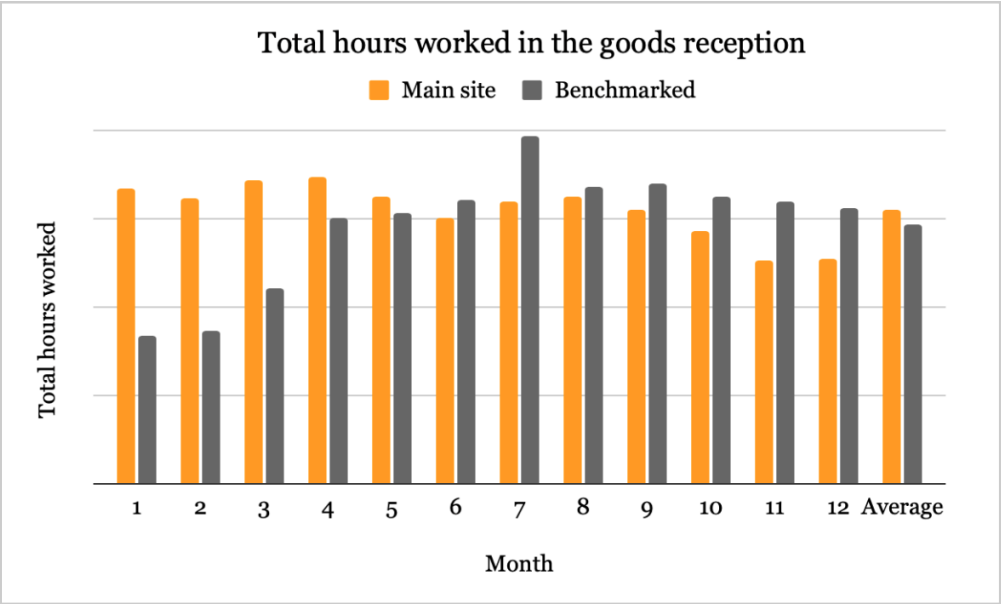

Figure 9: Total hours worked in the goods reception

4.3.2 Lead Time Variation

When analyzing the quantitative and qualitative data, the external bookings were identified as a bottleneck as they require quantity inspection and passage through the FIFO queue, which were found to be the biggest contributors to the goods receptions lead time. Because of this further analysis has been conducted between the external deliveries quantity inspection types, to identify the most time-consuming deliveries.

Lead times for all externally delivered bookings during the chosen time period were compiled from the gathered data and are visualized in Figure 10. The figure illustrates the different sites' mean and median lead times, for each individual quantity inspection type.

Figure 10 illustrates that there is a significant time difference between the different quantity inspection types as well as between the two sites. The figure highlights that the relationship between the main sites different quantity inspection types is the same regardless of whether mean or median are taken into consideration, with Type D having the highest lead time followed by Type A, Type C and lastly Type B. However, this pattern is not observed for the

benchmarked site, as the mean and median lead times do not follow the same order across the different quantity inspection types. Instead, the mean lead times at the benchmarked site follow the order, Type C, B, A and finally D, whereas the median follows the order, Type D, A, C, B.

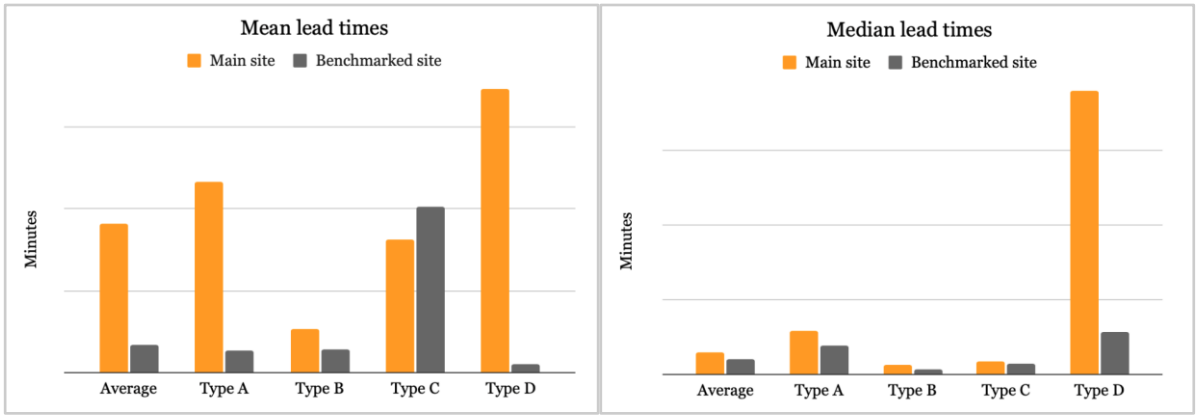

Figure 10: Relationships between lead times for the different quality inspection types

By comparing the lead time, with the volume for each quantity inspection type, as illustrated in Figure, Type A can be seen as the biggest contributor to the lead time variation. This is because it has the second longest lead time as well as representing 45,64% and 47,11% of the total positions arriving at the goods reception at the two respective sites. The reason why Type D is not considered as the biggest contributor is that, although it has the longest lead times, it only s 0,80 % and 2,11 % of the total volume at the respective sites, which therefore indicates that it has a lower overall impact on the performance variation. Additionally, Type D deliveries are inspected during idle time when excess capacity is available and are therefore considered as a positive thing within the case company. Because of this, they will not be further examined during this study.

When comparing the lead times between the sites, Figure 10 highlights that the average mean lead time is 446% longer for the main site. Furthermore, the figure illustrates that the main sites deliveries that require a Type A quantity inspection have a lead time which is 774% longer, as well that Type B deliveries have an 87% longer lead time compared to the benchmarked site. However, the main site actually managed to process Type C deliveries 20% faster than the benchmarked site.

In addition to examining the mean lead times, the median lead times have also been examined, as it is less sensitive to extreme values. This is because it represents the middle value of the dataset and can therefore be seen as a more representative measure of the day to day activity.

Figure 10 shows that the average median lead time for the main site is 50 % longer for the main site compared to the benchmarked site. It further illustrates that the Type A delivered is 48,72 % longer and that the Type B is 116,67 %. However, compared to the mean lead times, the median lead time for Type C is 21 % longer for the main site compared to being 20 % slower.

Because the median values were significantly lower than the mean values, it suggests that there is a lot of variation in the lead times for both the sites. To examine the variation in lead times between the sites where all external deliveries are divided into different lead time groups ranging from 1 as the shortest to 22 as the longest.

The results showed that the majority of both site's bookings are located within the first two time intervals, with 57.2% for the main site and 66.8% for the benchmarked site, as illustrated in figure 11. More specifically, 23.3% of the main sites bookings are in time interval 1 and 33.9% in time interval 2, whereas 31.6% of the benchmarked sites bookings are located in time interval 1 and 35.2% in time interval 2.

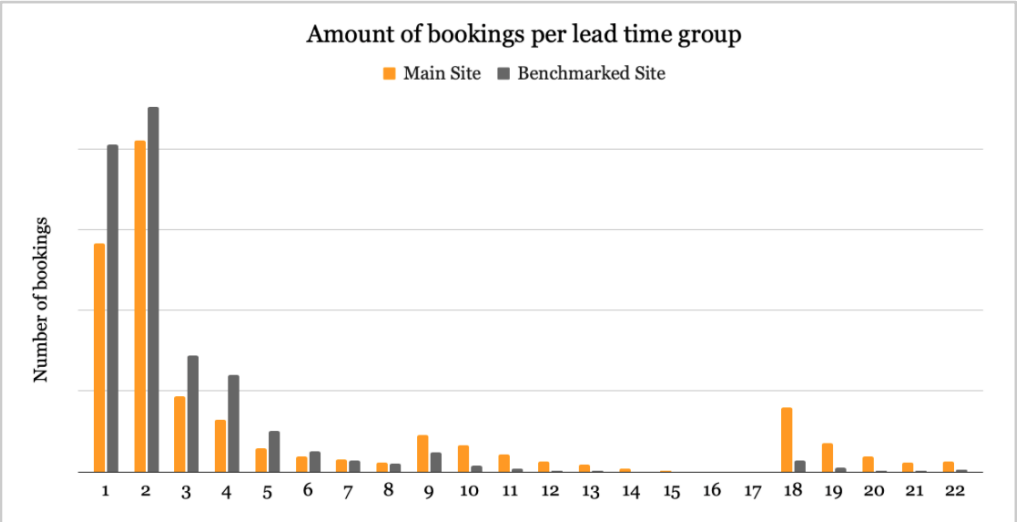

Figure 11: The relationship regarding the number of bookings per lead time group

Time interval 19 and above represents lead times longer than the desired maximum lead time, set by the case company. For the main site, this corresponds to approximately 6.5% of all bookings, whereas for the benchmarked site it only corresponds to approximately 0.8% of all bookings. Additionally, there is a significant volume difference in time interval 18 which is the last interval within the desired maximum lead time, where the main site has 6.5% of all its booked deliveries in this lead time group, whereas the benchmarked site only has 1,1 %.

This highlights significant performance differences between the sites, as the main site has significantly more extreme cases. To gain an even deeper understanding of how big the variation there was between the site, the both sites standard deviation where calculated. The results showed that the main site had a standard deviation which was approximately 68 % longer than the benchmarked sites.

Furthermore, it also illustrates that even though they both have the majority of their bookings in these time groups, there is still a significant performance difference between them and that the benchmarked site possesses the ability to process more deliveries at a higher pace then the main site does. Additionally, the main site adjusts a significant amount of more deliveries to bypass the quantity inspection even when they are supposed to be quantity inspected. This means that those deliveries are not subjected to one of the most time consuming activities within the goods reception, the quantity inspection, resulting in that their lead times dropping substantially. This suggests that if the main site had adjusted less deliveries, they would have had even more deliveries with higher lead times.

4.3.3 Missed Quantity Inspection Variation

By altering the quantity inspection type, the lead times may have been reduced, however, by doing that, it has increased the number of bookings that have not been quantity controlled even though it needed to be. Both the qualitative and quantitative data collection revealed that there is a significant number of errors within the deliveries the company receives, making it a crucial factor to tackle, as it results in a financial loss in the form of inventory discrepancies. If the bookings have not passed through quantity inspection even though they are required to do so, there is a risk of not receiving the correct items or the correct quantities from the supplier.

To get a better understanding regarding how big of a problem the missed quantity inspections were, the percentage regarding how many Type A quantity inspections were performed was collected and compared to how many they were supposed to perform. The numerical data gathered during the data collection process is illustrated in Figure 12 and Figure 13.

Figure 12 shows the average percentage of the bookings and their corresponding positions, that has not been quantity inspected even though it should have been. The data revealed that the main site on average bypassing to quantity inspect 11,56 % of the Type A bookings, which

corresponds to 23,97 % of the positions, whereas the benchmarked site skips 5,51 % of the bookings, corresponding to 15,99 % of the positions.

Figure 12: Average percentage of missed Type A inspections

As illustrated in Figure 12, the difference between what they were supposed to quantity inspect and what has been inspected is significantly larger for the main site compared to the benchmarked site. According to the collected data, the main site has adjusted 109,8 % more bookings, which corresponds to 49,9 % more positions, to become Type C bookings instead of Type A.

Because of this, a percentage error was calculated from the collected quantitative data for both sites, by dividing the “value of discovered errors for Type A bookings" with the “total value of the Type A bookings”. The percentage error during all deliveries for 2025 was 174,58 % higher for the main site compared to the benchmarked, highlighting just how crucial it is to tackle it. The precentral factor was then multiplied with the value of all the Type C bookings. This resulted in a theoretical loss of inventory for the period amounting to 970 076 SEK for the main site and 528 948 SEK for the benchmarked site.

To gain a deeper understanding of how these deliveries have been adjusted throughout the time period, two histograms were created, illustrating the missed percentage between what they have counted compared with what they should have counted (see figure 13). The figure illustrates that there is a big fluctuation for both sites with regards to both bookings and positions.

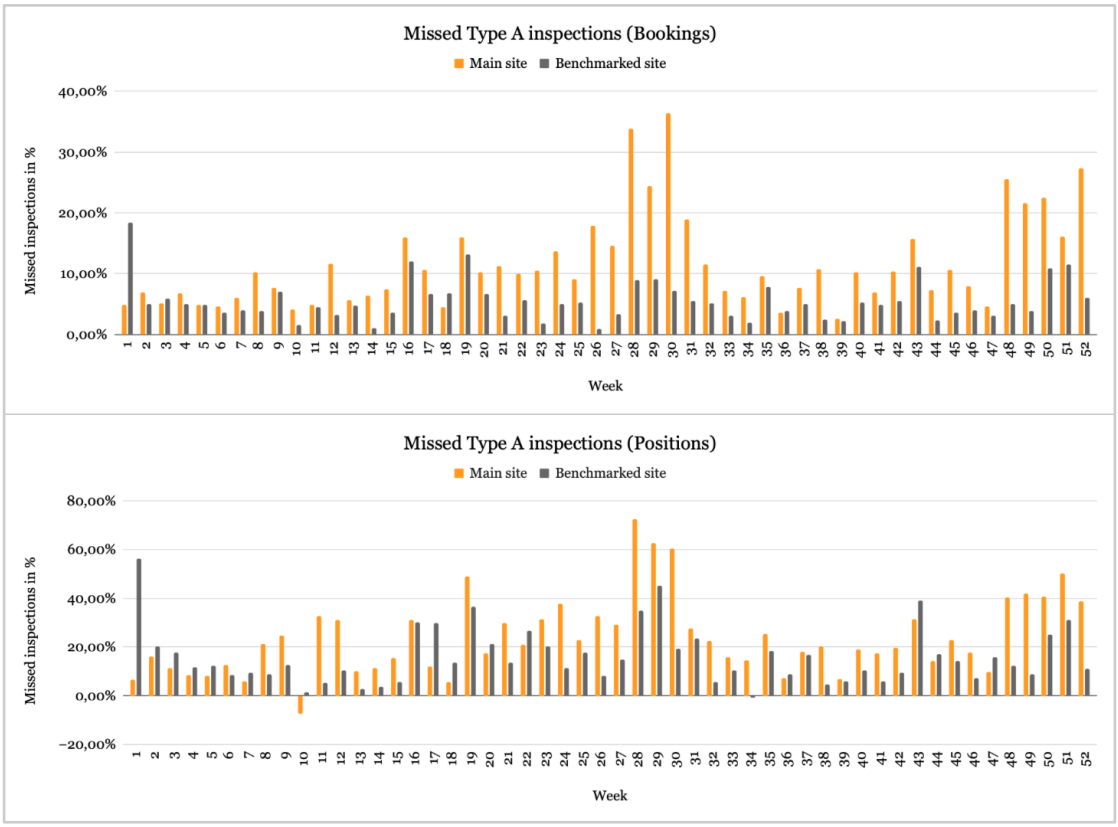

Figure 13: Missed quantity inspection for Type A, bookings and positions

For the main site, the booking percentages range all the way from only missing 2,65 % in week 39 to missing 36,43 % in week 30, whereas the positions range from 7,37 % in week 10, to 72,44 % in week 28. Furthermore, figure 13 highlights that the benchmarked site adjusted bookings fluctuated between 0,96 % in week 26 and 18,42 % in week 1, whereas the positions fluctuated between -0,74 % in week 34 and 56,28 % in week 1. This has resulted in the main site having a standard deviation which is 130,30 % bigger with regards to the bookings and 36,21% bigger for the positions.

4.3.4 Process Quality

Based on data from Figure 13, an I-MR control chart was constructed to visualize weekly performance of the goods reception. The lower specification limit (LSL) was set to 90%, representing the minimum acceptable completion rate, while the target level was defined as 100% representing the desired performance rate. However, the upper specification limit (USL) is not determined, since it does not weaken the performance if the quantity inspection goes beyond the target limit (see figure 14). When analyzing the performance of the bookings being

quantity inspected, there are 50% of the observations that fall outside the set specification limits, indicating a poor performance process.

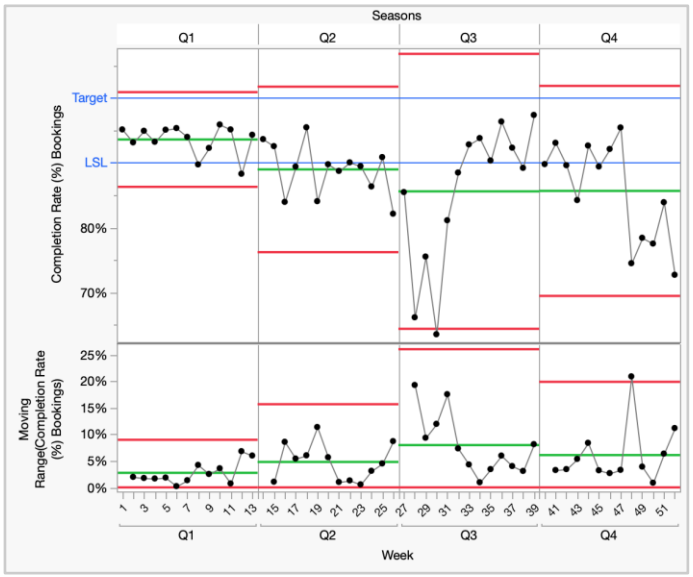

Figure 14: Control chart: Quantity inspection - Bookings (Main site)

The main sites missed to inspect on average 11,35 % of the bookings corresponding to 23,97 % of the positions and the benchmarked site missed 5,3 % of the bookings resulting in that they missed to inspect 15,99 % of the positions, indicating a big discrepancy. Figure 14 highlights the main site performance regarding the inspected positions during the time interval. From this graph, it shows that over 80% of the observations fall outside the specification limits, indicating an even more poor performing process than the booking process performance.

When investigating the control charts for the main site bookings and positions, it was possible to identify some extreme cases where for example one booking represented 21% of all positions during week 11. This highlights that even if the operator's performance lies within the specification limits regarding the bookings their performance lies outside the specification limits regarding the positions. This could indicate that operators avoid inspecting pallets that have a high number of positions, with other words avoiding inspection of time-consuming pallets. Further on, to track performance for the goods reception both bookings and positions should be taken into consideration.

Furthermore, the control chart shows that the process varies over time and does not remain stable throughout the observed period. Several data inputs fall below the LSL, especially between week 26 and 32, and 48-52, where a clear drop in performance can be observed. The

same period is also supported by the increased variation in the moving range chart. It is possible to observe an increase in performance afterwards, however values further fell below the specification limits. Overall, it is possible to see declining trend where performance decreases from week 1-31. To be able to understand this shift in performance, the authors divided that observation into 4 different seasonal behaviors to investigate further. Figure 14 highlights the grouped seasons into four quarters, where overall performance is observed to vary across the different quarters.

Starting by analyzing the different quarters of bookings on figure 14, it is possible to observe that most of the observations fall inside the specification limits on Q1. This represents that approximately 84.6% of the observations fall inside the specification limits, indicating a stable process. However, by analyzing the other quarters it is possible to see a larger drop and higher variety, making the process more unpredictable and unstable. The proportion of observations within the limits was approximately 38.5% for Q2, 46.2% for Q3, and 30.8% for Q4.

When examining the quantity inspection performance across different quarters in relation to the number of positions, an even larger proportion of observations fall outside the specification limits (see figure 15).

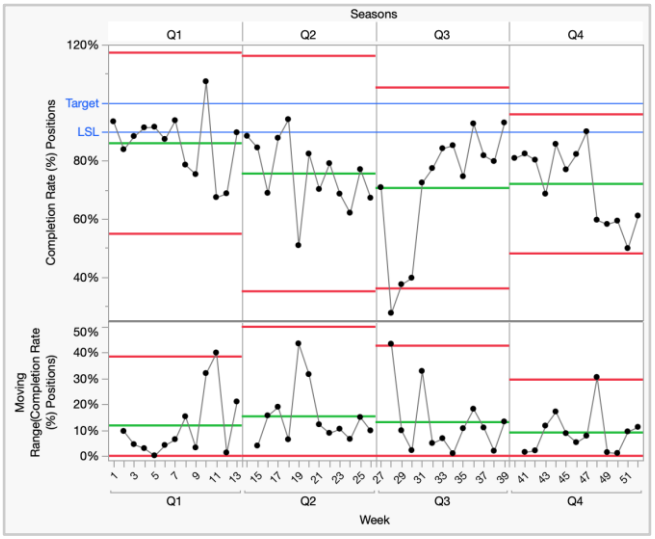

Figure 15: Control chart: Quantity inspection - Positions (Main site)

The proportion of observations within the limits was approximately 38.5% for Q1, 7.7% for Q2, 15.4% for Q3, and 7.7% for Q4. This suggests that bookings containing several positions are being bypassed in the system and reaching the set specification limits is a rare event. This

also suggests that pallets requiring more time to process and containing a higher variety of goods are more likely to be overlooked.

Additionally, these observations that contain high variation are probably caused by non-random variation, which demands further investigation through qualitative data findings. This will require an investigation through conducting interviews to reach specific causes during these low performing events.

The benchmarked site performance data regarding the number of bookings and positions within the specification limits during the targeted time period were analyzed. The results indicate that the site's weekly performance was generally maintained within the specification limits. As illustrated in Figure 16, the process performed well overall, with 88.5% of the observations remaining within the specified limits and only 11.5% falling below the lower specification limit (LSL).

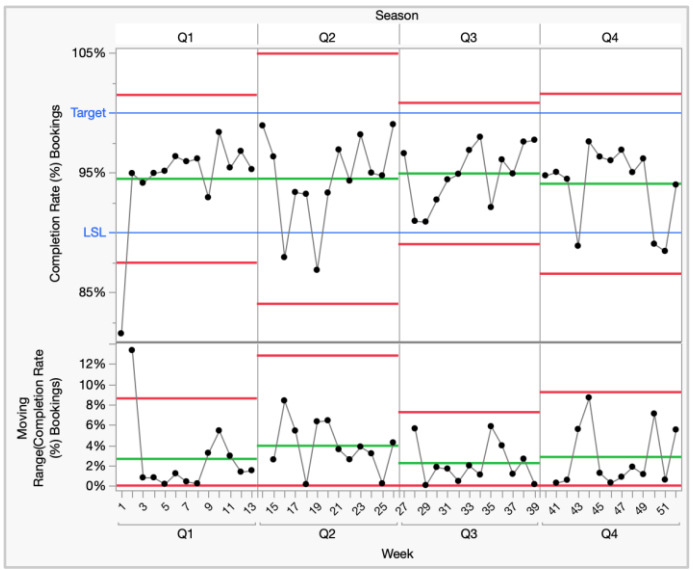

Figure 16: Control chart: Quantity inspection - Bookings (Benchmarked site)

Additionally, Figure 16 illustrates the site's performance throughout the selected time period. The results show that the majority of observations in each quarter remained within the specification limits, with 92.3% in Q1, 84.6% in Q2, 100% in Q3, and 76.9% in Q4 remaining within the acceptable range. Comparing this performance to the main site, this indicates that there is better performance. However, their process is not stable, indicating room for improvement as well.

However, when analyzing the number of positions for which the benchmarked site altered the quantity inspection process, a different performance pattern is observed, as illustrated in Figure 17. The figure shows that only 34.6% of the weeks remained within the specification limits during the selected time period. Furthermore, the results indicate that 46.2% of the weeks in Q1 remained within the specification limits, compared to 23.1% in Q2, 38.5% in Q3, and 30.8% in Q4.

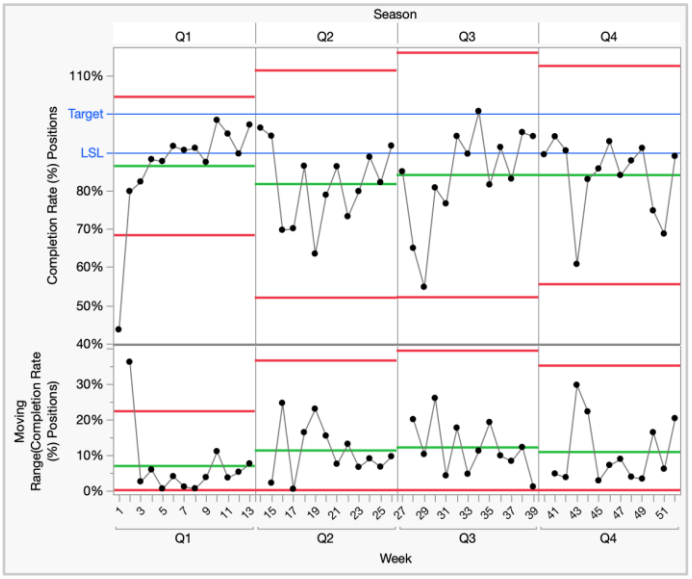

Figure 17: Control chart: Quantity inspection - Positions (Benchmarked site)

These findings indicate that although the benchmarked site performs well regarding bookings, the performance related to positions is considerably lower. Similar to the main site, this suggests that the benchmarked site tends to alter the quantity inspection type for deliveries with a high number of positions, i.e., the more time-consuming deliveries.

4.3.5 Statistical Summary

The following tables (table 2 and table 3) summarize the numerical data. They provide a overview of the key findings and important data aspects gathered during the Measure and Analyze phases.

Table 2 presents statistical metrics for both the main site and the benchmark site, as well as the differences between them. It provides an overview of the distribution of positions across Types A, B, C, and D, workforce variation, missed quantity inspections for both bookings and positions, and finally the estimated inventory loss in SEK.

Statistic	Main Site	Benchmarked Site	Difference
Type A (positions)	45.6%	47.1%	Benchmark higher
Type B (positions)	39.4%	43.7%	Benchmark higher
Type C (positions)	14.2%	8.2%	Main site bypasses more
Type D (Positions)	0.8%	2.1%	Benchmark executes extra inspections
Workforce variation	36,8%	135,1%	Benchmarked 121.4% higher standard deviation than main site
Missed quantity inspection (bookings)	11.6%	5.5%	Main site bypasses 6.1% more bookings
Missed quantity inspection (positions)	24%	16%	Main site bypasses 8% more positions
Estimated inventory loss	970 000 SEK	529 000 SEK	Main site has a 441 000 SEK higher loss

Table 2: Statistical summary 1

Table 3 summarizes the lead time statistics, presenting the mean lead time, median lead time, and standard deviation of lead time. Additionally, the table reports only the differences between these statistical measures for the two sites.

Category	Statistic	Difference
Mean lead time	Average	Main site 446% longer
	Type A	Main site 774% longer
	Type B	Main site 87% longer
	Type C	Main site 20% faster
Median Lead time	Avarage	Main site 50% longer
	Type A	Main site 48.7% longer
	Type B	Main site 116.7% longer
	Type C	Main site 21% longer
Standard deviation lead time		Main site 68% larger

Table 3: Statistical summary 2

4.4 Interviews

Interviews were conducted to confirm understandings from gemba walk, as well as gather data on what causes the performance of the quantitative findings and what factors that affect an effective change initiative. Additionally, interview 1 was the first conducted interview, this was used to validate the quality of the questions and therefore does not include all relevant inputs needed for the research.

4.4.1 Communication

Interview data regarding communication have been gathered, where information about general communication and communication channels are presented in table 4. This will later be used to answer RQ2 in the discussion chapter.

Findings indicate that communication within the department is generally perceived as open and functional during low operational workload. However, high operational workload and time pressure limits opportunity for communication especially in group context. This increases the risk of misunderstandings and reduces employees' willingness to raise issues or requests. This suggests that communication effectiveness is highly dependent on workload conditions.

Interviewee	Quote
	General communication
I3	*"The communication is good. If it is something that I would like to say, I will do it immediately"*
I4	*"It is difficult to communicate, due to the high workflow and I don't want to demand thing out of people since I know that people has much to do"*
I5	*The communication is good but it could always be better of course, we do not however have the time to talk together in groups, due to the high flow of goods."*
I6	*"The communication is in general good, but when we are stressed and have a lot to do misunderstanding can happen"*
	Communication channels
I4	*"All information is shared from the team leader meetings."[...]"It is supposed be a quick group meeting where group leader shares the information, but it doesn't happen so often."*
I5	*"We have both email and Teams. We also have a channel where all employees can log in and access information."*
I6	*"It is usually communicated through weekly newsletters, which are sent out by email and posted on the notice board, where information about what is happening in the store is also displayed."*

Table 4: Quotes - Communication

Furthermore, findings indicate that the organization has multiple communication channels available, such as team leader meetings, email, Teams, newsletters and notice boards. However, the success of these communication channels is dependent on the consistency of usage in practice. The limitation of group meetings might reduce the opportunity to clarify information or align employees with a shared understanding.

4.4.2 Change

Interview data regarding change have been gathered, where information about feelings toward change is presented in table 5. This will later be used to answer RQ2 in the discussion chapter.

The findings suggest that employees are generally open to change, but it is very dependent on whether the change is seen as meaningful and beneficial. Some employees believe that current ways of working already are good enough and do not see a strong need for change. There are

also indications that employees have become less motivated to suggest improvements because their own suggestions have not resulted in action. This could result in a lack of trust in the organization's ability or willingness to implement employee ideas.

Interviewee	Quote
	Feelings toward change
I4	*"I would actually not see a change."[…]"There haven't been any great changes, it has mostly been the same."*
I5	*"I would like to see change and think it is good to try to change, but if there is a concept that is already working I don't see a reason why you should change it."*
I5	*"If I see an improvement potential I communicate it to my manager, but over time I have been used to nothing happening so I have started to keep it to myself."*
I6	*"It depends on what change it is, I am however in general open to it."*
	How change initiatives currently are implemented
I2	*"It is called becoming a pilot. They do not roll the change out to all stores immediately, instead, they select one or two stores and implement it there first to see what works and whether it is something suitable for everyone. They then carry out a small evaluation to determine if it works for the organization."*
I2	*"It is difficult to say what metrics they base their decisions on"*

Table 5: Quotes - Change

Although the organization uses pilot projects to test change initiatives before a scale up implementation, the findings indicate that employees do not always perceive these initiatives as effective in practice. Interviews highlight a lack of follow-up, limited employee involvement and no proof of beneficial outcomes. This could reduce employee trust in change initiatives and scepticism towards future changes.

4.4.3 Current Activities

Interview data regarding opinions on current activities have been gathered, where information about the prioritization system and in-store transporter is presented in table 6. This is further used to answer RQ1 in the discussion chapter.

Interviewee	Quote
	Prioritization System
I3	*"We can't use the occupation board at all as a prioritization system. It is too high flow right now. However, in general we are already looking at what needs to go to the spots at the departments."*
I5	*"FIFO works well in theory, but you also need to consider what is ready in the departments."*
	In-Store Transporter Activities
I4	*"The in-store transporter is already heavily loaded with daily tasks."*
I5	*"I mostly see positive consequences from transferring the responsibility for returns and misplaced items to the departments. I have always felt that returns and misplaced items are not really something that should be handled by the goods reception, but rather by the departments themselves. At the same time, I understand management's perspective why they do not want sales staff leaving the departments, since they have to assist customers. However, it is not a difficult task. Someone can step away to handle it while there are still other sales employees remaining in the department."*
I6	*"Returns and misplaced items tasks can take anywhere from one hour to even longer."[…] "If the departments handled returns and UFOs instead, it would naturally help the in-store transporter focus on the other tasks."*

Table 6: Quotes - Activities at the goods reception

The findings suggest that standardized prioritization systems are difficult to apply during periods of high operational flow. Instead, employees rely on situational judgement and operational experience to determine what is most needed in the departments. Although the FIFO structure is intended to organize and prioritize the workflow, employees perceive that this approach does not fully align with operational realities, where high goods flow and department readiness require more flexible prioritization decisions.

Furthermore, findings highlight that the in-store transporter role includes multiple time-consuming responsibilities than its main task. Activities such as misplaced items and returns that consume time, limiting the operation of focusing on transporting pallets or helping out in the goods reception. Employees perceive the current allocation of responsibilities as inefficient and there would be more appropriately managed by each department instead of the goods reception.

4.4.4 The Current Flow

Interview data regarding the current flow were collected to gain an understanding of the process, from the supplier through the goods reception and finally to the store. The findings are presented in Tables 7 and 8. These inputs are analyzed to identify connections within the flow and to explain how they affect their overall efficiency.

Interviewee	Quote
	Supplier
I3	*"Internal deliveries are sometimes deviates from set time, resulting in arriving three times on the same day and this affects the efficiency of the daily operations in a negative way."*
I5	*"We receive a large number of small deliveries because orders are placed very frequently. These smaller deliveries are more time consuming to process, since each package requires the same administrative handling, regardless of the number of products included."*
	The goods reception
I1	*"When internal deliveries arrive at the goods reception it occupies a lot of space, since it almost every time is a full truckload."*
I4	*"When internal deliveries arrive, it blocks the way for other deliveries. Our goods reception does not have enough space, which makes things more time consuming."*
I4	*"Goods are either pushed out, pallets are stacked together, or items are placed in the outdoor yard, which results in a cluttered environment."*
I5	*"It is most stressful when we do not have space to place goods in the receiving area. However, we somehow always manage to create space inside the goods reception, as strange as it may sound."*

Table 7: Quotes - Supplier and the goods reception

The findings indicate that goods reception operates under flow pressure, where the volume of goods makes it difficult to maintain control. Employees describe situations where goods must continuously be pushed out even when departments are not fully prepared to receive them. This suggests that current work procedures are reactive and focused on preventing stocking rather than following processes.

A major issue identified is the lack of available space within the goods reception. Internal deliveries arriving simultaneously occupy large areas and could disturb handling of other

deliveries, contributing to higher time consuming work processes. Employees describe how temporary solutions, such as stacking pallets, pushing goods into departments, or placing items outdoors, are used to create space. However, this solution appears to contribute to a less organized work environment.

Table 8 further highlight that limitations within the departments in the store also affect the operational flow. Due to limited space in the departments, employees have been forced to place two or even three pallets on one spot to maintain flow of goods. However, the flow of goods is further difficult to maintain.

Interviewee	Quote
	Departments
I2	*"One internal delivery could contain over 60 pallets, but there are only 56 spots available at the store. Therefore, they must be processed immediately"*
I3	*"Now we have had to use double and even triple placements in certain areas at departments to make the flow work."*
I3	*"It is impossible to keep track of what is empty in the departments. The flow is too large right now, so everything just has to be pushed out."*
I3	*"Pallets at the departments do not need to be picked up immediately, since they have the mindset that the time spent with the customer should take as long as necessary, as the customer is the main priority."*
I6	*"As a rule, when using double placement, no more than two pallets allowed to be placed at one spot."*
I6	*"The stress is at its highest when we are unable to maintain the flow. We can do everything we can and still not get the goods out because the departments are too busy or the designated locations are full."*

Table 8: Quotes – Departments

An interviewee states *"One internal delivery could contain over 60 pallets, but there are only 56 spots available at the store. Therefore, they must be processed immediately"* (I2) and at the same time pallets are not always prioritized at the departments to be processed immediately, as department employees' primary focus is customer service. This indicates a mismatch between the goods reception and other departments, where there might be conflict between operational flow efficiency and customer oriented priorities within the store (see table 8).

4.4.5 Employee Competence

Interview data regarding employee competence have been gathered, where information about flexibility and competence limitations is presented in table 9. This is further used to answer RQ1 in the discussion chapter.

Interviewee	Quote
I1	*"The level of competence could have been better. The goods reception has often been seen as a department where employees are placed if they do not fit in elsewhere."*
I2	*"It is not possible to temporarily replace staff when they are absent. What we really need is greater employee flexibility."*
I2	*"The time is the problem why we can't train everyone, but we are trying to educate people when there is a gap, but it is very difficult to plan a session for it"*
I3	*"Not everyone can do the work we do out there. It is somewhat the same across all departments, people know their own department. Others can help with transporting goods, since anyone can do that, but replacing staff is difficult."*
I3	*"We strive for everyone in the goods reception to be able to perform all tasks and try all different processes. However, time is a major constraint, both in terms of carrying out the training and ensuring enough time to train everyone properly. As a result, employees only learn certain tasks occasionally when situations arise, making it very difficult to schedule dedicated training time."*
I4	*"I am self taught and I have needed to force myself to do tasks to learn as most as possible"*
I5	*"There isn't a problem to teach people, but to find time to do it"*
I5	*"Competence is a major shortage, we have only three people who are able to perform all tasks."*
I5	*"There must be certain requirements in order to work at the goods reception."*
I6	*"Right now, there is only one task I can perform"[...]"I want to learn several tasks, but there has not been enough time for it. If that had been possible, I could have helped ease the workload of others and made my own work less monotonous."*

Table 9: Quotes - Competence

The findings indicate there is limited employee flexibility at the goods reception. Multiple interviewees mention difficulties in temporarily replacing absent staff because the majority are specialized in specific tasks. This issue includes both the goods reception and other departments, meaning it is also difficult to temporarily replace employees. This creates greater dependence on employees with broader competence, reducing flexibility when they are absent.

A common theme identified was the lack of available time for training and competence development. There is an organizational demand for employees to learn multiple tasks and processes, but the operational demand limits structural training opportunities. Findings further suggests that the challenge is not only employees willingness to learn or the ability to teach tasks, but the high operational flow preventing training time. As a result, competence development becomes difficult to prioritize in a high flow environment.

Another issue identified is the perception of the goods reception being a department with low requirements. As interviewees state "*...the goods reception has often been seen as a department where employees are placed if they do not fit in elsewhere.*" (I1) and *"There must be certain requirements in order to work in the goods reception." (I5).* This suggests that it does not exist any requirements at the goods reception, which has contributed to a lower level of competence.

Operator	Competence	Flexibility Level
OP1	Flexible	High
OP2	Flexible	High
OP3	Flexible	High
OP4	In-store transporter	Low
OP5	In-store transporter	Low
OP6	Out-store transporter	Low
OP7	Goods receiver	Low
OP8	Reclamation	Low

Table 10: Flexibility level

Overall, the findings suggest that limited competence development, unclear competence requirements, and insufficient cross-functional training contribute to low workforce flexibility and increased operational vulnerability within the goods reception. Where all of these factors

have been affected due to limited time for training opportunities. From interviews a table has been created to visualize current flexibility level (see table 10).

4.5 Root Cause Analysis

Multiple procedural variations were observed to accomplish similar tasks and different procedures resulted in variation in the time required to complete the same process. Based on hypotheses developed from observations and interviews, a fishbone diagram was constructed to systematically identify, validate and visualize the root causes contributing to the identified problem (the big "Y").

By analyzing and validating the hypotheses, the diagram provides a structured overview of the key factors leading to inefficiencies in the goods reception process. Four main categories were formulated to organize the identified causes: Systems, Process, Management, and Employees, as illustrated in Figure 18. The findings are based on data collected through the gemba walk, through analyzing data from the companies database and interviews.

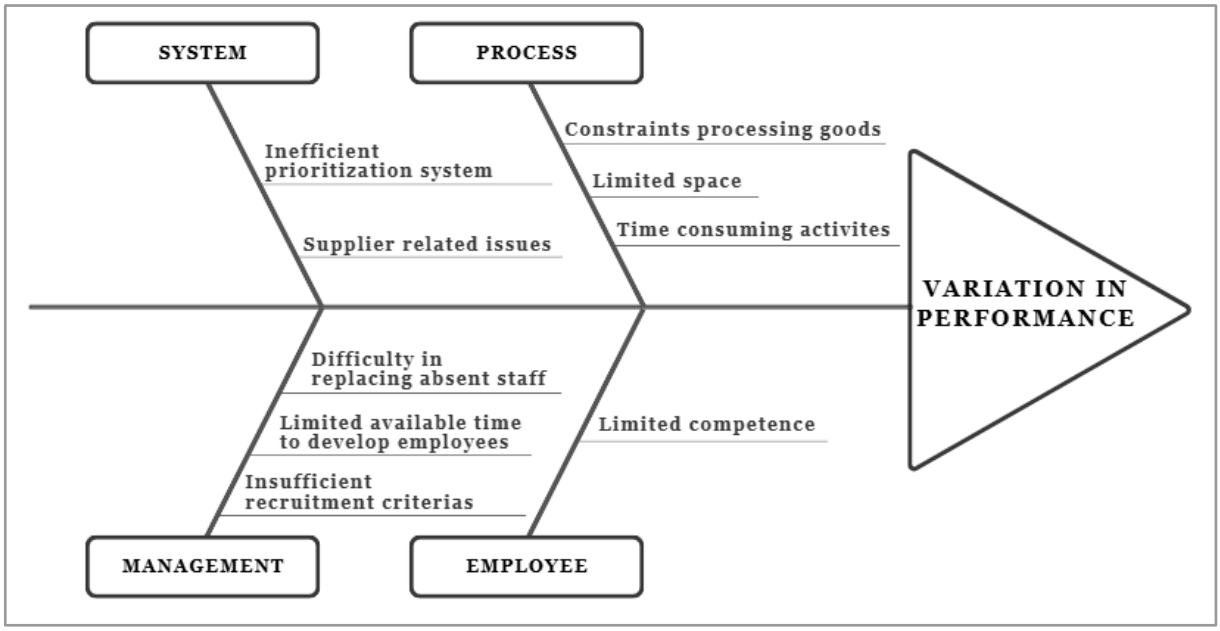

Figure 18: Ishikawa diagram

4.5.1 Systems

Inefficient Prioritization system

A key finding was how the main site prioritizes their external bookings and sorting their pallets in the queues before being processed. As observed, they follow the organizational standard and prioritize deliveries after the FIFO principle. To support this, they place the external deliveries into a FIFO queue before the handling process even begins, so that they know which delivery to choose. However, during peak periods, the goods reception deviates from this practice and starts to utilize the occupation board as a prioritization system similar to the benchmarked site. On the other hand, this is not optimal, since they don't have an organized queueing system, as the process is still designed around the FIFO structure.

On the contrary, the benchmarked site was observed to have opted for a more effective prioritization system where they prioritize external deliveries after what they are able to drive out to the departments, by looking at their occupation board. To further support this, the benchmarked site has remodeled the queueing system, where they divided up the deliveries by how time consuming they are. For instance, they place deliveries that they think or know are type B deliveries in the most accessible line, followed by normal deliveries in the other lines. However, one line is reserved for small packages containing only a few or one position which from the interview was identified as problematic, as they are very time consuming due to the fact that each delivery still requires to be registered in the data system.

This practice is therefore identified as a root cause affecting performance variation in lead time and quantity inspection completion rate. By using the benchmarked prioritization- and queuing system, the site can prioritize deliveries that can leave the goods reception immediately, thereby reducing the inventory build-up and freeing up storage capacity that may instead be utilized to store the internal deliveries. By freeing up space, will benefit the goods reception to focus on quantity inspection, contributing to a higher completion rate.

Additionally, separating the deliveries by how time consuming they are may reduce the overall lead time, as type B and small deliveries are no longer trapped behind more time consuming deliveries that may still be unable to leave the goods reception due to that their designated department is full and can’t receive any more deliveries. This would mitigate the high variation of lead time, contributing to a faster process.

Supplier related issues

A crucial impact of the variation of performance of the goods reception is related to deviations of the suppliers. Interviews highlight that the number of expected deliveries sometimes increases on the same day, contributing to difficulty in processing goods. The problem occurring is the lack of communication and coordination between the goods reception, the store and the supplier.

This means that there is a consequence where the suppliers are earlier or later than the original planned schedule, resulting in higher flow during that period. This creates disturbance at the store since good reception is not prepared and there is a need to be responsive to this and being able to communicate to the departments that they need to be prepared to process this delivery immediately.

4.5.2 Process

Time consuming activities

Another finding was the difference between the working tasks allocated to the in-store transporter. At the main site, the in-store transporter is responsible for driving the deliveries to its predetermined department and picking up the empty pallets with garbage that the departments leave behind after they have re-stocked the shelf and driving it back to the goods reception to be put away.

Furthermore, the in-store transporter is also responsible for collecting the returned goods at the check-out and driving it back to its designated departments as well as taking care of items that have been moved to the wrong department by a customer. However, at the benchmarked site, the in-store transporter only has to deliver the goods to the departments and retrieve the empty pallets and garbage left by the departments from when they restocked the shelves. The reason behind this is that the benchmarked site believes that this takes a significant amount of time and that the in-store transporter already has a high workload.

This has resulted in the in-store transporter being able to focus more on its core activity, which is transporting processed goods to the departments and that it could more frequently update the occupation board, needed for their prioritization system. From interviews this is also supported by the statement *"If the departments handled returns and misplaced items instead, it would*

naturally help the in-store transporter focus on the other tasks." (I6), indicating that employees at the main site see the possibility to free up time since it at least occupies one hour daily.

Constraints processing goods

Findings from the interviews and observations indicate that internal deliveries are one of the main factors contributing to performance variation at the goods reception. This is primarily due to the large volume of internal deliveries arriving simultaneously. It is confirmed in the numerical data chapter that both sites receive a similar amount of goods. However, in reality by comparing this finding with the qualitative findings, the goods are not capable of being moved to its designated department immediately.

What happens is that the in-store transporters are unable to immediately distribute the incoming goods to its designated departments. This is because departments have not yet finished processing previous goods or because employees must prioritize assisting customers, meaning they are not able to take care of the delivered goods. This results in goods being temporarily stored within the goods reception area creating a high pallet build-up at the goods reception affecting efficiency negatively. Figure 19 shows an example of when pallets have been transported to the departments occupying space. If more pallets arrive there is no place for the pallets to be placed at the department, meaning that it likely has to be stored at the goods reception.

Figure 19: Example of pallets build-up at a department

This means goods occupy a significant amount of space and disrupt the operational flow. Therefore, employees are sometimes required to rearrange pallets within the goods reception to create sufficient space for incoming deliveries. This leads to interruptions in value-adding

activities, increases the amount of time spent on non-value-adding tasks and difficulties of conducting regular tasks, negatively affecting efficiency.

Limited space

Furthermore, the interviews identified that several interviewees saw the lack of available space as a barrier towards a more efficient goods reception. The gemba walks at the different sites revealed that although the sites have the same amount of space to work with, they utilize it differently. More specifically, the benchmarked site has transferred responsibility of attaching alarms on goods that need it to another department. This change has freed up a significant amount of space that instead can be used to store internal deliveries.

Figure 20 highlights the occupied spaces at the goods reception. The red dashed lines highlights the areas which contributes to disturbances at the goods receptions, since these occupied spaces disallow operators to fully utilize this area towards placing goods that are ready to be transported to the departments.

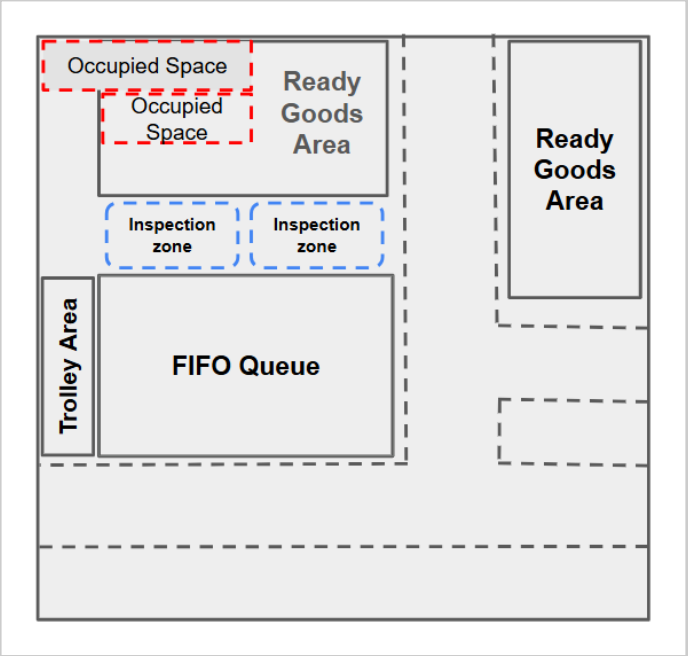

Figure 20: Illustration of occupied spaces at the goods reception

4.5.3 Management

Limited available time to develop employees

Findings from the interviews identified that one factor contributing to performance variation at the goods reception is the low competence level among employees. A key reason behind this was found to be the limited amount of time available to train both new and existing employees adequately. As a result, several employees have become self-taught or have only received training in specific tasks rather than the entire work process.

However, the interviews also revealed that employees would receive proper and sufficient training if enough time were available. This indicates that the main issue is not the quality of the training itself, but rather the lack of available time and resources to conduct continuous competence development. At the same time, limited training opportunities contribute to variations in employee competence and operational performance within the goods reception.

Difficulty in replacing absent staff

The interviews identified that the lack of workforce flexibility caused by the limited available time to develop employees, has created difficulties in reallocating employees to cover for workforce fluctuations resulting from sick leave or holidays. This is because it has resulted in that there is limited flexibility within the goods reception, thereby limiting the possible ways to manage the workforce in order to cover for absent employees, as not all employees know all tasks. Additionally, it has also resulted in a low cross departmental knowledge, making it difficult to temporarily relocate personnel from other departments to cover for the missing goods reception employee.

Insufficient Recruitment Criteria

From the interview, it was identified that the recruitment demands have decreased over the last couple of years. From the interview it emerged that before, there was a mandated training period when starting the job, which is something that now is not provided. This has resulted in several employees at the goods repetition are self-thought and a majority of employee lacks flexible knowledge. This is confirmed where the interviewees state, *"the goods reception has often been seen as a department where employees are placed if they do not fit in elsewhere." (I1)" and*

"There must be certain requirements in order to work at the goods reception." (I5), indicating current requirements are insufficient.

4.5.4 Employee

Limited operational competence

Findings suggest that the current workforce have a limited level of operational knowledge, as many employees are only experienced in a single task within the goods reception process. This is highlighted in table 9. Furthermore, less than half of the workforce is considered sufficiently experienced and flexible to perform all tasks within the department. The findings also indicate that several employees have fixed roles and responsibilities, which further restricts operational flexibility. Consequently, this has contributed to low task flexibility within the goods reception, where a workforce with broader competencies and higher flexibility is regarded as an important factor in reducing performance variation and improving operational efficiency.

5. Discussion

In this chapter the result of the study is discussed and a recommendation for how to proceed in order to ensure employee engagement is proposed.

5.1 Define

According to Schroeder et al. (2008) the first phase of the DMAIC cycle is the Define phase, which according to Tsarouhas and Sidiropoulou (2024) is about identifying the problem. Liebengood et al. (2013) emphasizes that gemba walks are a good way of identifying and understanding the problem. Therefore, gemba walks provided us with great insight regarding how the goods reception operated and a clear picture of where causes of variation in performance might occur.

Findings identified were the different factors for performance variation where factors such as quantity inspection, lead time and workforce variation were investigated. However, it was also noticed that by only focusing on increasing the speed of quantity inspection, it may lead to unintended consequences, such as employees bypassing or deprioritizing the inspection to cope with the time pressure.

Additionally, the gemba walk also identified the prioritization system and the number of tasks the in-store transporter had as possible root causes, meaning there are also other factors affecting the process. Thereby suggesting that further measures were needed to be gathered.

These findings thereby highlighted the importance of understanding the underlying factors contributing to the performance Variety in order to identify and mitigate them and only that by addressing these factors, can the goods reception achieve a more stable operational flow, improved performance, and increased efficiency.

5.2 Measure

Schroeder et al. (2008) emphasize that the second phase of the DMAIC methodology is the Measure phase. In this study, existing quantitative data together with collected qualitative data were utilized to measure the current performance and establish a reference point at the goods reception, which Tsarouhas and Sidiropoulou (2024) argues is the main objective in this phase. The process was also divided into different measurements in order to translate the process into

measurable terms, which aligns with recommendations presented by Tsarouhas and Sidiropoulou (2024).

The measure phase was conducted iteratively, where Exploratory Data Analysis (EDA) was primarily utilized to summarize and visualize the collected data, as according to Chatfield (1986) it is one of its main purposes. From the collected data relevant KPIs were established and the performance levels across the two sites measured. Further on, Chatfield (1986) argues that the visualization of data should be easy to understand, which has been taken into consideration in order to enhance its readability and make the graphs understandable.

Additionally, EDA tools have been utilized to illustrate the differences between the sites and show how long the lead times are, how well they follow the quantity inspection process and how the workforce capacity differs. The findings from the EDA also supported the Analyze phase by revealing patterns and potential root causes that guided the subsequent analysis. However, if the EDA indicated that not all root causes were identified, additional measurements were taken.

After the quantitative data had been collected and analyzed, the qualitative data collection began, where semi-structured interviews were conducted in accordance with what Bell et al. (2022) argues. The interviews further deepened our understanding between the differences among the two sites, but also to why the benchmarked site performs at a higher level. Similarly to the quantitative data, the qualitative data collection process was conducted in the same iterative way, meaning that if additional data was needed after the analysis, it was collected.

5.3 Analyze

According to Tsarouhas and Sidiropoulou (2024) the purpose of the analysis phase is to identify and verify the underlying root cause of the defined problem. This has been done by first identifying different types of performance variation, such as lead time, volumes, quantity inspection completion rate and workforce capacity. Secondly, causes of these have been identified through a root cause analysis where the qualitative data has been utilized to explain the findings.

5.3.1 Identified Performance Variation

In addition to being utilized in the Measure phase of the DMAIC methodology, the EDA graphs have been heavily utilized in the Analysis phase. However, as Chatfield (1986) argues that when population data is completed, no statistical inference is needed, has the tool only been used to summarize and visualize the result to get a better understanding of how the current state of the goods reception looked like. By using qualitative data to explain the findings from the quantitative data collection, several factors causing performance variation have been identified.

Control charts were further utilized to identify and visualize time events between variation in quantity inspection performance between the main and benchmarked sites. According to Montgomery (2009) control charts are an important tool within the Analyze phase as they enable continuous monitoring of process variation and facilitate the identification of uncommon activities. In this study, the control charts revealed high variations that indicated special-cause variation and inconsistencies within the process. This contributed to a deeper understanding of when deviations occurred, and that higher variation at the main site suggested a lower degree of process stability compared to the benchmarked site.

According to Novin et al. (2025) control charts make it possible to measure TBE, where we were able to identify a decrease over time in quantity inspection performance. This was observed to be a declining trend where it was concluded to be a peak demand period, affecting its performance. Novin et al. (2025) further describes control charts as the main purpose to determine whether variation is natural or caused by specific problems. We can identify that both of these occur, where during Q1 is a stable variation, however during the other quarters (Q2, Q3 and Q4) it is high variation caused by specific problems.

5.3.2 Causes of Performance Variation

To identify the causes of performance variation, a root cause analysis was conducted with the help of the Ishikawa diagram. Liliana (2016) argues that Ishikawa diagrams are used to analyze problems and identify major factors related to the problem. This enabled a thorough understanding of complexity within the goods reception and the discovering of several connections between causes within the different categories.

Inefficient Prioritization system

The current prioritization system used within the goods reception is based on a FIFO structure, which Smith and Srinivas (2019) identify as a common approach within warehouse operations. However, the findings from this study indicate that the FIFO strategy may not be the most suitable approach in this operational context. Numerical data and comparisons with the benchmarked site suggest that the current prioritization system contributes to pallet build-up, increased throughput times, and greater lead time variation.

These findings are supported by Smith and Srinivas (2019), who argue that FIFO-based strategies are not always optimal for reducing long turnaround times in warehouse operations. In the studied case, the application of FIFO appears to reduce operational flexibility during periods of high workload, where it is shown that the majority of incoming goods require prioritization to maintain workflow efficiency.

It should also be noted that operators at the main site were observed deviating from the FIFO structure during peak periods. This suggests that the current prioritization system does not sufficiently support the operational demands of the goods reception process, as employees adapt the workflow to manage high operational flows.

Supplier related issues

Operators at the goods reception identified supplier related issues as a significant source of operational variation and a major barrier towards efficiency. Deviations from scheduled delivery times created substantial disruptions within the goods reception process, as delayed or unplanned arrivals negatively affected workflow planning, staffing allocation, and the synchronization of internal activities. This suggests that the performance of the goods reception is highly dependent on external actors, making the process vulnerable to variations that are outside the operators' direct control.

These findings are consistent with Richard (2017), who argues that 80% of inbound operational problems can often be traced to only 20% of suppliers. This makes it difficult for operators within the goods reception to manage these variations, especially when there are workforce fluctuations. The results of this study indicate that such supplier related variability not only affects delivery precision but also contributes to increased operational uncertainty and difficulties in maintaining a stable workflow within the goods reception.

Furthermore, the findings highlight the importance of effective communication and coordination between suppliers and the goods reception department in order to align deliveries with operational schedules. Deliveries arriving in partial shipments were also found to increase process variability, as operators often lacked sufficient information regarding the timing and completeness of deliveries.

This supports Guimarães et al. (2022), who emphasize that logistical processes are highly dependent on efficient information flows. Where enhanced information sharing between suppliers and the goods reception department could improve planning accuracy and reduce operational disruptions. Findings indicate that insufficient coordination and inconsistent supplier performance are part of root causes of process variation, which negatively impacts operational efficiency.

Time consuming activities

Comparing the main and benchmarked sites the in-store transport has different roles. Where the benchmarked site has limited the roles task to only focus on assisting the goods reception. Jones et al. (1997) emphasizes that the main purpose with lean logistics is to eliminate unnecessary activities that do not contribute value to the customer. In this case the core value for the in-store transporter is to ensure as efficient flow of goods as possible to the right departments and removing empty pallets.

This problem can be connected to one of Jones et al. (1997) seven wastes “excess movement”. When the in-store transporter has to deliver returned and misplaced items to their designated department it means excess movement that does not contribute with value to the customer. Instead these activities contribute to its main task which is to ensure an efficient flow between the goods reception and other departments. This is also supported by interviews where it is said that the in-store transporter would be able to add one hour to assisting the goods reception daily.

Constraints processing goods

According to the Theory of Constraints (TOC), a system is only as strong as its weakest link (Pegels & Watrous, 2005). Within the goods reception, findings indicate that the process of distributing goods to their designated departments constitutes a major operational constraint. During peak periods, the departments lack sufficient capacity to process incoming goods, creating a bottleneck in the internal flow. Pegels and Watrous (2005) describe a bottleneck as

an operation that is unable to keep pace with the required throughput. In this case, the departments limit the ability of the in-store transporters to distribute goods efficiently from the goods reception. Furthermore, the findings highlight that the quantity inspection process also has a significant effect on the lead time, as the quantity inspection process is one of the most time consuming activities inside the goods reception.

As a consequence, pallet build-ups occur within the goods reception area, which Pegels and Watrous (2005) describe as work-in-process (WIP) inventory. The accumulation of pallets indicates disrupted flow caused by downstream constraints, forcing employees to rearrange pallets and create temporary storage space for incoming deliveries. This means that employees spend additional time on activities that do not contribute to any value creation. This supports indications of waste in the form of excess processing and excess inventory, which Jones et al. (1997) identify as non-value-adding activities.

Limited Space

Baller et al. (2022) emphasize that several operational constraints, such as storage capacity and goods reception capacity, are important factors affecting inbound logistics performance and overall logistics costs. The findings of this study support this perspective, as several interviewees identified limited available space as a major barrier to achieving a more efficient goods reception process. Further, by utilizing the EDA tools that Chatfield (1986) mentions, a great number of extreme cases in regard to lead times could be identified, as the analysis visualized a significant difference between the mean and median lead times for all the different quantity inspection types. These extreme cases can be seen as a contributor to the variation in performance, as they take up unnecessary space within the goods reception.

However, the findings also indicate that the issue is not solely related to the physical amount of available space, but rather to how the space is utilized and organized within the operation. Although the investigated sites had similar spatial conditions, the benchmarked site utilized the available space differently by reallocating the responsibility for attaching alarms to another department. This operational adjustment freed up space within the goods reception area, which instead could be used for internal deliveries and improved workflow management.

There are also indications that goods reception is temporarily being used as a storage area rather than a flow-focused operation due to the constraint of processing goods into the departments. Oliveira et al. (2022) highlights the function of a warehouse operation, where its main purpose

is to receive and put away into storage. In the context of the case company, the storage is located at the departments in the store, where the goods reception only is a flow focused operation.

Oliveira et al. (2022) further emphasize the importance of agile goods reception operations in order to reduce throughput times and maintain efficient logistics flows. However, the findings of this study indicate that implementing such flow-oriented practices becomes challenging in a warehouse environment where assisting customers represents the primary focus. As employees are frequently required to shift focus from logistics activities to customer service, maintaining a continuous and efficient flow within the goods reception becomes more difficult. This suggests that the operational context of the case company creates a more complex environment for improving inbound flow efficiency compared to the context described by Oliveira et al. (2022), where customer service isn't part of their problem.

Limited available time to develop employees

Findings indicate that limited time for development hinders the development of workforce flexibility, creating high variation in performance due to the lack of being able to replace staff temporarily. This is something also highlighted by Hopp & Oyen (2004), where workforce flexibility is acquired through training time and resources.

It is possible to conclude that the organization has not been able to provide either time or resources. As a result, several employees were either self-taught or only trained in specific tasks rather than the entire work process. This also highlights the current situation where there is low knowledge flexibility at the main site.

From analyzing the fishbone diagram there have been identified several causes to the variation in performance. Additionally, the limited available time to develop employee competence seems to have created a chain reaction to why several causes affect the performance variation when workforce variation occurs.

Difficulty in replacing absent staff

Due to the limited available time to develop employee competence, it has resulted in difficulty in replacing absent staff temporarily. Hopp & Oyen (2004) mentions it enables organizations to allocate their resources based on operational demand. Where allocating resources is a quality benchmarked site possess.

Findings based on the EDA tools presented by Chatfield (1986), highlight that both sites have significant variation in worked hours at the goods reception, but where the benchmarked site performs significantly worse as it has a standard deviation which is approximately 121 % larger than the main site. However, the findings indicate that despite this, the benchmarked site performs better in every single other performance measure, indicating that they are less affected by the fluctuation in workforce.

This is because the benchmarked site can more easily cover for one another, as all employees are trained to know all tasks due to their role flexibility structure. In contrast, the man site believes that there is no available time to train the employees to know all tasks, resulting in that the workforce flexibility remains low, thereby making it hard to reallocate personnel, which is consistent with the theory presented by Hopp & Oyen (2004).

Limited competence & recruitment criteria's

Furthermore, the overall competence among employees has made it difficult to replace absent staff temporarily, since there are only three out of eight employees that are able to execute tasks such as the quantity inspection process and conduct the internal and external delivery processes. This can also be connected to their insufficient recruitment criteria's where employees see there has to be certain people being able to work at a goods reception otherwise it affects the performance negatively.

5.4 Improve

According to Schroeder et al. (2008) is "Improve" the penultimate phase in the DMAIC cycle. Tsarouhas & Sidiropoulou (2024) emphasize that during this phase improvement suggestions are generated in order to solve the underlying root causes identified in the previous phase.

5.4.1 Changing Prioritization System

When analyzing the different work methods, it is possible to see why different lead time occurs between the sites. The main site applies a FIFO system, while the study by Smith and Srinivas (2019) confirms that most studies also adopt a FIFO queuing system, indicating a common approach.

In contrast, the benchmarked site adopts a different prioritization approach using the occupation board instead of a FIFO system. This allows operators to prioritize deliveries that can immediately be transported by the in-store transporter to the relevant department within the warehouse. Additionally, the benchmarked site uses an alternative queuing system, also deviating from the FIFO structure. This system separates Type A and Type B quantity controls, enabling Type B deliveries to be processed immediately rather than remaining in the FIFO queue behind Type A deliveries.

Further on, Smith and Srinivas (2019) describe FIFO as not an optimal strategy for reducing long turnaround times, which originally is caused due to variations in service time by the suppliers. This suggests that when processing time differs, shorter tasks can be delayed by longer ones, increasing overall waiting time. This can also be confirmed by the empirical material, where in figure 8, the benchmarked site performs an average four times faster in regard to the mean, however 50 % faster if one looks at the median lead times than the main without affecting the performance of quantity inspection. By integrating this new improvement suggestion they will mitigate variation and steer it towards the lower lead time intervals.

5.4.2 Introduce Cross-Functional Development

The interviews revealed that a significant challenge within the goods reception concerns the existing knowledge gap among employees and the difficulties associated with temporarily replacing staff members. Richard (2017) states that 48-60% of a warehouse total cost is caused from its labour cost, making it reasonable to focus on investing in developing current employee competence. Additionally, there are identified insufficient time availability within the goods reception making it difficult to develop employees.

A potential improvement would be to increase cross-functional training by enabling employees from other departments to learn and perform tasks related to the goods reception. Furthermore, Guimarães et al. (2022) emphasize the importance of a balance between responsive and efficient warehouse operation in order to achieve a sustainable operation. Therefore, improving workforce flexibility is important, as it enables the goods reception to respond more effectively to operational variations while improving overall efficiency.

Although such an initiative may initially lead to a temporary decrease in efficiency and performance due to the time required for training and learning, it is likely to strengthen

workforce flexibility and operational resilience in the long term. This is something Hopp and Oyen (2004) argue that there is no escaping investing time and resources to enhance flexibility. This means that the main site may experience short-term productivity losses, the long-term benefits associated with increased adaptability and reduced dependency on individual employees are expected to overcome these initial costs.

5.4.3 Standardized Guidelines for Placement of Incoming Goods

The processing of goods into the departments was identified as a factor that can negatively affect operational efficiency and cause performance variation within the goods reception area. To mitigate these challenges new standardized guidelines across the warehouse need to be implemented to improve coordination between departments and the goods reception area. This will also mitigate the risk of pallet build ups and non-value-added activities inside the goods reception since new guidelines will ensure the operators at the store will have a shared understanding where to place the goods when spots at departments are occupied. As Jones et al., (1997) argues that excess stock and excess movement is seen as some of the seven wastes.

Findings from interviews support that they are at the moment only allowed to place 2-3 pallets on each spot. This is supported by the statement *"Now we have had to use double and even triple placements in certain areas at departments to make the flow work."* (I3) and *"As a rule, when using double placement, no more than two pallets may be placed at one location." (I6)* Findings from gemba walks confirm that this guideline is insufficient since there is a issue process them from the goods reception

A proof of this is the statement *"One internal delivery could contain over 60 pallets, but there are only 56 spots available at the store…"* (I2) making the departments overcrowded after the arrival of three internal deliveries. It should also be noted that internal deliveries has been arrived at the same day, *"Internal deliveries are sometimes deviates from set time, resulting in arriving three times on the same day"* (I3) making the possibility of every spots being triple placed on the same day very high. This results instead of pallet build ups at the goods reception since departments do not want a high number of pallets in their department.

5.4.4 Reallocation of Activities

The next improvement suggestion is the reallocation of activities that do not create value towards the goods reception processes. Since the goods reception contains a high flow, it is important that activities in each process only focus on maintaining an efficient flow.

The analysis of the interviews highlighted that reallocating the process of tagging goods with alarms and the responsibilities of returns and misplaced items could free up a significant amount of time and space. Where from gemba walks it is possible to conclude that tagging of alarm occupies space at the goods reception. Interviews confirm this by the statement *"If the departments handled returns and misplaced items instead, it would naturally help the in-store transporter focus on the other tasks."* (I6).

Therefore, by removing these activities time could be used to frequently update the occupation boards and assist process small deliveries, as the interviews highlighted those as a major problem, "*...smaller deliveries are more time consuming to process, since each package requires the same administrative handling…"* (I5).

Compared to the benchmarked site this approach is already in use. Which has turned out to free up more space within the goods reception and also not overloading the in-store transporter with tasks, making that process more capable of executing its main tasks. This can be validated from Jones et al., (1997), where these activities can be seen as waste as they contribute to excess processing and excess movement not directly contributing to the purpose of the goods reception.

5.4.5 New Hiring Criteria's

A long-term suggestion is to start with stricter demands based on characteristics required for an employee at the goods reception. This will in the long-term ensure employees being able to conduct every task and being capable of increasing their competence flexibility as it according to Hopp & Oyen (2004) enables organizations to allocate their workforce where it is needed. Interviewees state *"There must be certain requirements in order to work at the goods reception.",* indicating there are not any criteria at the moment and the employee currently does not have the right conditions performing the everyday activities at the goods reception.

Hopp & Oyen (2004) further argues that flexibility is limited by competence requirements and cost. Where we can see at the main site there are employees with lower competence than the benchmarked site and this is due to wrong people at the wrong place. By taking the benchmarked site into consideration, they are more able to be flexible in their workforce, this is due to that they are capable of constantly switching every role positions for every employee.

5.4.6 Impact Matrix

Based on our suggested improvement suggestions, an impact matrix has been generated, highlighting how big the impact of the suggestion is believed to have, compared to how long it will take to implement it. Furthermore, the size of each bubble represents how difficult the improvement initiative is believed to be, with regards to adaptability and the requiring of new knowledge for the employees. By mapping the improvement suggestion, low hanging fruit is possible to identify, which is improvement suggestions that have a big impact, and takes short time to implement as well as being of low difficulty (see figure 21).

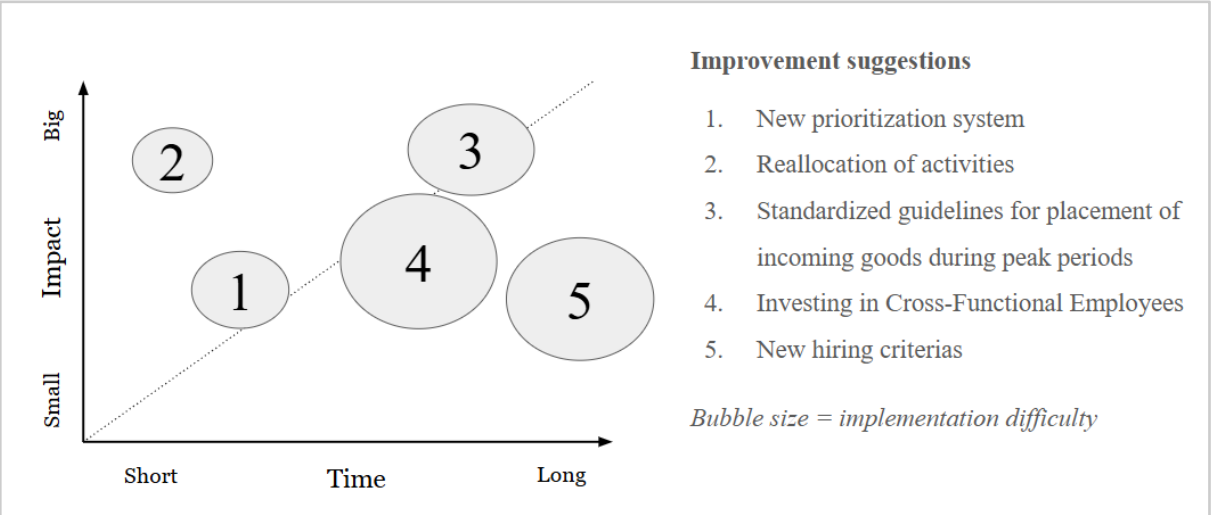

Figure 21: Impact matrix

5.5 Control: Implementation of Suggestions

The final phase of the DMAIC cycle is according to Schroeder et al. (2008) the control phase, which Tsarouhas and Sidiropoulou (2024) further argues about embedding the improvements initiatives within the organization in order to stabilize the process, thereby ensuring that the process performance is sustainable over time. To support the implementation of the suggested

improvement initiatives, Kotter's 8 step model is considered as an appropriate framework, as it helps guide the organization through a structured sequence of steps, which helps to facilitate a successful change (Kotter, 2007).

5.5.1 Establish Sense of Urgency

To achieve a sense of urgency, the organization has to create a shared understanding for both management and employees that current ways of working aren't sustainable. Kotter (2007) argues that many change initiatives fail, because organizations don't understand the importance of informing the critical mass why a change is necessary. In this study, there have been several identified causes to the problem.

By highlighting these problems, findings suggest the most effective way of convincing the critical mass is to show data on performance and cost driver, where the goods reception approximately missing 1 million SEK in detecting fault goods. There is also a winning in arguing what wins there are for everyone at the goods reception, where the improvement will result in increased flexibility which will facilitate their current ways of working.

To acknowledge change towards the critical mass of management, Kotter (2007) emphasizes that successful organizations create visibility around the operational problem. This could be communicated by presenting the root cause findings of what creates the high variation at the goods reception. Additionally, Butt et al. (2016), emphasizes the importance of stakeholder involvement early in the change process as it increases engagement and reduces the resistance to change.

5.5.2 Forming a Powerful Guiding Coalition

Kotter (2007) argues that establishing a strong sense of urgency is not necessarily sufficient to form a powerful guiding coalition, and that additional efforts may be required to get the necessary individuals involved in the effort. Kotter further argues that an off-site retreat can be a suitable method to achieve this. However, the interview results indicated that the employees generally had a positive attitude towards change, as long as the change is explained and is something they believe would work. As these employees represent the volume needed to achieve a critical mass, a workshop may therefore be a more suitable alternative, where the change initiative is presented and explained.

Furthermore, Kotter (2007) emphasizes the importance of having an active and involved top management during change initiative and argues that key line managers are better suited to be in charge of the change initiative than staff executives. With that in mind, a suitable person to lead the initiative would be the head of the department, as this individual possesses the necessary operational knowledge, is willing to take on the responsibility, and has the required formal authority to drive the change forward.

5.5.3 Creating a Vision

The third step is creating a vision for the change initiative. According to Kotter (2007), a successful change requires a clear vision and the vision should explain the direction of where the change is headed and align the organization toward a common goal. A rule of thumb according to Kotter (2007) is to be able to communicate the vision in five minutes or less and get a reaction that indicates both interest and understanding from the listener. If this is not achieved then the vision is not done and refinement is needed. An accurate vision to the study would be to focus on achieving a flexible and efficient goods reception process.

Kotter (2007), further states that the vision should not only contain an operational target but also include a direction to help the employees understand what the operation will look like in the future. Since the causes contributing to variation in performance are interconnected and involve multiple departments it is important for the vision to state that collaboration is the key of making a successful operation. Based on this a suggested vision is created:

"The goods reception shall be a well-organized and efficient function that ensures a smooth and reliable flow of goods. The focus should be on processing goods rather than storing them, while simultaneously creating a sustainable and well-functioning work environment for employees. Through clear leadership, effective planning, and collaboration, employees should be given the right conditions to perform their work efficiently and flexibly."

5.5.4 Communicating the Vision

The next step in Kotter's change model is to communicate the vision. According to Kotter (2007), organizations often underestimate the importance of this step, which contributes to many change initiatives failing. Kotter argues that employees will not fully commit to a change initiative unless the vision is communicated effectively and consistently throughout the

organization. Butt et al. (2016) further emphasize that effective communication involves ensuring that the right stakeholders receive the right information at the right time.

Findings indicate that the goods reception currently relies primarily on direct communication through the group leader when operational changes occur. However, there is a need for greater involvement from the department manager in communicating the vision and improvement initiatives. This means that the department manager should act as the commercial representative of the change initiative and continuously communicate the purpose, direction, and expected benefits of the improvements.

Findings further suggest that change initiatives are currently under communicated within the organization, which may create skepticism and resistance among employees. Although employees generally show acceptance toward operational changes, there are indications of uncertainty due to limited communication and insufficient involvement from top management. Kotter (2007) states that successful transformations require employees to actively support the change initiative, often involving short-term sacrifices in order to achieve long-term improvements. Therefore, increasing communication and employee involvement may be essential to strengthen commitment and reduce resistance toward future improvement initiatives.

This further supports the aspect highlighted by Kotter (2007) that leaders must lead by example. This means that managers and department leaders must consistently act with the proposed improvements and commit to the change initiative through their daily actions. In the studied case, this could involve prioritizing employee development and operational learning despite existing time constraints, in order to increase workforce flexibility and long-term operational efficiency.

Kotter (2007) further suggests an approach where leaders should utilize the communication channels to communicate the vision to the employees to integrate the vision into daily activities. Findings have identified that there are current channels in which the change initiative could be communicated, both through physical meetings and online platforms. However, these channels could be utilized better than they are currently.

5.5.5 Empowering Others to Act on the Vision

As highlighted in “Communicating the vision” chapter the importance of communication is also crucial in order to empower others to act on the vision. By continuing this type of approach, (Kotter., 2007) also suggests the encouragement of people to take action and try new ideas. Findings from the study indicate that improvement initiatives are primarily driven by management. However, employees also contribute with suggestions for operational improvements, although these suggestions are not always taken into consideration. This may reduce employee involvement and limit the organization’s ability to benefit from operational knowledge possessed by the workforce.

Furthermore, Kotter (2007) argues that employees often understand and support the vision, but are prevented from acting due to organizational obstacles. Findings suggest that there is currently a lack of leadership efforts aimed at removing such obstacles. As a result, employees may identify potential improvements but lack the authority, support, or conditions required to implement them. To empower employees, management therefore needs to actively involve the workforce in improvement initiatives and remove barriers that prevent employees from testing and implementing new approaches.

Kotter (2007) also emphasizes the importance of aligning incentives and benefits with the change initiative. If employees do not perceive any personal or operational benefits from the change, there is a risk that individuals will continue working towards recent routines or personal objectives instead of supporting the vision. Management should therefore clearly communicate how the proposed improvements can contribute to a better everyday work.

5.5.6 Planning for and Creating Short-Term Wins

The sixth step is according to Kotter (2007) to plan for and create short-term wins, as there is otherwise a risk of losing the momentum built up by the change initiative and its employee buy-in, as major changes take time. This is because urgency level can drop over time if no evidence of an increased performance as a result of the change initiative is presented.

Based on findings from the interviews, the department manager is actively looking for ways to improve the efficiency of the goods reception, in line with what Kotter (2007) argues. However, the findings highlighted that there was a lack of recognition toward the performance of the goods reception, as current metrics focused more on sales performance. Kotter highlights that

even promotions and money can be given if the goals are achieved, to further motivate the employees, however, in this case, we see that this is not suitable, as this could cause friction between departments and sites.

This therefore indicates that there is a need for new short-term wins specified towards the goods reception. Kotter (2007) emphasizes that a meaningful change has happened when relevant factors to the improvement initiative has been improved, therefore to not risk losing the momentum, improvements in suitable KPIs can therefore be utilized as short term wins and be presented to the employees through weekly or monthly meetings, summarizing the past time period and showing its performance.

The findings from this study suggest that suitable short-terms could be the gradual reduction of variation in moved quantity inspection, which could be evaluated on a quarterly basis, as the findings highlight a significant performance variation within this factor (see figure 14-15). An initial short-term win could therefore be to first reduce its variation, followed by the reduction in moved quantity inception for each following quarter. Another measurable short-term win could be the increase in task competence among the employees within the goods department, but also how many employees from other departments that temporarily could be reallocated to cover for absent personnel if needed.

Kotter (2007) further emphasizes that managers can have a negative attitude towards being forced to set short term wins, but it is a useful tool to utilize to make a change. The findings suggest that this is something that currently is not done, leaving a significant room for improvement.

5.5.7 Consolidating Improvements and Producing Still More Changes

The seventh and second to last step in Kotter's (2007) 8 step model is Consolidating improvements and producing still more changes. Kotter emphasizes the importance of not declaring the change initiatives as completed after the first initial performance increase, as it takes five to ten years for the change to fully embed itself within the organization.

Instead, Kotter (2007) argues that organizations should utilize the credibility awarded to them from the short-term wins to address other problems and continue their change. This means that just because the removal of unnecessary activities results in increased efficiency and additional space within the goods reception, their transformation process should not be considered as

finished. Kotter further emphasizes that new practices are prone to revert to old ways of working and that by stopping, it also provides the oppositions a possibility to further resist change. Instead, the credibility could be used to address several additional factors that were identified during the study, such as investigating how the departments can restock the shelves faster in order to allow the in-store transporter to transport more finished goods to the departments, thereby emptying the goods reception faster.

5.5.8 Institutionalizing New Approaches

The eighth and final step of Kotter's (2007) 8 step model is to institutionalize new approaches by embedding the change so far within the organization that it becomes the new norm. Kotter emphasizes that there are two different approaches to this.

Firstly, Kotter (2007) emphasizes the importance of showing the connection between the change initiative and increased performance, to stop individuals from drawing the wrong. This can either be done through the company newsletter as suggested by Kotter, however, the findings from the study suggests other possible outlets such as meetings or through mail.

The second approach to this step is to carefully choosing succession of leaders, Kotter (2007) mentions that a succession can undermine a decade of hard work. To ensure better succession findings highlight the lack of change management education among management. Currently, there is a on boarding training program for management, where they are able to learn how to manage various situations. However, change management is not part of this. By introducing change management into the onboarding program, managers will have greater understanding of how to embody change.

6. Conclusion

In this chapter the research questions will be answered, the theoretical- and managerial implications discussed as well as areas for further research will be presented.

6.1 Answering the Research Question

The study highlights factors such as lead time, quantity inspection and workforce as performance variation. The conclusion is that there are several factors affecting the performance variation at the goods reception. The factors identified are workforce level, low competence level, space constraints, non-value-added activities, processing difficulties and poor recruitment criteria's.

Several actions can be taken to mitigate the identified causes of performance variation. The first step is the implementation of the proposed improvement initiatives, including the redesign of the prioritization system to support more agile and flexible operations, the introduction of cross-functional employee development to improve workforce flexibility and enable temporary staff replacement, and the establishment of standardized guidelines for processing goods into departments to prevent unnecessary storage at the goods reception.

Furthermore, activities that negatively affect operational efficiency should be relocated or reorganized, while new recruitment criteria should be introduced to ensure having a capable workforce. These actions can contribute to reduced performance variation, by having improved responsiveness, and a more stable and efficient goods reception process.

To ensure a successful and sustained improvement integration, actions have to be taken in the control phase of the DMAIC cycle by using Kotter's 8 step change model. Where it is crucial to establish a sense of urgency, forming a powerful guiding coalition, creating a vision, communicating the vision, empowering others to act on the vision, planning for and creating short term wins, consolidating improvements and producing still more changes and lastly institutionalizing new approaches.

6.2 Theoretical Implication

This study contributes to existing research by showing how the integration of Six Sigma's DMAIC methodology and change management principles can be applied to investigate and address performance variation in goods reception operations. The findings support previous research highlighting the importance of process flow, knowledge flexibility, communication, and lean logistics in achieving operational performance.

Furthermore, the study shows that performance variation is not only related to process factors but is also influenced by organizational and managerial factors. By combining quantitative analysis with qualitative insights, these findings provide an understanding of the factors affecting performance variation, where these suggestions can be applied in similar situations.

6.3 Managerial Implication

The findings from this study indicate that performance variation is affected by limited competence, difficulties in replacing absent employees, inefficient prioritization system and activities negatively affecting the operational flow. Further, the benchmarked site indicates that differences in internal working practices can impact the operational performance.

This means that companies should adopt workforce flexibility, competence development. Management should also ensure that systems at the goods receptions support agile and efficient decision making. By doing this the organization will be able to manage high operational flow. Meaning that goods are being processed in the right way from the goods reception into the store. This will result in detection of fault items in the deliveries and in turn reduce unnecessary costs.

Because of this, organizations may have to think about sacrificing some short-term performance and provide the necessary time to educate the personnel, in order to benefit in the long term. Additionally, organizations have to have strict recruitment criteria’s ensuring that all personnel are capable of doing all tasks, as well as providing the necessary training when new employees join the goods reception, to ensure a flexible workforce.

6.4 Further Studies

During the study, only the processes within the goods reception have been analyzed, leaving the THM (out-store transporter) and the Drive-In uninvestigated. The reason for excluding them from the investigation was partly based on the fact that the Drive-In is a completely separate unit, even though they belong to the goods reception, but also due to a lack of time.

Furthermore, the proposed improvement initiative includes reallocating activities to other departments in order to free up time and space within the goods reception. However, the potential implications that this may have for the other departments have not been taken into conclusion due to time constraints. This is therefore something that needs to be further investigated. However, observations from the conducted gemba walks indicated that the employees at the other departments appeared to have more idle time than the employees at the goods reception, although this is something that needs to be further investigated and backed up by data.

In addition to the identified root causes, other factors that might improve efficiency at the goods reception were identified but excluded from the study, as they emerged too late in the research process and were therefore not persuaded due to lack of time. One of these factors was a data system that considers the expected volume arriving that day and matches it with the necessary workforce capacity.

Another factor was the potential need for a greater communication system between the purchase department, the goods reception and the other warehouse departments, where the departments could be told the volume they are expected to receive that day. This could potentially result in the departments being able to plan their time better, as they know how much time they have to set aside unloading finished goods from the goods reception. By doing this, there could be a reduction in technical stockouts as well as enabling the in-store transporter to transport more goods from the goods reception to the departments, thereby reducing the storage build-up inside the goods reception.

Finally, as this study adopted a benchmarking approach where a similar site was examined to investigate what affects/influences performance variations, further studies could be conducted where other criteria are analyzed, such as internal layout design or delivery arrival times, in order to optimize them.

References

Adeodu, A., Maladzhi, R., Katumba, M.G.K.K., & Daniyan, I. (2023). Development of an improvement framework for warehouse processes using lean six sigma (DMAIC) approach. A case of third party logistics (3PL) services. *Heliyon, 9*(4). https://doi.org/10.1016/j.heliyon.2023.e14915

Baller, R., Fontaine, P., Minner, S., & Lai, Z. (2022). Optimizing automotive inbound logistics: A mixed-integer linear programming approach. *Transportation Research Part E: Logistics and Transportation Review, 163*, 102734. https://doi.org/10.1016/j.tre.2022.102734

Bell, E., Bryman, A., & Harley, B. (2022). *Business Research Methods* (6th ed). Oxford University Press. E-ISBN 978-0-19-264050-5

Blakeslee, J. A. Jr. (1999), Implementing the Six Sigma solution. *Quality Progress, 32*(7), 77–85.

Butt, A., Naaranoja, M., & Savolainen, J. (2016). Project change stakeholder communication. *International Journal of Project Management*, *34*(8), 1579-1595. https://doi.org/10.1016/j.ijproman.2016.08.010

Chatfield, C. (1986). Exploratory data analysis. *European journal of operational research, 23*(1), 5-13. https://doi.org/10.1016/0377-2217(86)90209-2

Guimarães, R., Almeida, L., Barros, M., Afecto, M. C., Figueira, M. L., Mota, D., ... & Lima, R. M. (2022). Restructuring picking and restocking processes on a hypermarket. *Production Engineering Archives*, *28*(1), 64-72. https://doi.org/10.30657/pea.2022.28.08

Harry, M. J., & Schroeder, R. (2000). *Six Sigma: The Breakthrough Management Strategy Revolutionizing the World's Top Corporations*. Doubleday, New York.

Hopp, W. J., & Oyen, M. P. (2004). Agile workforce evaluation: a framework for cross-training and coordination. *IIE Transactions*, 36(10), 919–940. https://doi.org/10.1080/07408170490487759

HORNBACH. (n.d.-a). *HORNBACHs historia*. HORNBACH Sverige. Retrieved January 22, 2026, from https://www.hornbach.se/varuhusinfo/hornbachs-historia/

HORNBACH. (n.d.-b). *HORNBACH som företag.* HORNBACH Sverige. Retrieved January 22, 2026, from https://www.hornbach.se/varuhusinfo/hornbach-som-foretag/

HORNBACH. (n.d.-c). *Om HORNBACH*. HORNBACH Sverige. Retrieved January 22, 2026, from https://www.hornbach.se/varuhusinfo/om-hornbach/

HORNBACH Holding AG & Co. KGaA. (n.d.). *History of the HORNBACH Group*. HORNBACH Holding. Retrieved January 22, 2026, from https://www.hornbach-holding.de/en/company/history

Jones, DT., Hines, P., & Rich N (1997). Lean logistics. *International Journal of Physical Distribution & Logistics Management*, *27*(3-4), 153–173. https://doi.org/10.1108/09600039710170557

Kalaiarasan, R., Agrawa, T.K., Olhager, J., Wiktorsson, M., & Hauge, J.B (2022). Supply chain visibility for improving inbound logistics: a design science approach. *International Journal of Production Research*, *61*(15), 5228-5243. https://doi.org/10.1080/00207543.2022.2099321

Korkusuz, D., Raharjo, H., & Bergman, B. (2011, December). Process capability analysis for non-normal distribution with lower specification limit. *2011 IEEE International Conference on Industrial Engineering and Engineering Management* 1466-1470. IEEE. https://doi.org/10.1109/IEEM.2011.6118160

Kotter, J. P. (2007). Leading change: Why Transformation Efforts Fail. *Harvard Business Review, 85*(1), 96–103.

Liebengood, S. M., Cooper, M., & Nagy, P. (2013). Going to the gemba: identifying opportunities for improvement in radiology. *Journal of the American College of Radiology*, *10*(12), 977-979. https://doi.org/10.1016/j.jacr.2013.08.016

Liliana, L. (2016). A new model of Ishikawa diagram for quality assessment. *Iop conference series: Materials science and engineering, 161*(1), 012099. https://doi.org/10.1088/1757-899X/161/1/012099

Martínez-Jurado, P. J., & Moyano-Fuentes, J. (2014). Lean management, supply chain management and sustainability: a literature review. *Journal of Cleaner Production*, *85*, 134-150. https://doi.org/10.1016/j.jclepro.2013.09.042

Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & Prisma Group. (2010). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *International journal of surgery*, *8*(5), 336-341. https://doi.org/10.1016/j.ijsu.2010.02.007

Montgomery, D. C. (2009). *Introduction to Statistical Quality Control* (6th ed.). Wiley.

Novin, M. M., Amiri, A., & Castagliola, P. (2026). A comprehensive review of time between events control charts: models, applications, and future directions. *Computers & Industrial Engineering*, *213*, 111789. https://doi.org/10.1016/j.cie.2025.111789

Oliveira, A. V., Pimentel, C. M. O., Godina, R., Matias, J. C. d. O., & Garrido, S. M. P. (2022). Improvement of the Logistics Flows in the Receiving Process of a Warehouse. *Logistics*, *6*(1), 22. https://doi.org/10.3390/logistics6010022

Pegels CC, Watrous C (2005), "Application of the theory of constraints to a bottleneck operation in a manufacturing plant". *Journal of Manufacturing Technology Management, 16*(3), 302–311. https://doi.org/10.1108/17410380510583617

Richards, G. (2017). *Warehouse management: a complete guide to improving efficiency and minimizing costs in the modern warehouse* (3rd ed.). Kogan Page. E-ISBN 978-0-7494-7978-7.

Schroeder, R. G., Linderman, K., Liedtke, C., & Choo, A. S. (2008). Six Sigma: Definition and underlying theory. *Journal of operations Management*, *26*(4), 536-554. https://doi.org/10.1016/j.jom.2007.06.007

Smith, D., & Srinivas, S. (2019). A simulation-based evaluation of warehouse check-in strategies for improving inbound logistics operations. *Simulation Modelling Practice and Theory, 94*, 303-320. https://doi.org/10.1016/j.simpat.2019.03.004

Tsarouhas, P., & Sidiropoulou, N. (2024). Application of Six Sigma methodology using DMAIC approach for a packaging olives production system: a case study. *International Journal of Lean Six Sigma, 15*(2), 247–273. https://doi.org/10.1108/IJLSS-06-2022-0140

Uluskan, M. (2016). A comprehensive insight into the Six Sigma DMAIC toolbox. *International Journal of Lean Six Sigma, 7*(4), 406–429. https://doi.org/10.1108/IJLSS-10-2015-0040

Vännman, K., & Albing, M. (2007). Process capability indices for one-sided specification intervals and skewed distributions. *Quality and Reliability Engineering International*, *23*(6), 755-765. https://doi.org/10.1002/qre.877

Wang, C. N., Nguyen, T. D., Nguyen, T. T. T., & Do, N. H. (2025). The performance analysis using Six Sigma DMAIC and integrated MCDM approach: A case study for microlens process in Vietnam. *Journal of Engineering Research, 13*(2), 538-550. https://doi.org/10.1016/j.jer.2024.04.013

Appendix 1 - Pilot Interview

Introduction

- Are you a full time employee?
- How long have you worked for Hornbach?
- Have you worked for another department before?
- How many are you on average that work in the goods reception?

Main questions

- Can you describe your main responsibilities?
- Can you describe the working procedure from start to finish?
- When do you experience the most stress at work?
- What have you been told about bypassing the quantity inspection?
- What is your main opinion on why bookings get bypassed? Does it vary from day to day on how many bookings are getting moved?
- What process do you believe is the most time consuming, and why is that?
- Do you have any idea of what the lead time is in general for deliveries to pass through the goods reception and end up at the line feeder?
- Does it usually occur that employees from the store comes and grab items from GM
- Can you describe the working culture? Do people help each other out?

Final question

- Do you have any suggestions for how to improve the goods reception?

Appendix 2 - Interview Questions Operators

Start

- How long have you worked at Hornbach?
- Have you worked at another department before starting to work at the Goods reception?
- Do you know all the tasks within the goods reception?

General

- Can you describe your main responsibilities?
- Do you know how long it takes on average to handle an internal delivery?
    - And how often do they arrive?
    - Does the time it takes to unload an internal delivery affect the number of pallets you are able to fully inspect?
- Does the time it takes to unload the internal delivery affect the number of external deliveries that you are able to quantity inspect?
- Do you know how many deliveries that it is allowed to alter the quantity inspection type on?

    - What have you been told about it?

Communication

- How often is it talked about goals and vision that the goods reception want to achieve
- How do you communicate with your bosses?
    - Do you have any morning or weekly meetings?
- Do you feel that your bosses are listening to what you have to say?
- Do you know what intel channels Hornbach have to hand out information to the employees?
    - How often do you check it?

Training

- Did you feel that you received sufficient training before starting the job?
- Do you feel that there would be a problem teaching everyone all the tasks in the GM?
    - Do you feel that it is important that everyone knows all the tasks in the GM?

Management

- When do you experience the most stress at GM?
    - Do the leadership help you during that time, for example steps in and helps to count or rearranges personal to help count (forces Peter to count)
- Do you feel that the leaders lead by example?
- Are there something you feel like the leadership don't do, but you wish that they did?

Change

- How do you view change? Do you think change in the goods reception department is important?
- What is required for you to work towards a change?
- If you have an improvement initiative, do you feel that you can communicate it with the leaders and that it is something that they consider testing?
- What obstacles do you see in changing from FIFO to using the occupancy board as the priority system?

Final questions

- Do you have any suggestions for how to improve the goods reception?

Appendix 3 - Interview Questions Group Leader

Intro

- How long have you worked at Hornbach?
- Did you work in another department before you started at GM?

General

- Can you describe your main responsibilities?
- Do you know how long it takes on average to handle an internal delivery?
    - And how often do they arrive?
    - Does the time it takes to unload an internal delivery affect the number of pallets you are able to fully inspect?
- Is it difficult to replace someone when they are sick due to the limited level of knowledge within GM?
- Who is allowed to change a full inspection into a basic inspection? Is it only you, or can all employees do it?

Training

- Did you receive any special training before taking over as group leader?
- Do you see any problems with teaching everyone in GM all balancing tasks?
- Are you aware that if you receive a product that comes in packs of 5, but you only ordered 4, you can report it to purchasing so they can adjust it for next time? That way, you will have less work to do in the future.

Management

- Do you feel that you receive the support from the department manager that is needed to do a good job?
- Do you feel that the manager leads by example?

Communication

- How would you describe the communication between you and the department manager?

- Do you feel that you have good communication with each other, and that the communication is accessible and clear?
- Do you feel that what you say is taken seriously, and that you have the freedom to try new ideas?
- How would you describe the communication between you and the employees?
- How do you communicate what needs to be done during the week?
- For example, do you have morning meetings?
- Do you follow up with your employees regarding how the work during the week has gone?
- How often do you discuss the goals and visions that the goods reception wants to achieve, if there are any?
- Do you communicate much with other departments?
    - For example, do they call and say that a pallet is ready to be picked up, or do you inform the garden department that you are placing a pallet in their red zone because their own area is full while the garden department has no incoming pallets?

Change

- How do you view change? Do you think change in the goods reception department is important?
- What is required for you to work towards a change?
- Do you try to drive change initiatives?
    - If not, why?
- What obstacles do you see in changing from FIFO to using the occupancy board as the priority system?

Appendix 4 - Interview Questions Department Manager

General

- How long have you worked at Hornbach?
- What are your main responsibilities?
- Did you receive any specific training before taking on the role as department manager?
- Have you received any training in change management?
- Do you feel that it is difficult to replace someone who is absent due to limited operational competence?
- Do you try to identify short-term wins?

Change

- How do you view change?
    - Is it important?
    - Are you open to change?
- Do you think change within the goods reception department is important?
- What would be required for you to be convinced to implement a change initiative coming from management?
- Do you try to come up with and drive change initiatives yourself?
    - If not, why?

Communication

- Are there goals and a vision for GM?
- How are the goals and vision for the goods reception department communicated?
    - If so, how often?
- How would you describe the communication between you and the group leader?
- Do you feel that the communication is sufficient?

Obstacles

- What obstacles do you see when trying to create change?
- What obstacles do you see in changing from FIFO to using the occupancy board as the priority system?

Creating engagement

- How do you work to help employees understand the importance of change?
    - Have you used data, customer feedback, or results to demonstrate the need for change?
- Is the group leader allowed to take independent initiatives and drive their own change proposals?
- If an employee comes up with a suggestion for improvement, is it considered and potentially tested?

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