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Improving Supplier Delivery Precision Through an OTIF KPI and Root Cause Analysis

A Case Study at Wellspect

Master's thesis in Supply Chain Management Master's Programme

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ABSTRACT

This study investigates how supplier delivery precision for inbound logistics can be measured and improved through an OTIF KPI. The research was conducted as a case study at Wellspect, a medical technology company, with the aim of increasing the visibility of delivery deviations and improve the supplier performance evaluation.

To address the research questions, a qualitative approach was applied, including semi-structured interviews with people across procurement, supply chain, logistics functions as well as analysis of internal data from the company's ERP system. The findings reveal that the current measurement is structured, but mainly outcome-based, from the compressions between requested delivery dates and goods receipt date.

The analysis identifies that NOTIF deliveries are caused by a combination of internal and external factors. Internal causes include planning inaccuracies, inventory- and ERP-issues. External factors include supplier-based deviations and transport disruptions. To address these limitations, an OTIF KPI was developed in a Power BI dashboard. The dashboard improves transparency and enables continuous monitoring by including filtering through order lines, suppliers and delivery terms.

The findings emphasize that improving inbound delivery precision requires more than just performance measurement. It also requires improved visibility, internal process alignment and a more differentiated supplier management.

Keywords: inbound logistics, OTIF, supplier performance, Power BI, incoterms, delivery precision, procurement.

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List of abbreviations

OTIF – On Time In Full

NOTIF – Not On Time In Full

KPI – Key Performance Indicator

Power BI – Power Business Intelligence

RQ – Research question

ERP – Enterprise Resource Planning

M3 – Infor M3 (ERP system)

SRM – Supplier Relationship Management

TBL – Tripple Bottom Line

DAP – Delivered at place

DDP – Delivered Duty Paid

FCA – Free Carrier

EXW – Ex Works

CPT – Carriage Paid To

RFI – Request for information

RFQ – Request for quotation

SLA – Service level agreement

PPAP - Production Part Approval Process

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1. Introduction

Reliable inbound deliveries from suppliers are mandatory in order to ensure material availability, stable warehouse operations and a high level of customer service. When inbound deliveries become unreliable, organizations might risk production interruptions, inventory shortages and inefficiencies in warehouse activities. These possible disruptions can affect the rest of the supply chain and thus a company's ability to meet customer demand. Therefore, managing and controlling inbound delivery performance is a critical aspect of supply chain management. (Bower, 2021)

To address these challenges, reliable and systematic ways of monitoring the inbound delivery performance are crucial. A well-designed monitoring system should include reliable metrics that can be extracted from a database. This enables companies to continuously track supplier performance and root causes deviations from planned delivery schedules. Such a system can improve visibility across the supply chain, support decision-making and provide a stronger foundation for supplier dialogues. (Durivage & Parker, 2023)

When measuring and evaluating delivery precision, OTIF (On Time In Full) requirements have become a common concept for companies worldwide. The OTIF concept focuses on ensuring that deliveries arrive at the right time and in the correct quantities. Achieving high OTIF performance allows companies to have material available which supports the right conditions to maintain effective warehouse operations. On the other hand, a NOTIF (Not In Time In Full) delivery can lead to problems with material availability or excess inventory. This can cause production delays and problems with order fulfilment, highlighting the importance of consistently meeting OTIF requirements. (Bower, 2021)

1.1 Background

Recent global disruptions, including geopolitical conflicts and the COVID-19 pandemic, have significantly impacted supply chains, leading to delays in logistics operations and increased uncertainty in inbound deliveries (Camur et al., 2024). This uncertainty is visible in supplier deliveries, where companies often lack clear information regarding when goods will be ready for shipment. Uncertainties and deviations in the suppliers' delivery performance may lead to either stockouts or overstocks for the buyer. Both scenarios are not good since the stockouts will lead to lost sales and backlogging penalties whereas overstocks will lead to tied up capital and holding costs (Kogan et al, 2018). As a result, managing the inbound delivery performance has become important for organizations in order to maintain stable operations and high service levels.

In order to address the challenges of suppliers' delivery performance, companies rely on performance measurement systems to monitor the delivery reliability. One commonly used indicator is OTIF, which evaluates whether deliveries meet agreed time and quantity requirements (Tian et al., 2024). However, achieving high delivery performance remains complex and the delivery performance is influenced by multiple interconnected factors within the supply chain. This includes coordination between

actors, efficiency of logistics processes and information regarding availability. This complexity makes it difficult to identify the root causes of delivery deviations.

1.2 Aim/Objectives

The purpose is to develop a reliable OTIF KPI in Power BI and increase the visibility of delivery deviation causes. This will be done by re-evaluating and improving the measurement of supplier delivery precision for inbound deliveries. To address the purpose of developing a reliable OTIF KPI in Power BI, it has been broken down into four study questions.

To get an overview of the current supplier performance and more specifically the current supplier precision at the case company, a research question which covers this area is needed. This can later serve as a reference when attempting to achieve improvements. Hence, the first research question is:

RQ1: How is the supplier delivery precision for inbound deliveries to the warehouse currently measured?

To be able to analyse the current supplier performance situation, it's not only about what the situation looks like, but also why it appears the way it does. To understand the underlying causes of the current situation is fundamental when trying to develop improvements. Therefore, the second research question is:

RQ2: What are the main underlying causes of deliveries not being on time and in full (NOTIF), and how can these causes be categorized in order to improve performance follow up?

To be able to see whether the supplier's precision increases, some kind of measurement is needed which can verify potential improvement. Still, it's important to consider the underlying causes somehow in the measurements since they form a basis of the numerical outcome. Thus, the third research question is:

RQ3: How can an OTIF KPI be developed to increase supply delivery precision transparency while accounting for root causes of NOTIF deviations?

Measurements and numbers often become easier to analyze and understand when they're visualized. To easier understand the numbers and the underlying causes, visualization could be helpful even for this study. This leads to the fourth research question of the study which is:

RQ4: How can the supplier delivery performance and NOTIF causes be visualized in a Power BI dashboard?

1.3 Limitations

The report focuses on re-evaluating and improving the measurement of supplier delivery precision. In the re-evaluation and improvement, the work will be based on the available data from the case company and not data from the suppliers. The findings and conclusions are therefore dependent on the quality, availability and completeness of this data. Only using data from the case company can somewhat

constrain the re-evaluation and improvement, but it is also necessary to ensure the study remains manageable. Trying to access data from different suppliers would increase the complexity remarkable.

The report also focuses on developing a more reliable OTIF KPI in an already existing modelling program called Power-BI, which the case company has already been using. Thus, the study will not create a new modelling program. This would require additional skills in programming and software which the authors do not have at their disposal for this study.

Since the study has a conducted time frame of around 20 weeks, the depth of qualitative data is restricted. Interviews and stakeholder inputs are mainly used to support the understanding of existing processes, practical requirements and data interpretation.

1.4 Outline

This thesis was divided into six main chapters, with each chapter contributing to the purpose and research questions in the study.

Chapter 1 introduces the background of the study, the problem description, the purpose, the research questions and limitations in the thesis.

Chapter 2 presents the theoretical framework and includes theories related to procurement processes, sourcing strategies, supplier relationship management, delivery precision, OTIF KPI, inbound logistics and supplier evaluation.

Chapter 3 describes the research methodology and how the study was conducted. The chapter includes the research design, data collection methods, interview processes, data analysis combined with consideration regarding validity and reliability.

Chapter 4 presents the empirical findings that was collected through interviews, internal documents, reports and Power BI analysis. The current supplier delivery performance measurement process is described in combination with delivery challenges and the developed OTIF dashboard solution.

Chapter 5 contains the analysis of the empirical findings in relation to the theoretical framework. Supplier delivery precision, sourcing strategies, supplier relationships, OTIF measurements and NOTIF causes are analysed.

Chapter 6 lastly presents the conclusions of the study by answering the research questions. This chapter also includes recommendations for Wellspect in combination with suggestions for future research.

2. Frame of reference

The purpose of this section is to discover previous research made within the scope for this specific research topic. Additionally, the purpose is not to review all the related theory, but to present concepts that are relevant to the purpose of this study. This will provide an idea of how unique this study is and what potential gaps might exist between this study and other research. To discover the specific research topic, scientific articles and reports will be used. This can also help to analyse and investigate the four research questions moreover.

2.1 OTIF KPI

Tian et al. (2024) conducted a research within the fresh food e-commerce, investigating how large retailers have improved their delivery precision in outbound distribution. The authors highlight that large companies such as Amazon and Walmart have managed to increase their OTIF levels from approximately 70% to nearly 98% over the period of a few years.

The improvement was mainly achieved through investments in logistics infrastructure, information systems and improved coordination in the distribution network. Companies focused on improving warehouse efficiency, optimizing transportation planning and increasing the visibility through tracking systems. By implementing these, they were able to identify bottlenecks in the distribution processes and take action. Another important factor was the use of performance measurement systems where OTIF is monitored. In many cases, OTIF KPI are integrated into supplier contracts and agreements, in order to achieve high delivery precision. With continuous monitoring and integrated feedback, companies are able to react quickly if deviations occur and improve the delivery performance. It is further highlighted that improvements in OTIF often require a combination of better collaboration between actors in the supply chain and operational improvements. This since it enables more accurate delivery planning and at the same time reduces the risk of delays or deliveries not being in full.

Tian et al. (2024) mentions that high OTIF performance requires investments in resources and distribution processes. On the other hand, distribution systems have limited resources to achieve optimal results. The key is in efficiently using available resources to meet OTIF targets. It is further mentioned that OTIF is usually presented as a percentage, representing the ratio of the deliveries that are on time and in full. In order to calculate this indicator, the number of in time and in full deliveries should be divided by the number of deliveries.

Another KPI that has been used in order to both monitor and influence the distribution processes is Delivery in Full (DIF), Delivery on Quality (DOQ), Delivery In Full and On Time (DIFOT) and Delivery on Time (DOT). DIF indicates the completeness of an order by dividing the Quantity supplied by the Quantity ordered multiplied.

DOQ is important in product distribution, since it indicates the quality of the delivery. In order to calculate this indicator, all non-conformities from the receipt of goods are needed to be identified. This is further calculated as $1 - \frac{\text{the quantity delivered with quality issues}}{\text{the Quantity ordered}}$.

DOT indicates whether the agreed delivery time is met and can be calculated by dividing the quantity ordered on time with the quantity supplied. In order to meet the DIFOT indicator, the previous DIF, DOQ and DOT are multiplied.

2.2 Procurement process

The procurement process is a cross-functional and complex function which in practice may vary to a great extent. The biggest issue with effective procurement is often described as being able to direct the efforts of the various organizational parties in such a way that the optimal result is achieved for the organization (Van Weele & Rozemeijer 2022). Thus, effective strategic purchasing fosters cross-functional integration among different supply chain activities and facilitates beneficial alignment of working-environments (Chen et al, 2004). Although different procurement processes may vary, they often include similar stages, according to Van Weele and Rozemeijer (2022). For example, the 3P-model of public procurement, described by Gandia and Volker (2023), is another similar useful model. Even though the model visually looks different it mostly includes the same steps as the linear procurement model. In addition, the different steps in procurement models comes with purchasing decisions that needs to be made. These decisions, described by Gandia and Volker (2023), can for example be to what extent use technical and functional specifications, how to select supplier, what type of contract to use and what type of buyer-supplier relationship to aim for (Gandia & Volker, 2023). These are similar decisions that Rozemeijer and Van Weele (2022) emphasizes need to be made in the linear procurement process.

As seen in Figure 2.2, the linear purchasing model is one useful model for visualizing how companies can achieve effective procurement decision-making by using a step-by-step cross-functional approach (Van Weele & Rozemeijer, 2022).



Figure 2.2: The linear procurement process, from Van Weele and Rozemeijer (2022).

Phase 1

The first phase in the procurement, “define specifications”, is about determining requirements. One of the most important parts here is deciding what products and activities to produce by the company itself and what to contract out to other actors. Defining technical and functional specifications is also an important part in this step to make sure the suppliers can meet the company’s expectations. The specifications can include quality-, logistics-, maintenance- and environmental requirements (Van Weele & Rozemeijer, 2022). Furthermore, integrating other functions in this kind of planning phase can facilitate alignment within the organization (Chen et al, 2004)

Phase 2

In the second phase, the company starts to conduct supply market research to later choose which supplier to do business with. Choosing who to do business with is a crucial point in the procurement process since relational supplier-facing purchasing and supply management practices directly affect business performance (Foerstl et al, 2016). The decision is based on the set specifications and how well the supplier is expected to be able to meet these requirements.

In general, the part about selecting suppliers contains three steps. The first step is preliminary qualification of suppliers. An initial bidders list is created which indicates which suppliers may be capable of performing the work. In the second step, preparation of request for information (RFI) and quotation (RFQ) is made. The request for information sent to all suppliers on the initial bidders list, requests for references from previous projects and experiences. Based on the RFI a shorter list of suppliers is created. Based on this shorter list, the request for quotation is about getting a proposal from the supplier about how the business can be done. After proposals have been received from the suppliers, the procurement department will weigh technical, logistical, quality, financial and legal aspects. This leads to a final decision about which suppliers the company chooses to do business with (Van Weele & Rozemeijer, 2022).

It is important that this part of the procurement process is not too cost oriented. If it is too cost oriented, it will lead to firms more often choosing the cheapest suppliers without considering important aspects like sustainability, risk management and supplier development enough (Ellram et al, 2020).

Phase 3

The third phase in the procurement process is negotiating and contracting the chosen suppliers. Contracts will most often include prices and terms of delivery, terms of payment, penalty clauses and warranty conditions but also other arrangements. The contracts serve as a foundation if either party fails to meet their obligations. Therefore, contracting suppliers in a proper way will be very important for companies to minimize exposure to supply risk. Incoterms have for many years been an important aspect regarding contracting suppliers worldwide. Incoterms works as a framework which defines and allocates responsibilities, tasks, costs and risks associated with transportation of goods. This helps buyers and sellers to arrange who will be responsible for transport, loading, offloading and paying for insurance etc. (Van Weele & Rozemeijer, 2022)

Phase 4

In the fourth phase, the ordering can start after the terms and conditions of the contract have been agreed. In today's industry, many companies' orders are initiated by electronic materials planning systems (MRP). This means that the MRP system will generate a signal to the procurement department to make an order when inventory levels are lower than the acceptable minimum. It's also important to consider how long it takes for the supplier to deliver the requested materials. International suppliers with longer delivery times will most often have to receive the orders earlier than local suppliers to be able to deliver on the same day (Van Weele & Rozemeijer, 2022). MRP systems have been shown to be able to improve delivery on time and operational performance, even in environments where the demand may be intermittent. This is done by the MRP system combining several factors such as buffers, production times, delivery lead times and demand etc (Rivera-Vargas et al, 2025).

Phase 5

The fifth phase in the procurement process is the expediting process which requires much of the buyer's attention since it is about continuously working and

communicating with the supplier. A firm's ability to integrate and reconfigure internal and external competences can engender synergistic and positive gains through collaboration (Chen et al, 2004). Quality and technical assistance programs, information sharing and joint problem solving are such forms of collaboration that have been shown to be key aspects in successful supply base partnership (Nishiguchi, 1994).

The expediting phase can help to ensure that the suppliers deliver on time and don't fall behind schedule. This can be done in a few different styles. One way is that the internal customer contacts the buyer and informs the buyer that they won't be able to deliver on time. Then the buyer must take immediate action to make sure the delay doesn't cause a disruption. Another way which is more often recommended is more of a preventive approach. Using this method, the buyer contacts the supplier in advance of the delivery to make sure everything is going well. This reduces the risk of unpleasant surprises before delivery. Thus, this approach is often better since it gives the buyer better conditions to replan in case disruptions occur (Van Weele & Rozemeijer, 2022).

Phase 6

Finally, the last phase is about evaluating the business with the suppliers and figuring out how to improve the performance of the relationship in the future. The supplier evaluation involves continuous monitoring performance parameters of strategic interest (Fitzpatrick, 1996). This helps to allocate the suppliers' actual capabilities, which can be useful for both the buyer and the supplier. The suppliers are informed how well they perform and how they can improve. The buyer on the other hand gets a clear overview of which suppliers can meet expectations continuously. In the future, this can help companies to reorganize their supplier base. Most common is that companies start working more closely with fewer suppliers with proven capabilities (Van Weele & Rozemeijer, 2022).

2.3 Sourcing strategies

Sourcing strategies define how the supply base is structured and how the relationships are managed and established with suppliers. According to Van Weele and Rozemeijer (2022), sourcing strategies should not only be based on portfolio analysis, but instead on a combination of internal and external analyses that support well based sourcing decisions. This is supported by Jenoui and Abouabdellah (2016), highlighting that sourcing decisions require balancing multiple criteria such as delivery time, cost, and quality when selecting suppliers. The development of a sourcing strategy is further described as a structured process that begins with an internal analysis of the company's business strategy, procurement spending, buying behaviour, contracts, specifications and requirements. This is then complemented by an external analysis of the supply market, including market trends, supplier capabilities and competitive dynamics. Sourcing managers can in some cases also extend the analysis further upstream by mapping the supply chain. This can be done in order to gain a better understanding of inventories, cost, logistics structures, sustainability performance and innovation opportunities.

By combining the internal and external factors, a category sourcing strategy can be formulated. Questions that are central to this process is whether the supply base should be expanded or reduced and from which geographical region the suppliers

should be sourced from. Van Weele and Rozemeijer (2022) mentions that reduction of suppliers should not be considered as the main goal. Instead reducing the supply chain risk, complexity and total costs of materials and service costs should be the main objective.

2.3.1 Single vs multiple sourcing

One of the different sourcing strategies is single vs multiple sourcing. The single sourcing consists of products that are purchased from one supplier, which therefore may indicate dependency and increased supply risk (Van Weele & Rozemeijer, 2022).

On the other hand, multiple sourcing can reduce dependency and supply risk, but with the downside of higher transaction costs. As highlighted by Jenoui and Abouabdellah (2016), the decision involves trade-offs between risk, cost and delivery performance, where supplier selection should be treated as a multi-criteria decision problem.

2.3.2 Global vs local sourcing

Van Weele and Rozemeijer (2022) mention that local sourcing may be preferable when flexibility, high delivery precision and intensive communication is required. Global sourcing can be favourable when it comes to sourcing standardized or bulk products, large price differentiation between suppliers for the same products, large quantities that favour transport economies. It is further mentioned that the decision should be based on the total cost of ownership and the degree of demand predictability.

This is further supported by Zeng et al. (2023), highlighting that firms often engage in local sourcing in order to improve flexibility and delivery reliability. Global sourcing, may on the contrary increase exposure to supply chain disruptions and uncertainty.

2.3.3 Partnership or competitive relationship

Partnership relationships can be preferred if the suppliers agree to open book calculations, willing to share the type of contractual arrangements and sensitive information. A competitive relationship requires placing tenders on a regular basis to previously approved suppliers. The total volume is then divided over the most attractive suppliers. This means that each supplier may receive different volumes from year to year. Competitive relationships are mostly used when many suppliers are available, commodities are purchased or when products are purchased in large volumes. (Van Weele & Rozemeijer, 2022)

Zeng et al. (2023) emphasize that closer relationships increase information sharing coordination and stability in the supply chain, but may also lead to higher dependence on suppliers.

2.3.4 Contract strategy

Van Weele and Rozemeijer (2022) mention that the sourcing manager can develop a contract by considering buying on contract or buying on spot basis. When buying under contract, the volume is bought at agreed price, and the buyer is informed regarding delivery. The disadvantage is that the total volume is sensitive to market changes. If the price is expected to increase, a contract that covers the total part of the procurement volume is preferred. If the price is expected to decrease, the opposite is

applicable. It is therefore common that companies use a combination of both spot and contract buying.

In volatile and uncertain supply chain environments, caused by trade disruptions or geopolitical tensions, contract strategy play an important role in risk management and supply stability. (Zeng et al., 2023)

Another factor that the sourcing manager can use when making the decision is basing the contract on price agreement or performance agreement. Price agreement can be sufficient when it comes to products with standard qualities. A more detailed SLA (Service Level Agreement) with agreements on tests, maintenance, delivery, guarantees is more appropriate when contracting specific products. (Van Weele & Rozemeijer, 2022)

2.4 Supplier relationship management

Supplier relationship management (SRM) is a crucial part of a company's procurement management and plays an important role in gaining competitive advantage. More outsourced processes also make companies even more dependent on their suppliers. Thus, finding ways to engage with suppliers to make them perform is very important.

2.4.1 Building sustainable relationships

Building sustainable relationships is about becoming closer and more collaborative with your suppliers. In parallel, the potential of business returns from these relationships might increase. Even though you want to create sustainable relationships, all suppliers shouldn't necessarily be treated equally. The business returns from the most strategic suppliers are usually bigger. Thus, companies should most often invest more time, energy and resources in the most critical suppliers who deliver the most strategic products. (Van Weele & Rozemeijer, 2022)

According to McQuiston (2001), sustainable relationships can be presented and built according to Figure 2.4.1. Relationships are supported by six core values, and they are all equally important. Shared goals and objectives are one of the core values, where both parties must be in line with what they aim to achieve with the relationship. This gives direction and reduces the chance of conflicts appearing. Another factor is mutual dependence, which reflects the extent of reliability on each other. Open lines of communication are also one of the key factors, and it is emphasized that transparent collaboration with transparent communication results in better understanding between the parties. This further leads to the parties being in line with each other. This, since open communication can resolve potential misunderstandings as changes can appear. Another contributing factor is trust, which is gradually developed as parties show their consistency and reliability in their actions. With trust, the uncertainty is reduced and supports the willingness to be a part of a long-term relationship. Mutual commitment is also a part of the six core values, since it reflects the intention of the parties to maintain the relationship over time and to invest in further development. Lastly, concern for others' profitability indicates when parties recognize each other's business interest and constraints. The parties can become less committed to the relationship if they do not receive the expected financial gain. (McQuiston, 2001)

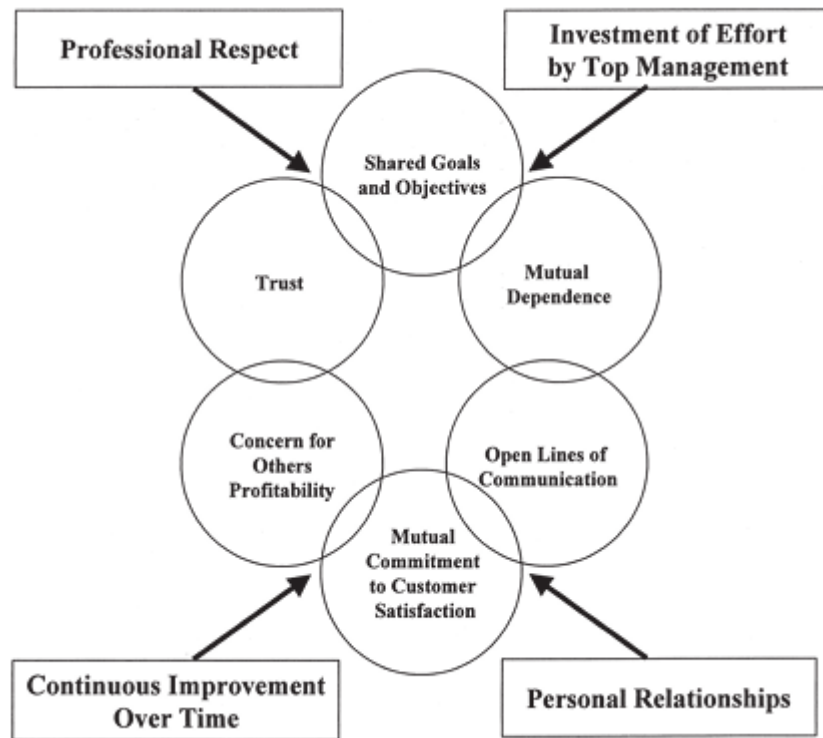


Figure 2.4.1: The conceptual model for building relationships (McQuiston, 2001)

Guarnieri and Trojan (2019) highlight that supplier selection is often described through the Triple Bottom Line (TBL), which emphasizes the integration of environmental, economic and social objectives in the supply chain decision making. The companies can influence sustainability performance across their supply chains when selecting suppliers. This is since many firms outsource their production and therefore relies on global network suppliers. Therefore, the responsibility for labour conditions, environmental impacts and ethical practices is transferred upstream. Purchasing organizations are thereby expected to evaluate suppliers not only on operational performance, but also on their compliance with environmental regulations, social standards and ethical norms.

It is further mentioned that sustainability-centered supplier selection requires a structured multi-criteria approach, since sustainability dimensions often involve conflicting and qualitative objectives. Environmental aspects may include criteria such as waste management, emissions and environmental management, while social and ethical dimensions may focus on labour conditions, human rights and compliance with legislation. These criteria should not replace but complement the traditional supplier evaluation dimensions. By incorporating social, environmental and ethical criteria into the supplier classification and selection, firms can enhance transparency, reduce supply chain risk and align purchasing decisions with sustainability goals. (Guarnieri & Trojan, 2019)

2.4.2 Supplier relationship development

To be able to implement SRM effectively in your business, Van Weele and Rozemeijer (2022) describe four management activities which needs to be done: control, manage, develop and innovate.

Control phase

The control phase focuses on creating professional procurement processes. That means clear routines and standard procedures with the suppliers are needed. This simplifies the business for both the buyer and the seller. Thus, suppliers will more easily know how to do business, what requirements need to be complied with and what performance is expected from the buyer. To reach that stage, companies should prequalify, audit and check the suppliers' financial and legal references. This will prevent the supply risk of doing business with the wrong type of suppliers but also make sure the chosen suppliers get onboarded in a proper way. (Van Weele & Rozemeijer, 2022)

Manage phase

When the controlling phase has been executed, the manage phase can start. The manage phase is about developing the business with the suppliers towards full compliance with the agreed contracts. In a real case scenario, there will be delays, quality issues and disruptions etc. This phase aims to coordinate activities and maintain stable operational relationships in order to ensure consistent performance. Continuous tracking and monitoring the performance is also an important part. In that way the buyer can provide feedback to the suppliers on how to perform better. In a best-case scenario, the supplier responds to the feedback by giving feedback back to the buyer. Then the buyer can start improving its own way of doing business as well, which leads to the next stage. (Van Weele & Rozemeijer, 2022)

Develop phase

As suppliers and companies begin to provide each other with feedback, a developing relationship starts to grow. The development phase aims to improve supplier performance and capabilities through structured follow-ups and feedback. This can be in terms of sharing specialist knowledge, providing supplier training programs, on-site consulting projects or problem solving with supplier teams etc. The development of suppliers requires the buyer to spend time and resources in order to make it successful. (Van Weele & Rozemeijer, 2022)

Innovate phase

The last phase, the innovative phase, represents the most collaborative supplier relationships with the most critical suppliers. This is where the supplier and buyer grow business together by working closely to innovate new processes or solutions for instance. Both parties are convinced that they can benefit from each other's expertise, knowledge and experience. (Van Weele & Rozemeijer, 2022)

2.5 Kraljic matrix

The Kraljic matrix was introduced by Kraljic (1983) in order to increase the strategic importance of purchasing. Initially, the model was referred to as the stages of purchasing sophistication. The framework is relevant for procurement analysis, since it highlights that suppliers and purchased items varies in terms of their importance to the buying organization.

The matrix is based on the assumption that strategy should be adapted according to the strategic importance of the purchased item and the complexity of the supply market. The strategic importance reflects the operational and financial impact of the

purchase on the organization. Supply market complexity includes factors such as entry barriers, availability of suppliers and supply risk. By evaluating the level of purchases on these two dimensions, four categories can be identified: non-critical items, leverage items, bottleneck items and strategic items. (Kraljic, 1983)

Van Weele and Rozemeijer (2022) further describe how the model can be applicable to suppliers, as they contribute to different levels of value and risk. Therefore, different sourcing strategies and relationships approaches are needed. They present the traditional portfolio matrix, as seen in Figure 2.5.1, but also the supplier portfolio matrix, as seen in Figure 2.5.2.

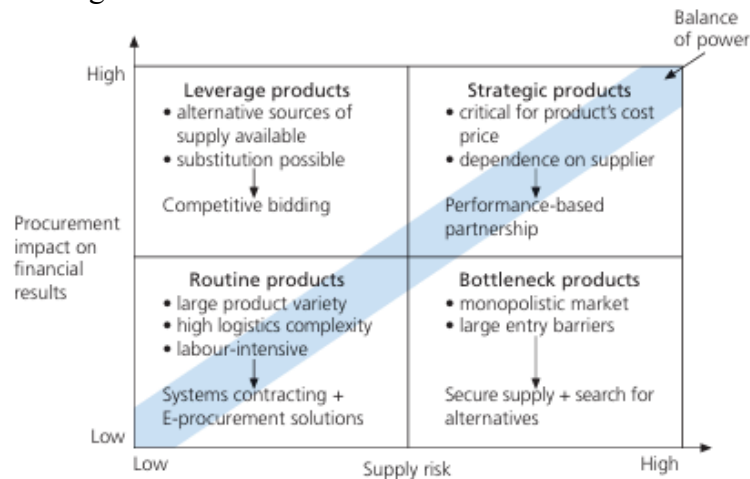


Figure 2.5.1: Procurement product portfolio (Van Weele & Rozemeijer, 2022)

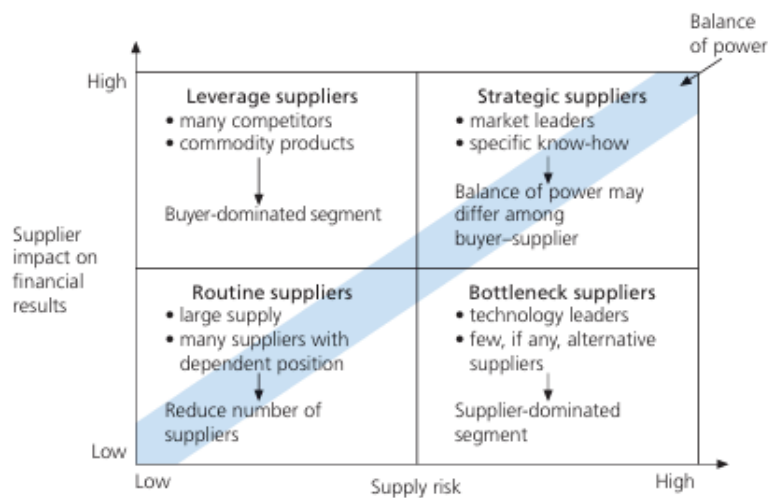


Figure 2.5.2: Procurement supplier portfolio (Van Weele & Rozemeijer, 2022)

2.5.1 Routine suppliers and products

Routine products have a low supply risk and low financial impact (Kraljic, 1983). These items are typically low-value products, standardized and can be sourced from many alternative suppliers. Van Weele and Rozemeijer (2022), point out that even though the products are inexpensive, the logistical and administrative cost associated with the purchasing may exceed the product value. The main sourcing objective is therefore to reduce the transaction cost and product complexity. Kraljic (1983) further suggests strategies such as simplification of order processes, standardization and order volumes optimization. Van Weele and Rozemeijer (2022), mention that efficiency can

be improved by reducing the logistical complexity, number of suppliers, e-procurement or outsourcing the procurement of routine items to specialized service providers.

2.5.2 Bottleneck suppliers and products

Bottleneck products are characterized by a high level of supply risk in combination with a low impact on the financial results (Kraljic, 1983). These products are often sourced from a limited number of suppliers, in some cases only one, which places the buyer in a dependent position (Van Weele & Rozemeijer, 2022). It is further emphasized that buyers should focus on risk mitigation strategies, such as identifying substitute products or alternative suppliers, maintaining appropriate inventory levels and improving forecasting accuracy. Consequences of failure to manage bottleneck products effectively, are according to Van Weele and Rozemeijer (2022), long delivery times, bad service, and high prices.

2.5.3 Leverage suppliers and products

Leverage products are associated with a low supply risk in combination with a relatively high impact on financial performance (Kraljic, 1983). These products are usually available from several sources and suppliers, which gives the buying organization a strong negotiating position (Van Weele & Rozemeijer, 2022). Therefore, sourcing strategies for leverage items often focus on exploiting purchasing power through price negotiations and competitive bidding. Kraljic (1983) highlights that successful management of leverage products requires access to accurate market and vendor data information in combination with forecasts related to prices and transportation rates. Due to the low supply risk, long term commitments through contracts are often less critical and sourcing strategies can remain flexible (Van Weele & Rozemeijer, 2022).

2.5.4 Strategic suppliers and products

Strategic products are characterized by a high level of supply risk in combination with a high level of impact on the company's financial performance (Kraljic, 1983). These products are often customized to specific customer specifications and represent a high share of the total cost of the final product (Van Weele & Rozemeijer, 2022). Due to the limited availability of alternative suppliers, it may be costly and difficult to change suppliers, which therefore increases the organization's dependence on the supplier. For this reason, long-term collaboration and close cooperation with the supplier is emphasized. Van Weele and Rozemeijer (2022) mention that partnership-oriented relationships are often most suitable, since they enable joint improvements related to processes, costs and product development.

2.6 Inbound delivery

Inbound delivery represents the combination of where procurement decisions are executed, and delivery performance becomes observable. Kalaiarasan et al. (2023) mentions that limited visibility in inbound logistics restricts organizations' ability to manage delivery deviations effectively. When deviations are detected late in the inbound delivery process, companies must react through corrective actions such as adjusting production schedules or increasing safety stock. These measures may therefore reduce the efficiency and increase the operational costs.

2.6.1 Delivery precision KPI

Delivery precision is a central aspect in the procurement performance, as it reflects how suppliers meet agreed delivery conditions. Ganguly (2025) investigates how on-time delivery by packaging suppliers affects the performance of restaurants. The study shows that supplier performance and transportation reliability influences the ability to maintain the operations in the restaurants. It also affected the service quality and the overall business performance of the restaurant, which highlights that delays in inbound logistics can affect customer satisfaction.

According to Van Weele and Rozemeijer (2022), measuring the procurement performance can help companies to improve decision-making since it identifies deviations between planned and actual outcomes. Analysing the variances can in turn help to identify the causes behind and plan actions to prevent them from occurring in the future. It is further emphasized that performance measurements should not be limited to monitoring outcomes, but also support continuous improvement and corrective actions. Therefore, the delivery precision can be improved by reviewing the procurement strategies and translating them into measurable and clear performance targets.

Trying to improve the performance of the procurement also requires strategies to be reviewed and translated into clear targets. When targets have been set, procurement KPIs are essential to properly evaluate and measure the procurement processes. Without any measurements for the targets, it will be very difficult to recognize any potential improvement or on the other hand if the suggested actions work badly. (Van Weele & Rozemeijer, 2022)

Performance measurements through key performance indicators (KPIs) enables organizations to evaluate whether procurement activities contribute to the defined objectives. Van Weele and Rozemeijer (2022) describe procurement performance measurements as the translation of operational and strategic goals into measurable indicators that allow for comparison and follow-up over time.

Accordingly, it is mentioned that procurement performance cannot be captured in a single indicator and instead requires a multiple KPIs covering different performance dimensions in areas such as cost, quality, sustainability and supplier relationship. Within the supplier relationship dimension, KPIs are used to monitor supplier operational performance. Examples given include rejection rates, delivery reliability, inventory turnover ratio, JIT deliveries and OTIF. The KPIs are distinguished between being measured on a continuous basis or assessed incidental, depending on their purpose and data availability. Incidental indicators are often used for assessments, audits or periodic evaluations while continuous indicators enable ongoing monitoring. (Van Weele & Rozemeijer, 2022)

2.6.2 Incoterms

Incoterms (International commercial terms) are standardized contractual clauses that are used in trades internationally. They are used in order to define how costs, risks and responsibilities are distributed between buyers and sellers during the delivery of goods (International Chamber of Commerce, 2020). They clarify which party is responsible for activities such as transportation, customs procedures, insurance and delivery coordination throughout the supply chain.

As international supply chains have become more complex with multiple actors, logistics processes and transport modes, incoterms act as a coordination mechanism. They connect agreements with logistical processes, ensuring that the responsibilities are clearly defined. They also contribute to more efficient logistical operations and reduce the risk of disruptions and misunderstandings. (Stojanovic & Ivetic, 2020; Van Weele & Rozemeijer, 2022)

Incoterms determine the extent of the sellers' logistical obligations and depends on the chosen term. According to Stojanovic and Ivetic (2020), the seller's responsibility can range between minimal involvement, when goods are available for pickup, to full responsibility. In that scenario, there is need for arrangement and management of the entire delivery process to the buyer's location. EXW (Ex Works), represents the lowest level of seller responsibility, where the sellers only make the goods available at their site (International Chamber of Commerce, 2020). The buyer is responsible for transportation and takes over the risk from that point. D-terms, such as DAP (Delivered at Place) and DDP (Delivered Duty Paid) represent the highest level of seller responsibility. The sellers manage the logistics processes which includes the transportation the buyer's destination. (Stojanovic & Ivetic, 2020)

F- and C-terms represent the intermediate level of responsibility. FCA (Free Carrier), requires the seller to deliver the goods to a carrier at a specific location. Thereafter, the responsibility is transferred to the buyer. The seller is only responsible for the initial stage of the logistical processes, and the buyer takes over the control of the transport. On the other hand, C-terms such as CPT (Carriage Paid To) involve the seller arranging transportation and the risk is transferred earlier in the process. (International Chamber of Commerce, 2020; Stojanovic & Ivetic, 2020)

The choice of incoterms depends on several factors, and companies choose terms that align with their ability to handle risks and manage transportation effectively. As highlighted by Stojanovic and Ivetic (2020), the selection is not only contractual preferences but also underlying capabilities and the structure of the supply chain.

3. Methodology

The following section outlines the approach for this thesis. It describes the conducted activities during the study, the concepts and applied methods.

3.1 Research design

The research design followed a case study approach by combining empirical data with theoretical frameworks to address the research objective. Case study research is well suited when the purpose is gaining an in-depth understanding of practices and processes in an organizational context. (Bryman & Bell, 2022)

The thesis followed an approach based on the principle of systematic combining, as described by Dubois and Gadde (2002). This is characterized by the continuous movement between empirical observations, theoretical frameworks and data analysis, compared to a linear research process. Instead of defining all analytical assumptions in advance, the research focus was gradually adjusted as insights arise from the empirical data. The approach is suitable for this case, since the objective was not to test predefined hypotheses, but to develop a measurement framework that is connected to the empirical context of the case company.

In this study, the analytical framework was defined by basic concepts related to delivery precision, such as on-time delivery and OTIF measurement. As the data was analyzed and discussed with internal stakeholders, the concepts were refined to reflect how quantities and delivery dates are interpreted and used in the company's systems. The research design furthermore integrated multiple sources of evidence, including qualitative input from internal stakeholders in combination with quantitative delivery data. The continuous interplay between data collection, analysis and theoretical reflection allowed the study to be flexible to new insights throughout the process, accordingly to the systematic combining (Dubois & Gadde, 2002).

3.2 Research process

The master's thesis was conducted during the spring semester of 2026 in collaboration with the case company Wellspect. The research process began with an initial pre-study phase, which included an overview of internal company systems, documentation and introductory meetings with key stakeholders at Wellspect. During this phase, the company describes its operations, roles, how the current supplier performance is evaluated and expectations for the thesis.

Based on the pre-study and initial discussions, the authors formulated preliminary research questions. These were refined through continuous dialogue with the company and by early insights from relevant literature. This is in line with the principle of systematic combining, where problem formulation, theory and empirical understanding develop in parallel rather than sequentially (Dubois & Gadde, 2002).

Afterwards, a background and theoretical framework was developed through secondary research. Course literature, scientific articles and textbooks were reviewed to establish a theoretical foundation related to supplier relationships, procurement processes, performance measurement and sustainability. The empirical phase focused on developing an understanding of the current delivery performance situation at

Wellspect. Quantitative data was therefore extracted from the company's ERP system. This data was analysed to identify patterns, inconsistencies and limitations in how delivery performance is currently measured.

In parallel with the quantitative analysis, qualitative data was collected through meetings and semi-structured interviews with internal stakeholders from relevant roles. These interactions were used to clarify how delivery dates, procurement process, supplier evaluation and responsibilities are interpreted in practice and to understand how the existing data is used in the decision-making processes. Insights from empirical findings led to revisiting and refining theoretical concepts, which is in line with Dubois and Gadde (2002) systematic combining approach.

The last stages of the research process focused on evaluating the current measurement approach and developing an improved tool through Power BI with OTIF KPI. Based on the analysis, improvement opportunities were structured and identified using analytical tools. The findings were discussed in relation to the theoretical framework and conclusions were drawn on how the supplier delivery performance can be improved in the case company.

Throughout the thesis work, regular contact was maintained with representatives from Wellspect through process updates and meetings. Additionally, continuous supervision was provided by Chalmers University of Technology to ensure that the research process followed academic requirements and standards.

3.3 Data collection

The data in this thesis was primarily collected from two types of research methods, a quantitative- and a qualitative method. A combination of the two approaches was considered most suitable to obtain as nuanced and comprehensive understanding as possible. In addition to the two research methods, literature reviews were made in order to get a better understanding of the relevant study area and its related models and concepts.

3.3.1 Quantitative data

The quantitative data collection method was applied to gather numerical data that enables measurement comparison and analysis of patterns related to the study. The data was extracted from the company's internal systems and reports, including information regarding mainly delivery dates, quantity, lead times and but also some other indicators. This contributed to a more objective evaluation and facilitated the identification of earlier trends within the collected data. Analysing earlier numerical measurements and an existing Power BI dashboard towards the customers, also provided valuable insights into how new measurements towards suppliers could be developed. Thus, the quantitative data collection method was helpful for both analyzing the current situation but also for developing a new OTIF Power BI dashboard. Once the new Power BI with OTIF KPI towards the suppliers was developed, this tool was also used to gather numerical data and analyse patterns. (Galletta, 2013)

3.3.2 Qualitative data

Parallel with the quantitative data collection method, a qualitative method was also applied. Qualitative data allows for exploration of experiences and perceptions which the quantitative method may not be able to capture. An interview guide was used to align with the research questions and by conducting semi-structured interviews with the people who are employed at the company. Therefore, the answers to our questions were obtained while allowing the employees to elaborate on other important aspects. In this study, interviews were held with managers and planners responsible for the supply chain and more specifically for the procurement. The qualitative method of data collection contributed to a better understanding of the current situation but also to the development of a new OTIF KPI. Furthermore, the collected data from the semi-structured interviews was organized into documents and analyzed, which allowed a map of the current situation. (Galetta, 2013)

Interview sampling

A sampling strategy was applied in the qualitative part of this study, meaning that the authors purposefully selected the respondents for the interviews. Sampling is a good strategy to ensure that the respondents have knowledge within the study area and that the answers provided are relevant (Mohammadi et al, 2025). In this study, the main criteria to be included in the interviews was that the respondent should have good insights and knowledge about the company's procurement. Thus, the different respondents in the interviews were a part of the supply chain team. The respondents possessed different kinds of knowledge and information since they were responsible for different suppliers and different parts of the procurement process. This led to the different interviews being more relevant for certain research questions than others in this study.

Regarding the first research question, the roles currently responsible for measuring, analyzing and summarizing the inbound delivery precision were out of most interest. This narrowed the size of the sample a bit since this is a more specific part of the procurement process. Still, the authors were open for additional perspectives which may verify what other perspectives had provided. Thus, the credibility would increase of the data collected from the interviews (Ahmad & Jan, 2018).

For the second research question the sample broadened. Regarding this research question, insightful perspectives could be given from almost all roles within the procurement and supply team. Struggles with deliveries can occur almost everywhere in the procurement process (Van Weele & Rozemeijer, 2022). Thus, it was important for the authors to have interviews with respondents with different roles, since they face different kinds of problems. This allowed the study to capture a wide range of causes of deliveries not being on time in full.

In the third research question, the sample was again targeted towards those who had been responsible for the measuring, analyzing and summarizing the inbound delivery precision. The interviews could this time give more inspiration and ideas for the authors rather than raw data. This was because the third research question was more about developing something new based on the analysis from data collected from the two previous research questions. Therefore, interviews weren't as relevant for this research question. More relevant was how the collected data from the interviews

related to research question 1 and 2, could contribute to the development of an OTIF KPI in research question number three.

For the fourth research question, the sample was quite similar to research question number three. This means that the roles responsible for measuring, analyzing and summarizing inbound delivery precision were targeted again. Since, the fourth research question aimed to create and develop something new, the interviews had like in research question number three more of an inspiring outcome.

Semi-structured interviews

Semi-structured interviews were decided to be the best option for this study. This was because the authors wanted to get answers related to the research questions but also be able to get other worthwhile insights from the respondents who had much experience. According to Galletta (2013), semi-structured interviews provide a balance between openness and structure, making it suitable for the researched subject. To secure that the respondents felt safe to provide as honest answers as possible, they were informed in the beginning of the interviews that they will remain anonymous in the report.

The semi-structured interviews were held in different rounds. The purpose of the first round of interviews was to get an overview of the current situation and to understand the problem on the depth for the authors. The business systems, programs and way of working at the company also needed to be introduced. Because of this, the first round of interviews had interview guides based on the respondents' specific roles. The authors had some preconceived thoughts about what they wanted each respondent to give them insights about, and the questions were adjusted based on the context and expertise of the respondent (Galletta, 2013). Thus, the interview guide was dependent on what role in the supply chain team each respondent had. The interview guides for this round of interviews were not sent to the respondents beforehand. This was because this round of interviews was more about becoming familiar with the situation for the authors rather than contributing as data to the study.

The second round of semi-structured interviews on the other hand, were more intended to contribute as data to the study. To make sure the answers provided was considered well by the respondents, the interview guides were in this round of interviews sent to the respondents beforehand (Kothari, 2004). The interview guides for this round were more related to the research questions, since the authors now had a good understanding of the situation from the previous interview round. Sometimes additional follow-up questions were asked based on the answers the respondents provided. As in the first round of interviews, the design of the interview guides was in this round dependent on what role the respondent had in the supply chain team. Furthermore, the interviews were held face-to-face e.g., not digital.

Table 3.3: Overview of interview participants

Interview code	Function	Interview was related to RQ number	Department	Date	Duration
R1	Planner I	2	Supply chain	2026-02-20	60 min
R2	Planner II	2	Supply chain	2026-02-23	35 min
R3	Procurement manager	1 & 2	Procurement and Supply Chain	2026-02-23	35 min
R4	Sourcing Lead	1 & 2	Materials & Purchasing	2026-03-02	60 min
R5	Customer Order Coordinator	3	Shipping & Receiving	2026-03-04	35 min
R6	Supplier Quality Engineer	1 & 2	Materials & Purchasing	2026-03-06	70 min
R7	Planner II	2	Materials & Purchasing	2026-01-26	40 min

3.3.3 Literature review

A literature review was conducted in order to establish the theoretical frame of reference for the thesis. This contributed to a broader understanding of the relevant research area and provided a broader understanding of frameworks, concepts related to the topic and other existing models. Scientific journal articles constituted the primary source of literature and were complemented by relevant industry publications and books. The literature was primarily sourced through Chalmers Library and Google Scholar. The articles were revisited throughout the thesis to deepen the understanding of concepts and to support the empirical findings, according to Dubois and Gadde (2002). Keywords and main topics used for this study included supplier delivery performance, OTIF, delivery precision and inbound logistics.

3.4 Data analysis

After the data collection was completed, an analysis of the data was made to see how the collected data were relevant as contribution to answering the research questions. The analyzed data were both data from the qualitative part with the semi-structured interviews, but also from the quantitative part with the delivery reports provided from the company.

3.4.1 Thematic analysis method

The qualitative interview data was analysed by using the thematic analysis method. According to Braun and Clarke (2006), thematic analysis is a method used to identify, analyse, and find patterns within the qualitative data. The method was considered

suitable by the authors for this study, since the interviews generated a combination of operational and process-related information that was connected to different areas and needed to be structured.

The process was inspired by the six-step process presented by Braun and Clarke (2006). Firstly, the interview notes and collected material were reviewed multiple times to familiarize with the data. Secondly, relevant observations and statements connected to supplier delivery precision, deviations, procurement processes, communication issues and transportation responsibilities were highlighted and categorised.

The quantitative delivery data was analysed using Power BI and Excel in order to identify patterns, different OTIF performances and trends related to NOTIF deliveries. Requested delivery dates, actual goods receipt dates and delivered quantities were compared in order to evaluate the delivery precision and identify deviations. Different filters and visualization tools were then used in Excel and Power BI in order to analyse the supplier performance based on different delivery terms, time periods and suppliers.

3.4.2 SWOT analysis

In order to structure the empirical findings, a SWOT analysis was applied as an analytical tool. According to Gould (2021), it is used as strategic planning tool in order to evaluate an organization's internal weaknesses and strengths together with external threats and opportunities that may influence its competitiveness. The purpose of conducting a SWOT analysis was to provide a structured mapping of the organizations current situation and to support the new implementations. The traditional structure was presented as a four-quadrant matrix, with one category in each quadrant. The purpose of this structure was to support defensive and offensive strategies. By clear identification of strengths and opportunities, the organization could leverage favourable conditions. Weaknesses and threats highlighted instead areas that required improvement.

Gould (2021) mention that SWOT focuses on internal factors such as processes, employees and organizational capabilities, while also pointing out external conditions that may affect performance. Internal strengths refer to areas where the organization performs well or have advantageous capabilities. Weaknesses represent areas that require improvement or have internal limitations. Opportunities arise from external developments that could influence the organization positively, while threats arise from external risks that may affect the organization negatively.

In this study, the SWOT analysis was used as a tool in the analytical phase where the existing delivery performance measurement is evaluated based on the strengths, weaknesses, opportunities and threats.

3.4.3 Analysis approach

The frame of reference provides the theories used to interpret the empirical findings to answer the research questions.

OTIF KPI and delivery precision are presented as tools for evaluating supplier performance and to monitor inbound logistics. Previous research highlights that OTIF performance is not only influenced by supplier capability, but also by factors such as information sharing, transportation planning, coordination and visibility in the supply chain. This theoretical perspective forms the foundation for analysing the current delivery precision measurement and developing an OTIF KPI, which supports RQ1 and RQ3.

The procurement process theory further explains how supplier selection with contracting, ordering, expediting and supplier evaluation influences the supplier performance combined with the inbound delivery reliability. The linear procurement process highlights the importance of structured supplier management, continuous follow ups and collaboration. These concepts are relevant for analysing how the current procurement process at Wellspect influences the delivery precision and NOTIF deliveries. This mainly supports RQ2.

The theories regarding supplier relationship and sourcing strategies emphasise that suppliers should not be managed identically, since different suppliers have different levels of importance and supply risk. Strategic suppliers require closer collaboration, continuous communication, while less critical suppliers can be managed through more standardized approaches. These theories support the analysis of supplier communication and follow-ups connected to delivery performance in RQ1 and RQ2.

Together, the presented theories create a framework that connects procurement processes, delivery precision measurement, supplier relationships and inbound logistics. This guides the analysis of the empirical findings and supports how supplier delivery precision can be measured and improved with and OTIF KPI in a dashboard, according to RQ4.

3.5 Validity, reliability and trustworthiness of thesis

The evaluation of case-based research should consider both validity and reliability, emphasizes Gammelgaard (2017). Similarly, Price et al. (2015) mention that reliability and validity are central criteria for evaluating the accuracy and consistency of the research findings.

Validity concerns whether the study analyzes and measures what it intends to investigate (Price et al., 2015). In this thesis, validity refers to whether the analysis reflects the structure, functioning and interpretation of the existing delivery performance measurement system. In order to ensure validity, the research questions are closely aligned with the purpose of the thesis. Interview questions were developed and based on the theoretical framework, to ensure that relevant aspects of performance measurement, procurement process, delivery precision and supplier evaluation were addressed. Furthermore, preliminary interpretations and findings were discussed with representatives from the case company. This feedback allowed the key stakeholders to confirm whether the analysis reflected their operational reality and therefore strengthened internal validity.

Reliability is referred to as the consistency of the research process and that its results can be compared, meaning that the study should enable transparent data analysis (Price et al., 2015). Therefore, semi-structured interviews were conducted with

predefined guides to ensure consistency across the respondents, but at the same time leave room for flexibility with follow-up questions. The guides are in line with the research questions and theoretical framework to ensure that all relevant themes are mentioned. Additionally, interviews are documented and some recorded, if allowed, in order to be transcribed and minimize the risk for misinterpretation. The selection of interview participants is based on their relevance to the thesis scope, including representatives from logistics, purchasing and supply chain functions. This wide selection of roles increases the likelihood that the collected information is relevant to the research area.

Trustworthiness is an important dimension of research quality and according to Connelly (2016) it is defined by four criteria: credibility, transferability, dependability and confirmability.

Credibility refers to the extent to which the findings represent the studied context (Connelly, 2016). In this study, credibility is strengthened through the integration of data, interviews and internal documentation. Transferability concerns the extent to which the findings may be relevant to others (Connelly, 2016). While the study focuses on a case company, the analytical framework, methodology and result of KPIs that can be integrated into Power BI, may be applicable to similar organizations. However, the findings are primarily context specific. Dependability relates to the consistency of the research process (Connelly, 2016). To ensure dependability, the interview procedures, analytical steps and research design are clearly described, to motivate the reached conclusions. Confirmability addresses the objective of the research and the degree to which the findings are shaped by actual data rather than researcher bias (Connelly, 2016). In this study, confirmability was strengthened through the documentation of the interviews by being recorded, when possible, in order to review the information.

3.5.1 Use of AI

Artificial intelligence tools have been used in order to improve language quality, assist with translations between Swedish and English and refine phrasings. The purpose of the usage has been to enhance clarity and readability of the text, as English is not the native language of the authors. This approach aligns with recommendations from Gatrell et al. (2024), who emphasizes that AI may be used as a supportive tool for tasks such as language formatting and editing as long as it does not replace human authorship and intellectual contribution.

Importantly, AI has not been used to generate any parts of the thesis and all data collection, analysis, interpretations and conclusions presented in this study are the result of the authors' work.

3.6 Societal, ethical and ecological considerations

The paper by Guerrero et al. (2018) mentions that sustainability challenges are often complex and require the combination of multiple tools and perspectives, rather than relying on a single method. In this thesis, the approach was integrated in the improvement of the delivery performance measurement within the organization. This by combining the quantitative delivery data with the input from stakeholders who worked with reporting and supplier follow-up.

Ethical considerations in this thesis were primarily related to the handling and collection of qualitative data and the use of internal company information. All participants involved in the interviews were informed about the purpose of the study and that the interviews may be recorded. This was with the purpose of transcription and in the cases of longer interviews. In order to protect the integrity and privacy of the participants, anonymity was ensured if the respondents did not accept their names or roles to be disclosed in the thesis. The interview data was only used for research purposes and handled with confidential manner. (Miles et al., 2020)

By developing a clear OTIF KPI, the study will better support the identification of delivery issues and their underlying causes. This will further help reduce unnecessary corrective actions in terms of logistics, such as urgent transport solutions caused by incomplete or late deliveries and re-deliveries. Over time, fewer corrective transports may lead to a more efficient use of transport resources and as a result, a reduced environmental impact.

4. Empirical findings and Analysis

This chapter presents the empirical findings of the study at Wellspect. The purpose of the findings is to describe the current delivery performance measurement structure, its setup and how it is used within the organization. In order to gain an in-depth understanding of the current measurement practices and systems, semi-structured interviews were conducted with employees in logistics, supply chain management and procurement. Table 3.3 presents an overview of the interviewed stakeholders.

The empirical findings aim to provide a structured description of the current state at the company, serving the foundation for the analysis in Chapter 5. The findings about the current state are presented in relation to the research objective of developing an OTIF KPI and improving the delivery performance measurement. Thus, the empirical findings can almost be divided into two parts. One part including findings about the current state and one part with findings from the developed OTIF KPI in Power BI. The research questions guiding the chapter are: (1) How is the supplier delivery precision for inbound deliveries to the warehouse currently measured? (2) What are the main underlying causes of deliveries not being on time and in full (NOTIF), and how can these causes be categorized in order to improve performance follow up? (3) How can an OTIF KPI be developed to increase supply delivery precision transparency while accounting for root causes of NOTIF deviations?, while accounting for root causes of NOTIF deviations? (4) How can the supplier delivery performance and NOTIF causes be visualized in a Power BI dashboard?

4.1 Case description

Wellspect is a medical technology company that specializes in products and solutions for bowel and bladder care. They develop, manufacture and market medical devices that are made with the scope of improving the quality of life for people with bowel and urinary dysfunction. (Wellspect, n.d.)

In order to support its operations and ensure product availability to their customers, Wellspect relies on inbound deliveries from a wide range of suppliers to their warehouse in Mölndal. The inbound flows are critical in order to maintain stable material availability and support downstream operations. If deviations occur in quantity or time, it may lead to planning disruptions and operational inefficiencies. Currently, the supplier performance data is extracted from the company's ERP system (M3) and further transferred into different Excel-files that extract the information into a monthly supplier report, where each supplier is identified by a unique supplier number. They are evaluated across several performance dimensions such as creditworthiness (Creditsafe), turnover, average lead time, delivery precision, number of serial deliveries and quality measures. Based on these metrics, suppliers are given a colour code classification such as green, yellow, orange or red. The colour indicates the supplier's overall performance status as well as specific classification on the given metrics. (R6, personal communication, March 6, 2026)

Wellspect has defined performance targets and unacceptable levels across several supplier criteria. They are based on general performance, sustainability, quality and delivery. For delivery performance, the targets are differentiated by supplier categories and include a minimum delivery precision which is set as between 90 – 95 % within $\pm 1 - 3$ days for certain categories (R6, personal communication, March 6,

2026). Depending on these parameters, the color-coded supplier classifications are set in the monthly follow-up.

Although this evaluation structure provides an overview of the supplier's performance, the delivery precision is not always correctly interpreted. The requested delivery date is specified in the purchase order, under DAP incoterms. However, the responsibility for transportation varies depending on the agreed delivery terms and supplier. This means that in some cases Wellspect assumes responsibility for transportation, while in other cases the supplier is responsible for the goods arriving at the warehouse on time. There have been situations where delays have occurred even when a supplier has dispatched the goods according to the agreed lead time. This is due to carrier related issues such as incorrect pallet quantities, misrouting via distribution centers or deliveries to incorrect locations. (R7, personal communication, January 26, 2026)

Certain suppliers operate under vendor-managed inventory (VMI) agreements, meaning that Wellspect share inventory levels and the supplier is responsible for maintaining agreed stock levels. Therefore, these suppliers are not evaluated on delivery precision as of the rest of the suppliers, but more on inventory accuracy and stock availability. In cases where the supplier's performance deviates from the defined targets, Wellspect typically engages in follow-up meetings and regular communication with the suppliers. This includes certain procedures in action plans aimed at restoring acceptable performance levels. (R6, personal communication, January 21, 2026)

In order to address these challenges, there is a need to re-evaluate how the supplier delivery precision is currently measured using updated delivery data and to develop a reliable OTIF KPI for the deliveries to the warehouse in Mölndal. By complementing the KPI with a structured overview of causes for deliveries that are not on time in full can therefore improve the transparency and support the decision making in logistics, planning and purchasing.

4.2 Delivery precision measurement

The delivery precision at Wellspect is monitored based on data extracted from the company's ERP system M3 and further analysed in Excel. Purchase orders, requested delivery dates, goods receipt registrations and supplier information are stored in M3. Within the system, each purchase order contains a requested delivery date, as of the date when the supplier is expected to deliver the ordered materials to the warehouse in Mölndal. When the goods are delivered, the delivery is registered through a goods receipt transaction, which records the actual delivery date. The delivery precision is then calculated by comparing the requested delivery date with the actual delivery date from the time of receipt. Below in figure 4.2 is a visualization of the current delivery precision measurement process.

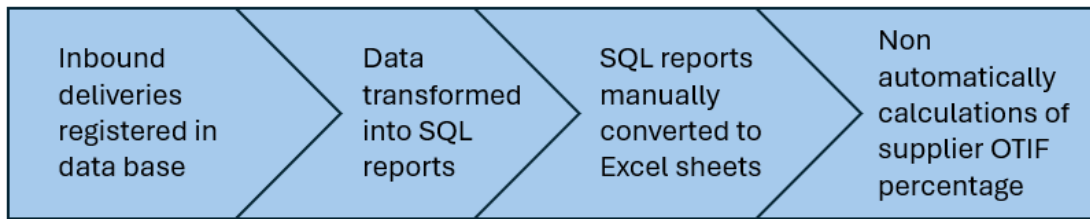


Figure 4.2: Visualization of the current delivery precision measurement process.

The delivery precision analysis is performed by transforming the data into an Excel dataset directly from M3, internally referred to as Purchased per Supplier-report. This dataset contains information both on a supplier level and detailed order data, providing a summary table with delivery performance indicators for each supplier and a detailed result table on deliveries. The summary table provides an overview of supplier data regarding the reporting period with several metrics. These include supplier name, total received quantity, received value of delivered goods, number of Vendor Managed Inventory (VMI) deliveries, number of project-related deliveries number of serial deliveries. For serial deliveries, they are differentiated into deliveries that were received on time and those that were received late based on different day-gaps. Gaps that are included are number of serial deliveries on time within +/- 1 day, outside the +/- 1 day and the resulting delivery precision calculated for the level. For exceptions there is also a +/- 2-day gap, in order to map down supplier performance on a larger tolerance. The use of the different days gaps is to compare the supplier performance. In most cases a tolerance of +/- 1 days is considered acceptable, but can be longer for less critical products.

With the current dataset of multiple tolerance gaps allows Wellspect to evaluate the supplier performance under different delivery precision standards. One example, related to the goods receipt process is that deliveries are tracked by lot numbers. If a supplier delivers a purchase order in multiple batches with different lot numbers, the delivery may be registered as multiple goods receipt even through it belongs to the same to the same purchase order line. The system can in such cases show two separate receipts for what is considered a single delivery, and it affects how the delivery is interpreted in the dataset and may need manual handling during analysis. Another potential issue related to purchase order lines is when the received quantity remains zero and no actual delivery date has been marked. This can be due to orders being cancelled, replaced or never delivered and in those situations the data may need manual review.

Additionally, the Excel dataset also contains a detailed result sheet, providing information regarding the orders. This includes factors such as supplier number, supplier name, purchase order number, order date, requested delivery date, actual delivery date, invoice date and received quantity. During the preparation of the excel dataset, the data is filtered ensuring that only relevant deliveries are included in the measurement. One example is deliveries marked with priority level 0, representing project-related deliveries. These may include sample deliveries, first deliveries of newly developed components or deliveries that require additional approval before acceptance. Such deliveries may involve longer lead times or additional testing and are therefore excluded from the measurement.

Another category that may be treated differently in terms of how critical the materials are can be identified through SI item numbers. These items have SI in front of each item number, representing consumables such as bags, gloves or other operational suppliers that are often purchased through internal procurement catalogues. These items are considered lower priority from a production planning perspective and are therefore not included in the monthly report with the largest, most important suppliers.

The monthly supplier report presents delivery precision by calculating the precision and using a color-coded classification system to provide a clear visual overview of the supplier's performance. Suppliers that achieve a delivery precision above the defined target are marked as green, indicating a good delivery performance. If a supplier fails to meet the delivery precision target during the period, the supplier is marked as yellow. This signals a warning and indicates that the performance should be monitored closely. If the supplier continues to miss the delivery precision target after three months, the classification advances to red, which indicates a severe delivery performance issue and requires follow-up.

The monthly reports serve as an important base for the twelve most important supplies indicating their performance. Annual or twice-a-year meetings with supplier evaluation are conducted cross functionally. These evaluations include delivery precision, quality performance and overall collaboration. The suppliers are graded as approved, require improvement or not approved. When deviations occur, a system correction is registered and if it is supplier related, a Supplier Deviation Report (SDR) is issued. The supplier is then required to provide a corrective plan and a root cause analysis.

4.2.1 Existing OTIF Power BI towards customers

To evaluate the delivery performance at Wellspect towards the customers, an existing OTIF Power BI dashboard is used to monitor the deliveries. The existing dashboard illustrates how the delivery performance can be measured and analysed in Power BI. This allows the management team to monitor the delivery performance to the customers. The target level for OTIF is set at 95%, meaning that 95% of customer order lines should be delivered in full and in time within the defined tolerance of +/- 1 day.

The OTIF dashboard is integrated based on data from sales orders in the company's ERP system. Each sales order represents a customer order with information such as planned delivery date, shipment status and ordered quantity. The dashboard extracts the data from delivery tables with dates and quantities that then are used to calculate the OTIF ratio.

In the system, each order line represents the planned delivery date and ordered quantity. The actual delivery date is then compared to the initially planned delivery date, and the order is marked as OTIF or NOTIF. If the order line does not meet the criteria, an additional sequence is added to identify the reason for the deviation.

In order to evaluate the reasons for the deviations, products are split in two groups: make-to stock order and make-to order. This, since they may require different delivery timings as a due date may be different depending on if the product is

manufactured specifically for one customer. To identify the cause of NOTIF, the system uses snapshot tables that shows the status of the order lines at different times. These snapshots allow the system to show when a deviation occurred, for example if an order was placed on credit hold between two dates. In that case the system shows delay due to credit hold. NOTIF reasons are placed through different codes that represents the state of the order line at the deviation time. Status code 10 represents preliminary order lines that have not been accepted yet, code 22 indicates that the order line was not allocated to inventory when the due date passes. When the order has been fully complete and the entire quantity has been delivered, code 77 is shown.

4.3 Procurement process

The procurement process at Wellspect involves several functions, including sourcing leads planners, procurement managers, supply chain engineers and quality representatives. Based on the conducted interviews and a general supplier selection form, procurement activities can be divided into contracting and supplier selection, operational purchasing and performance management. When contracting a new supplier, Wellspect uses a process which initially includes 8 steps until the chosen supplier is contracted. The first 8 steps are more of the managers' responsibility whereas the planners then take over the responsibility for ordering and having contact with the suppliers. Below is the identified procurement process at Wellspect described step by step in Figure 4.3.

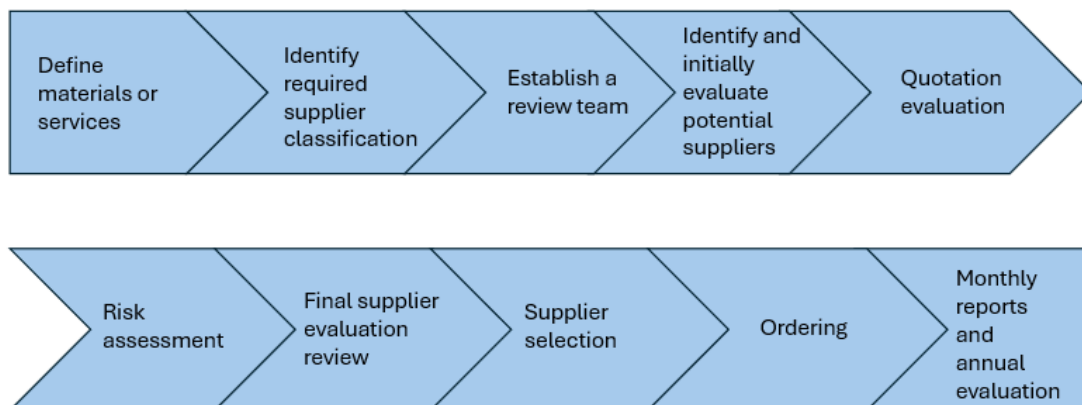


Figure 4.3: The identified procurement process mapped out.

The first step begins with clearly defining the materials or services and the underlying business need. When a new supplier is sourced in the development of new products, the process begins once R&D has defined the technical and functional specifications and requirements of the product or service. Product specifications are strict and highly regulated, and include material properties, dimensional tolerances, traceability standards and compliance with certifications such as ISO 13485 for medical components. The R&D department is responsible for the product requirements, while procurement is responsible for evaluating potential suppliers that are capable of meeting the requirements.

Next step is about specify required supplier classification in correlation with the set supplier selection strategy. The category for the purchase will either be direct material and service or indirect material and service. More important products or services will

require higher supplier classifications whereas less important products or services may be accepted to have lower classification for the supplier.

After this, a cross-functional supplier review team is established which later reviews the suppliers' commercial-, technical-, quality- and sustainability aspects. The purpose of the team is to assess whether suppliers meet requirements such regulatory compliance, financial stability, production capacity, sustainability standards and sometimes relevant experience. The review team comes in the end up with the suggestion of which supplier to choose based on their assessments and reviews.

In the next step, potential suppliers are identified through the existing supplier base, market screening, industry fairs or previous collaborations. A screening is allied by the review team in order to assess whether the suppliers have the right technical capability, certifications and organizational stability, in order to meet Wellspect's standards. Sustainability aspects and the acceptance of Wellspect's Code of Conduct are also evaluated in this phase. Not all suppliers require the same certification level, some medical components demand ISO 13485 and in most of the cases ISO 14001. Less critical components have lower formal requirements.

After the screening, a limited number of suppliers are requested for quotation (RFQ). At this stage, typically two or three suppliers receive detailed technical specifications, quality requirements and volume forecasts. The suppliers respond with offers including pricing and proposed terms. A supplier selection form is used in order to compare alternatives across multiple criteria such as certifications, price, company stability, sustainability performance. Respondents emphasized that price is an important factor, but not decisive on its own.

Later on, a risk assessment is conducted. The purpose is to identify and mitigate potential risks before entering into a contractual agreement. The risk assessment includes reviewing the suppliers' risks regarding communication, capacity, business continuity plan, sourcing, sub-tiers and experience with more. Based on the risk assessment, the supplier can either be acceptable or disqualified from the selection process.

Last step before the final supplier selection is to do a supplier evaluation review. This is more of a evaluation summary of the earlier reviews of the supplier. This final evaluation makes the basis for which supplier to choose.

Before a supplier agreement is signed, the decision must pass a formal gate review within the product development process. Cross-functional departments review whether commercial, technical and supply related risks have been correctly addressed. Only after approval from all departments can the contracts be signed. Once contracted, validation activities begin with initial samples being produced and evaluated. For critical components, a structured validation process referred to as PPAP is conducted. This process ensures that the suppliers production processes are stable, able to deliver according to specification and tolerances. The validation includes reviewing process parameters and ensuring that the production can be accordingly. Only after successful validation can the production start be approved.

Once the contract is agreed upon, orders can start to be made in accordance with agreed terms. The responsibility for the ordering, tracing the orders and communicating with the suppliers is for the planners. When orders are made, they are registered in the organization's system and delivery schedules are monitored.

Finally, the procurement process at Wellspect includes continuous monitoring. This is done through monthly reports to review how well the suppliers have performed in the last month. The monthly reports are also combined with evaluations which are most often made 1-2 times a year. The evaluations' purpose is to support decisions regarding how the supply strategy should be developed in the future.

4.3.1 Supplier dependency

The interviews showed that Wellspect mainly apply a single sourcing strategy for several critical suppliers and components. It was also mentioned that supplier changes within the med-tech industry are time-consuming and complex due to validation requirements, regulatory constraints and specific product specifications. Dual sourcing is not an alternative for critical components, due to the complexity of switching suppliers in combination with the long qualification processes. Instead, Wellspect manages supply risk through safety stock levels, long-term supplier relationships and close collaboration with their suppliers.

4.3.2 Supplier evaluation

The supplier evaluation form is the formal document to assess both new and existing suppliers. It includes commercial, quality, technical, sustainability and audit-related dimensions.

The evaluation process begins with basic supplier information and classifications, where suppliers are categorized from A-E. This classification determines the level of control that is required. Additionally, suppliers are assessed through Sustainable Sourcing Management (SSM) risk classification, which considers country risk, product/service risk and diligence screening results. These classifications have an influence on the required level of monitoring. The suppliers are also evaluated based on their commercial and capacity. Under the commercial evaluation, the suppliers are assessed based on financial stability, company size, and estimated share of business with Wellspect and ownership structure. The capacity assessment evaluates whether the suppliers have sufficient production capacity to meet the demand requirements.

The document also includes a specific field for additional criteria, such as Business Continuity Planning (BCP) and single sourcing considerations. Single sourcing is used for critical components to ensure long term relationships.

Quality certification requirements are evaluated under the quality section, where suppliers are required to show compliance with quality standards such as ISO 13485 or ISO 9001, depending on how critical the material is. Sustainability is evaluated in the next section, where it includes requirements for ISO 14001, supplier's code of conduct and sustainability self-assessment. The next phase is the technical evaluation which assesses experience, personnel expertise, equipment, process capabilities, material knowledge and facility standards. A quality, sustainability and technical evaluation is made based on the given factors and the suppliers are categorized into acceptable, acceptable pending actions, not acceptable or not applicable. The form

also includes a part for on-site audits, and can result in suppliers being approved, placed under evaluation or disqualified.

4.3.3 Ethical, societal and ecological considerations

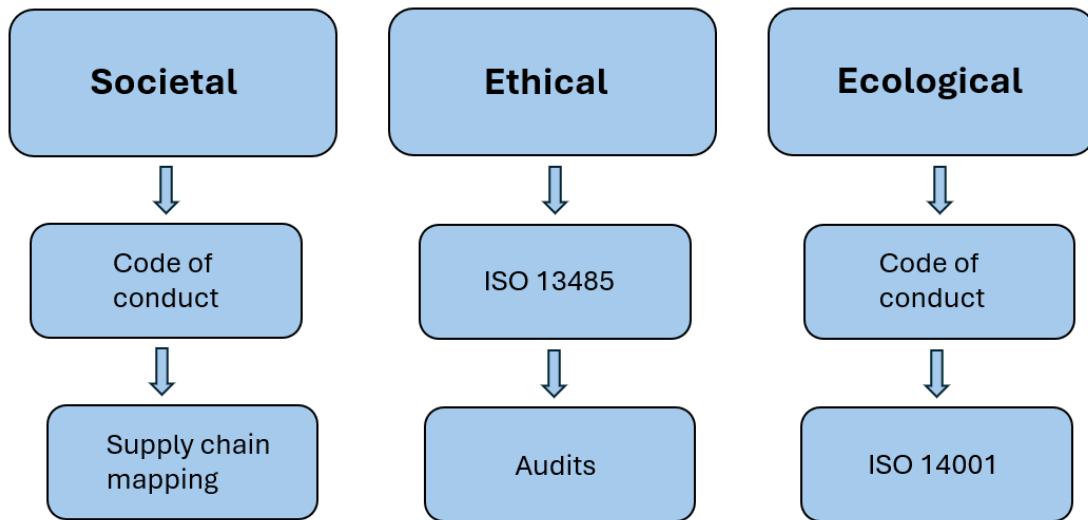


Figure 4.3.3: Illustration of the identified actions and considerations within the sustainability categories societal, ethical and ecological.

Ethical and sustainability considerations are integrated into the procurement process at multiple levels as shown in Figure 4.3.3. All suppliers must sign Wellspect’s Code of Conduct in order to be approved and included in the supplier database. The code establishes minimum standards related to human rights, working conditions, responsible sourcing and environmental responsibility.

In addition to signing the Code of Conduct, certain certifications are required. For medical components, ISO 13485 is typically mandatory, while ISO 14001 are required for some suppliers. Suppliers for other less important products are evaluated based on risk and how critical the component is. Supply chain mapping and risk-based evaluation of suppliers is conducted in order to increase visibility beyond tier one suppliers, especially in higher risk regions. The Code of Conduct supports this by requiring suppliers to ensure compliance throughout their supply chain.

If necessary, Wellspect conduct audits and corrective action plans in terms of deviations. Since the medical products such as the different types of catheters are used on patients, ethical considerations must be made regarding if the observed deviations can be dangerous for the patient. Furthermore, the products must be safe throughout the whole lifetime when they are being used. Thus, it’s not acceptable if a deviation can lead to problems after being used for a while.

The sustainability requirements for the products and its related processes are increasingly driven by customer demand. Public healthcare authorities are continuously following and reviewing Wellspect’s business activities. Therefore, in some market’s sustainability performance can influence the competitiveness of tenders. Not meeting sustainability requirements can sometimes lead to customers doing business with competitors instead and lost market shares, like respondent 4 said:

” If we don't deliver to the regional council on time, we'll incur penalties, or in the worst case they'll have to find another option. If they switch to our competitors, they'll keep using the competitor and then we'll lose our share of the market”

4.4 Delivery challenges

Interview respondents described several operational challenges that can affect the delivery performance in the inbound supply chain. These challenges can be tracked from multiple sources, including internal planning processes, supplier related issues, transportation conditions and external factors such as seasonal disruptions or geopolitical events.

Once suppliers are validated and contracted, the procurement process is transferred into operational purchasing. Purchase orders are placed in the ERP system M3, primarily by planners. The system generates signals based on parameters such as safety stock levels, reorder points and supplier lead times. Internal system inaccuracies such as incorrect lead times, inaccurate parameter settings and delayed inventory reporting result in order being placed too late. In some cases, system data indicated inventory in stock even though physical inventory was insufficient, leading to delay.

Respondents also described how the complexity of the production can influence delivery deviations. It was explained that even if small deviations are found in large batches, the entire batch will be placed under evaluation. It will be blocked from further processing until the issue has been investigated and resolved, in order to ensure that the rest of the products are safe to use.

Delivery terms vary across suppliers and influence how delivery performance is measured. According to the respondents, the most commonly used incoterms are DAP (Delivered at place) and FCA (Free Carrier), while EXW is used less frequently. In DAP, the supplier is responsible for transportation until the goods arrive at Wellspect's warehouse. Under FCA, the responsibility is transferred when goods are at the carrier, while Wellspect measures delivery precision based on delivery arrival at its facility. This means that deliveries can be classified as delayed even if the supplier dispatched the goods according to plan. The delay can be caused by factors such as transportation disruptions, customs delays, issues in terminal handling or incorrect documentation.

External factors were also mentioned as potential contributors to delivery disruptions. Examples were given to freight disruptions, seasonal effects such as holidays in supplier regions and geopolitical developments that can affect the supplier capacity and delivery schedules, as seen in Figure 4.4.1.

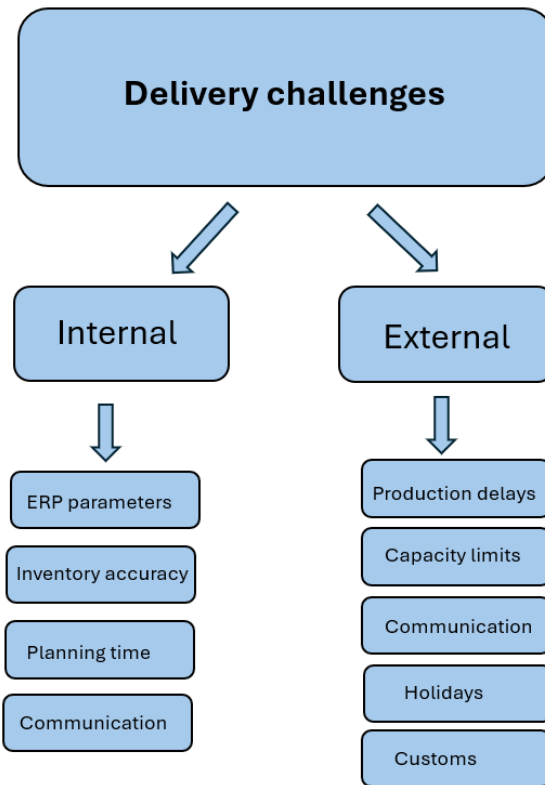


Figure 4.4: Illustration of the identified internal and external delivery challenges

4.4.1 Supplier relationships

According to the interview respondents, the communication with suppliers varies depending on how critical the suppliers are. Strategic suppliers generally have more structured communication, while less critical or smaller suppliers are mainly contacted when specific issues arise. It was explained that regular meetings with key suppliers are held weekly, monthly or twice per month. They often include multiple departments such as procurement, planning and supplier quality engineers. The purpose of these meetings is to discuss potential issues, ongoing deliveries and follow up on the supplier performance.

For less critical suppliers, the communication is less formal and more based on when situations occur and is mainly through email. Contact is usually initiated with questions or if problems occur, typically related to delayed deliveries or issues with the order. If the issues are not addressed by the suppliers, additional meetings may be arranged to solve the problem. It was described during the interviews that close dialogue with suppliers have contributed to transparency, improved collaboration and problem solving. One example that was given is if the production department identified that a delivered component does not meet the required specifications. The issue is further communicated to the supplier. In such cases, the supplier may be required to internally investigate the issue and provide a root cause analysis in combination with how similar issues may be prevented in the future.

Wellspect also conducts supplier visits when necessary. These visits may involve departments such as engineering, quality representatives and procurement, in order to review their supplier's production processes. These visits typically strengthen the collaboration with their suppliers at the same time as challenges are discussed.

Several respondents mentioned that Wellspect aims to maintain long-term relationships with their suppliers. One of the reasons that was mentioned was that introducing a new supplier can be a long process and can take up to two years, due to validation and regulatory processes. Due to this, it is preferred to maintain stable relationships with existing suppliers.

4.5 OTIF KPI in Power BI

The developed Power BI which measures the delivery precision from the suppliers does that with help from an OTIF KPI. The calculations for the OTIF KPI are automatically made by the computer in the developed Power BI which only shows the delivery precision percentage, but this is the explanation of the underlying calculations.

The OTIF KPI is dependent on two factors. First factor is when the deliveries arrive and the second factor is what the quantities are. If at least one of these factors is not fulfilled for the specific order, it will cause a NOTIF delivery. Otherwise, if both factors are fulfilled it will be categorized as an OTIF delivery. To get the delivery precision for a specific supplier, the number of OTIF deliveries are divided by the total amount of deliveries. The delivery precision will then be shown as a percentage, indicating how many deliveries that has been OTIF deliveries. Specifying within which time frame the delivery precision is being measured is also important. The deliveries included in the calculations must be within that period to give the right delivery precision percentage.

4.5.1 Visualization in Power BI

The developed Power BI dashboard by the authors, connects information from the internal business systems and reports. The information which the Power BI bases on, comes originally from the internal database which is transferred into the business system M3 but also SQL (Structured Query Language) reports. The developed Power BI cannot fetch the data from the M3 system or the SQL reports. Therefore, the data is transferred into Excel sheets which the Power BI can fetch the data from, as seen in Figure 4.5.1.

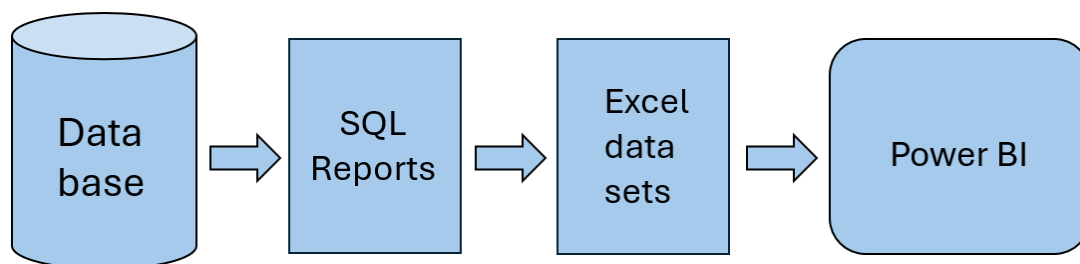


Figure 4.5.1: Illustration of the used data in Power BI.

After the extraction, a new column is made in the Excel dataset where the In Full column is multiplied with the On Time column. If the order is on time and in full, a value of 1 is given in each column, as in Figure 4.5.2. On the opposite, if the order is not on time or not in full a value of 0 is given. The values are thereafter multiplied in a new column. On time deliveries multiplied with in full deliveries will result in the value 1 in the OTIF column, meaning the delivery is OTIF. Otherwise, the value 0

will be shown in the OTIF column, meaning NOTIF delivery. The total values of the OTIF column are divided with the total number of deliveries, in order to achieve a percentage of the OTIF deliveries, as in Figure 4.5.3 and Figure 4.5.4.

Purchase Order Number	Purchase Order Line	On Time	In Full	OTIF
SExxxxxxx	xx	1	1	✓
SExxxxxxx	xx	1	1	✓
SExxxxxxx	xx	1	1	✓
SExxxxxxx	xx	1	1	✓
SExxxxxxx	xx	1	0	✗
SExxxxxxx	xx	0	1	✗
SExxxxxxx	xx	0	1	✗
SExxxxxxx	xx	0	1	✗
SExxxxxxx	xx	0	0	✗
SExxxxxxx	xx	1	1	✓
SExxxxxxx	xx	1	1	✓
SExxxxxxx	xx	0	1	✗
SExxxxxxx	xx	0	1	✗
SExxxxxxx	xx	0	1	✗
SExxxxxxx	xx	0	1	✗
SExxxxxxx	xx	0	1	✗
SExxxxxxx	xx	1	1	✓
SExxxxxxx	xx	0	1	✗
SExxxxxxx	xx	0	1	✗

Figure 4.5.2: Overview of orders in time and in full, in the Power BI dashboard.

Compared to the internal business systems, these Excel sheets do not update themselves with real time data. This means that an updated version of the Power BI dashboard with the recent deliveries from the suppliers, requires new downloads of the data from the internal systems with new created and updated Excel sheets. Once the new Excel sheets are created and uploaded into the system, the Power BI dashboard can update itself with the latest information.

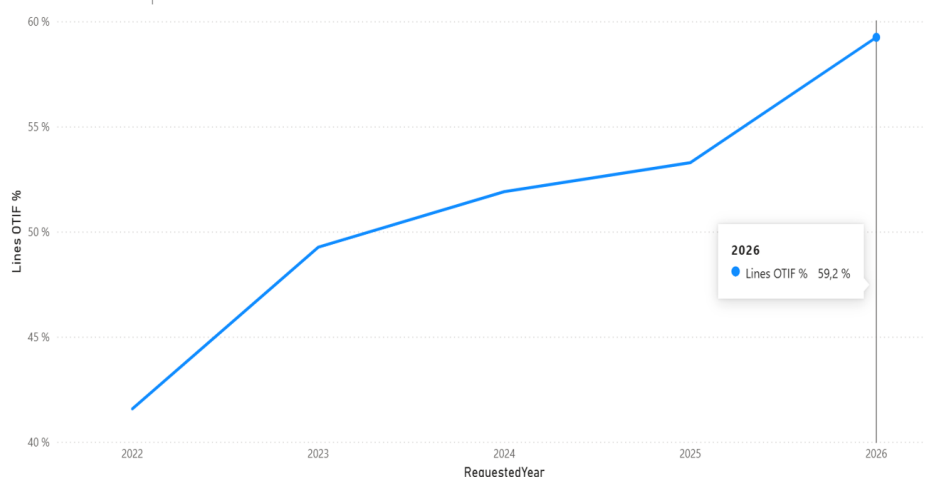


Figure 4.5.3: Chart in the Power BI dashboard showing the OTIF percentage during different periods

The Power BI bases on information from the Excel data set about the suppliers, the orders, requested quantities, received quantities, requested delivery dates and actual

delivery dates. All the data for these categories are only related to the specific division of the warehouse within the company which are being investigated. The Power BI analyses and creates links between the information from the internal business systems and the reports. An external Excel data set is made with a summary of the active suppliers and their incoterm. The Power BI can put together gathered data and show information on the dashboard which necessarily aren't taken from the same information source. To exemplify, the Power BI dashboard shows the OTIF percentage for suppliers with the same incoterms even though the incoterms and OTIF percentage data come from different information sources. The Power BI dashboard doesn't show most of the underlying data. Instead, only the most important data is showed to reduce the messiness and priority clarity. The prioritized categories are the suppliers, the incoterms, the orders and the OTIF percentage.

Supplier	Supplier name	Delivery terms	%GT #Lines due	Lines OTIF %
SExxxx	Supplier A	DAP	24,31%	92,3 %
SExxxx	Supplier B	DAP	6,59%	89,1 %
SExxxx	Supplier C	DAP	6,45%	90,9 %
SExxxx	Supplier D	CPT	3,80%	55,5 %
SExxxx	Supplier E	FCA	3,64%	3,5 %
SExxxx	Supplier F	FCA	3,21%	9,3 %
SExxxx	Supplier G	FCA	3,04%	73,3 %
SExxxx	Supplier H	FCA	2,00%	43,1 %
SExxxx	Supplier I	DAP	1,92%	50,9 %
SExxxx	Supplier J	FCA	1,49%	12,0 %
SExxxx	Supplier K	DAP	1,36%	81,1 %
SExxxx	Supplier L	FCA	1,34%	18,0 %
SExxxx	Supplier M	DAP	1,17%	18,9 %
SExxxx	Supplier N	EXW	0,89%	14,2 %
SExxxx	Supplier O	CPT	0,86%	41,9 %
SExxxx	Supplier P	FCA	0,75%	36,6 %
SExxxx	Supplier Q	DDP	0,74%	62,1 %
Totalt			100,00%	50,3 %

Figure 4.5.4: Overview of OTIF in relation to delivery terms and number of order lines.

In the dashboard it's possible to use filters if the OTIF percentage for a certain category wants to be showed. By simply pressing on a specific supplier, delivery term or order, the Power BI dashboard will show the OTIF percentage for that specific category. As shown in Figure 4.5.4, the all-time overall OTIF percentage for all the suppliers are about 50%. Furthermore, the figure shows how big share of the total amount of the deliveries a single supplier has. This is shown in the column "#Lines due".

Delivery terms	Lines OTIF %
CPT	48,7 %
DAP	84,3 %
DDP	46,4 %
EXW	9,9 %
FCA	22,7 %
Totalt	50,3 %

Figure 4.5.5: Overview of OTIF percentage in relation to delivery term in the Power BI dashboard

In Figure 4.5.5, the result for the delivery precision for suppliers with certain incoterms is shown. This was seen as one of the more interesting categories and therefore the result is shown above. As mentioned earlier in the empirical findings, different filters can be used to show the same results but for other categories. This can for example be the delivery precision for certain suppliers or within a specific time frame.

5. Discussion

This chapter presents the empirical findings in relation to the theoretical framework in order to answer the four research questions. The purpose is to analyse the current approach to measure the supplier delivery precision and to identify how the company can improve its OTIF performance.

The discussion is guided by the research questions: (1) How is the supplier delivery precision for inbound deliveries to the warehouse currently measured? (2) What are the main underlying causes of deliveries not being on time and in full (NOTIF), and how can these causes be categorized in order to improve performance follow up? (3) How can an OTIF KPI be developed to increase supply delivery precision transparency while accounting for root causes of NOTIF deviations? (4) How can the supplier delivery performance and NOTIF causes be visualized in a Power BI dashboard?

5.1 NOTIF reasons

The empirical data indicates that the delivery deviations, NOTIF, are not caused by a single issue, but from a combination of internal and external factors. This means that delivery problems could be seen as a system problem and not always as a supplier issue. This is in line with the theoretical perspective by Van Weele and Rozemeijer (2022) that procurement performance should not only rely on quantitative measurements like KPIs. Instead, it should also be analysed in more qualitative aspects as well to be able to identify deviations between planned and actual outcome, in order to have corrective actions (Van Weele & Rozemeijer, 2022). However, the current measurement system does not clearly differ between different causes of deviations. This means that the KPI may give a simplified picture of reality and in some cases place responsibility on the suppliers even in the cases when the cause is transport-related or internal. The identified NOTIF reasons are structured into internal and external categories, allowing a clearer understanding of how the delivery precision can be improved.

5.1.1 Internal and external OTIF challenges

Several internal identified in the empirical data, including inaccuracies in ERP parameters such as reorder points and lead times, insufficient inventory accuracy and delays in planning and internal communication. Respondents described situations where the internal systems indicated available inventory, while there was a shortage which resulted in late placed purchase orders. Additionally, incorrect planning parameters and delayed updates in inventory levels contribute to an incorrect order placement. The operational consequences of delivery deviations are also in line with Ganguly (2025), emphasizing that supplier delivery reliability affects downstream operational performance and service quality. This means that this part of the NOTIF performance is not related to the supplier, but to internal process inefficiencies.

From a theoretical perspective, this can be in line with the importance of accurate data and structured processes within inbound delivery management. Kalaiarasan et al. (2023) emphasize that inaccurate information and limited visibility in inbound logistics restricts organization's ability to manage and detect deviations. At the same time, Van Weele and Rozemeijer (2022) highlight that performance measurement should support continuous improvement with the identification of root causes. In this

case, the internal inaccuracies and planning inefficiencies show that the current system does not fully enable to proactively detect deviations. Instead, they react as the issues occur.

Additionally, the empirical findings also highlight external causes of NOTIF. These include supplier-related issues such as capacity constraints and production delays as well as logistics disruptions such as transport delays, customs issues, terminal handling and incorrect documentation. Geopolitical factors and seasonal effects were also mentioned as contributors to deviations, which shows how complex the inbound supply chain is when multiple actors and external conditions influence the delivery outcome. It is emphasized that supplier relationship management require effective communication and collaboration, in order to manage disruptions and improving the supplier performance (Van Weele & Rozemeijer, 2022).

An important observation is that the current delivery precision measurement does not clearly separate between the external causes. Under incoterms such as FCA, suppliers can deliver according to the agreed terms, while the delay occurs later in the transport process. Despite this, the delivery is still registered as late and therefore creates a potential misalignment between actual responsibility and measured performance. From a theoretical perspective, this raises an issue regarding the KPI design. Van Weele and Rozemeijer (2022) mention that performance indicators should reflect the processes they will measure. If the KPI is not sufficiently aligned with the processes it is measuring, gaps like this between actual and measured performance can occur which makes the KPI misleading.

5.1.2 Procurement process

The procurement process at Wellspect is analysed to be able to recognize what works well and potential deficiencies. According to Van Weele and Rozemeijer (2022), the procurement process affects many other functions of a company. The performance of the suppliers is one such thing that can be affected by the procurement process if it's done badly. Therefore, it is relevant to investigate how the procurement process in this case might affect the delivery precision from the suppliers.

The identified procurement process at Wellspect includes similar phases as the general procurement process described by Van Weele and Rozemeijer (2022). There are not really any phase that seems to be missing according to the linear procurement process. Furthermore, the different phases include purchasing decisions similar to those described by Gandia and Volker (2023). What might be unique for Wellspect's procurement process is instead in how the different phases are executed. Some phases seem to be executed well according to the theory whereas some phases also have the potential to be developed.

During the defining specifications phase, the procurement department has a dialogue with and involves the R&D department. The R&D department helps to identify both functional and technical specifications which the product must have. This is in line with Chen et al (2004), claiming that cross-functionality should be included in efficient strategic purchasing. Furthermore, the defining specification phase at Wellspect includes more requirements than only product features, which according to Van Weele and Rozemeijer (2022) is necessary to have. The specifications also

include traceability standards and compliance with certifications. Regarding the compliance with standards, Wellspect identify required supplier classification to be able to meet these standards.

In the next identified phase, a review team with employees with different roles from different departments is established. This creates cross-functionality since different types of expertise knowledge can be combined to assess the suppliers better. This is again in line with that the description of effective strategic purchasing should involve cross-functionality (Chen et al 2004). Once the review team is established, potential suppliers who seems to be able to meet the requirements are identified. After that a request for information, quotation evaluation, risk assessment and final supplier evaluation is made. This is very similar to the general procurement process from the theory (Van Weele & Rozemeijer 2022). The general procurement process also includes identifying potential suppliers, request for information, quotation, risk assessment and a final supplier evaluation before selecting supplier. Moreover, the review team reviews different types of aspects such as commercial-, technical-, quality- and sustainability aspects. In relation to Ellram et al (2020), this should lead to the firm more often choosing the most suitable supplier and not only the cheapest one.

In the supplier selection and contracting phase, the contracts being used include the mentioned aspects from the general procurement process (Van Weele & Rozemeijer, 2022). These are aspects such as price, incoterms, warranties and obligations. Since the used contracts include the necessary aspects and clarify responsibilities between Wellspect and the suppliers, there is not much in this phase that needs to be changed according to the theory. This is also in line with Foerstl et al. (2016), emphasizing that purchasing and supply management directly affects business performance, meaning that the way suppliers are evaluated has implications for later delivery outcomes.

Regarding the ordering phase at Wellspect, the orders are initiated from some suppliers by the planners and for some suppliers done automatically by an electronic system which recognizes inventory levels. In today's industry, it is common that many companies initiate orders with automatic electronic material planning systems since they have been proven to be able to improve delivery on time and operational performance if they are implemented effectively (Rivera-Vargas et al, 2025). The MRP system might not be applicable for all orders from all suppliers, but the manual ordering at Wellspect leaves room for manual errors and less optimal order placements. The MRP system considers and combines several factors to calculate the optimal ordering which can be hard to do perfect manually. Thus, considering how to effectively integrate the MRP system more comprehensive could potentially lead to a more solid procurement process and better inbound deliveries (Rivera-Vargas et al, 2025).

When Wellspect continues to make orders to the suppliers after the contracting phase, the problems with disruptions and delays seems often to be recognized when they occur. The suppliers contact Wellspect and inform why they will not be able to deliver on time. This is a reaction to a problem which has already occurred and not in line with the "expediting phase" in the general procurement process (Van Weele & Rozemeijer 2022). The "expediting phase" emphasizes how companies should ensure that suppliers can deliver on time and do not fall behind schedule. To do that, a

preventive approach is recommended rather than a reaction approach. According to Chen et al (2004) Wellspect might also miss out of synergistic gains through effective collaboration, if the internal competences of the company and the external competencies of the suppliers are not integrated effectively. Thus, this is one of the phases with highest identified potential for improvement in the procurement process for this case. Additionally, this reactive approach limits the possibility for joint problem solving and information sharing with suppliers, which Nishiguchi (1994) identifies as important elements in successful supply base partnerships.

In the last phase, Wellspects continuously tracks their suppliers and review their monthly delivery performance in terms of quantities and arrivals. This in line with Fitzpatrick (1996) meaning that the evaluations of suppliers should be aimed towards the aspects out of most interest. Furthermore, the suppliers are evaluated on an annual basis. Van Weele and Rozemeijer (2022), claims that continuously tracking the suppliers' delivery records is essential for improving the performance of a relationship. Since Wellspect does that, it becomes easier to recognize if the supplier base needs to be reorganized or if the performance of the existing relationships needs to be improved. Thus, the evaluation phase indicates good conditions to work towards the set supply goal of 95% OTIF deliveries.

5.2 Delivery precision measurement

The delivery precision is currently measured through data extracted from the ERP system M3 and thereafter analyzed in Excel, primarily through the purchased per supplier report. This is based on comparing requested delivery dates with the actual goods received date and the performance is then evaluated based on the tolerances of +/- 1 day. From a theoretical perspective, procurement performance measurements should translate operational goals into measurable indicators and support continuous improvement (Van Weele & Rozemeijer, 2022). By using the SWOT analysis as visualized in Figure 5.2, the current delivery precision measurement is evaluated in relation to the theoretical principles (Gould, 2021).

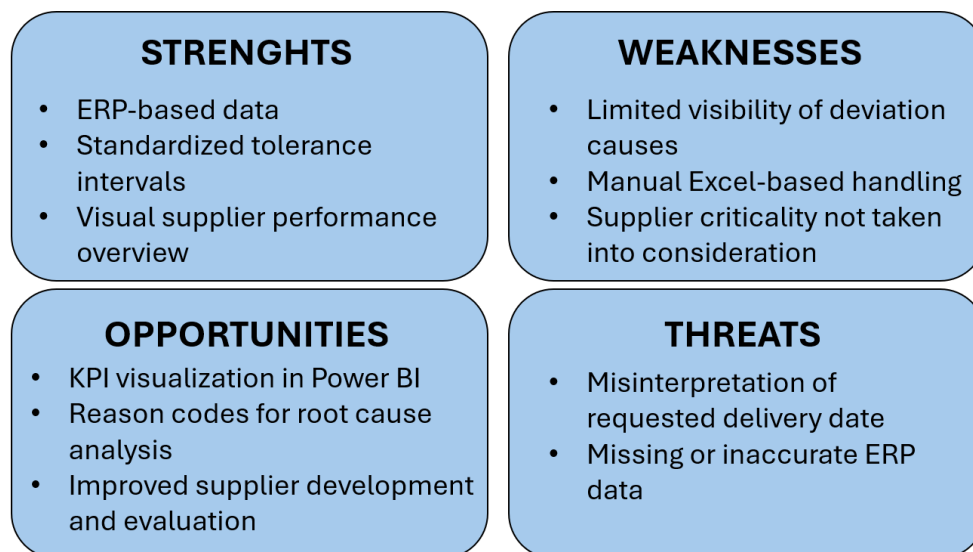


Figure 5.2: SWOT analysis of the current OTIF supplier delivery measurement

Strengths

One of the main strengths of the currently used measurement is that it is structured and based on data from the used ERP system. By extracting the data directly from the ERP system, the delivery data is measured and based on actual data from the transactions which therefore increases reliability. The use of standardized tolerance intervals also provides a clear definition of what is considered being on time, which as a result enables comparison across different suppliers.

Additionally, the monthly report provides a clear overview of supplier performance which the integrated colour classifications with red, yellow and green. This visual approach can be linked to continuous improvement practices as it enables an easy identification of the suppliers that underperform in order to initiate corrective actions (Van Weele & Rozemeijer, 2022; Tian et al., 2024).

Weaknesses

Firstly, the measurement is only based on the comparison between requested delivery date and goods receipt date and therefore does not fully capture the complexity of the inbound delivery performance. According to Kalairasan et al. (2023), limited visibility can restrict the organizations' ability to manage deviations effectively. This being said, it does not take into consideration the delay causes such as transportation issues or internal warehouse handling problems. This may therefore distort the supplier performance evaluation.

Secondly, the dependence on Excel-based analysis brings risks related to manual handling, such as data insert and lack of real-time visibility. This limits the ability to proactively work in the expediting phase 5, where early detection of delays is essential (Van Weele & Rozemeijer, 2022).

Lastly, the standardized tolerance of +/- 1 day may not be applicable for all suppliers, since it does not take into consideration the criticality of the materials. From a Kraljic perspective, different suppliers require different performance expectations where critical items should have a smaller tolerance compared to routine items that are not as critical (Kraljic, 1983).

Opportunities

There are several opportunities that can improve the current measurement system. With the integration of OTIF KPI in a Power BI dashboard, the information can be seen in real time and with improved visibility. This would address the lack of information sharing across the inbound logistics, and as Kalairasan et al. (2023) highlights that it will support a more proactive approach in the expediting process. It is further highlighted by Tian et al. (2024), that improved visibility and performance monitoring are central factors in order to achieve higher OTIF performance.

Another opportunity is to add reason codes for delivery deviations, which would enable more information in a root cause analysis for the suppliers that do not reach the OTIF goal. This would improve the supplier relationship management and is essential for moving from the manage phase to the develop phase according to Van Weele and Rozemeijer (2022).

Threats

One of the threats is the potential misinterpretation between how suppliers interpret the requested delivery date and how it is measured internally. This shows that there can be challenges in the contracting phase, where the delivery terms may be unclear, which may lead to inconsistencies in the supplier performance (Van Weele & Rozemeijer, 2022).

Another threat is that incomplete or inaccurate data from the ERP system can affect the validity of the information. This can occur if wrong data is collected from misplaced orders in the ERP system and can therefore affect the reliability and decision making on suppliers according to Van Weele and Rozemeijer (2022).

5.3 Power BI

The developed Power BI dashboard is analyzed with a SWOT model according to Gould (2021), where the strengths, weaknesses, threats and opportunities are visualized in Figure 5.3.

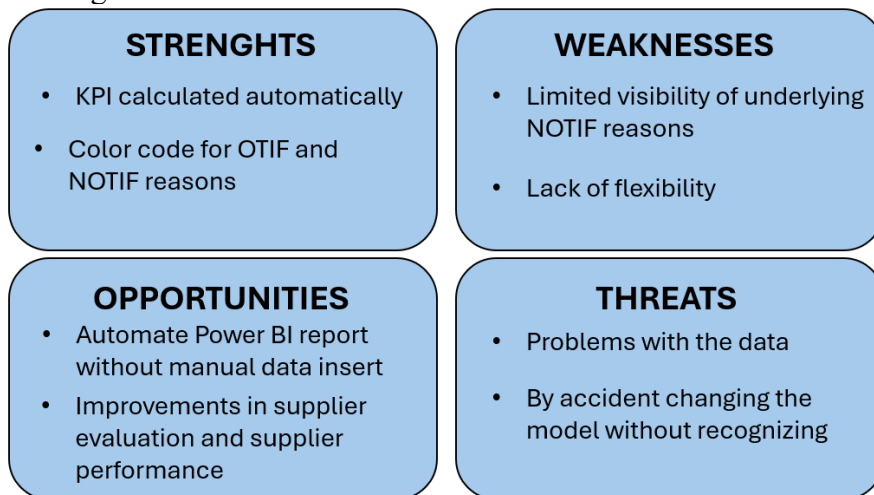


Figure 5.3: SWOT analysis of the developed OTIF Power BI

The developed Power BI dashboard works as a tool to help analyse the delivery precision from suppliers in an easier way. The calculations which the Power BI bases itself on to visualize the delivery precision could be done manually but would require more effort and time. The new solution enables data to be visualized in a simple way which enables continuous monitoring of the suppliers and how their delivery performance. This is also consistent with Tian et al. (2024), showing that improvements in OTIF performance are supported by increased visibility, continuous monitoring and investments in information systems that enable deviations to be detected and addressed effectively.

One of the features with the dashboard is the numerical structure of delivery performance being on-time and in-full, which creates the OTIF metric. This is visualized through either green or red colour coding and a checkmark at each order line. This makes it easy for users to quickly identify whether a delivery meets the defined criteria and enables analysis of the order line. This is in line with the theory, that KPI should be clearly defined and easy to interpret (Van Weele & Rozemeijer, 2022).

The dashboard also enables tracking of performance development across longer periods, which allows continuous monitoring. This is essential in order to evaluate whether procurement needs to do a re-evaluation of their suppliers or how they should continue working with them. One of the opportunities is to automate the Power BI to automatically insert data from the ERP system without having to manually extract data. This will then strengthen the feedback processes in the supplier management phase and contribute to a better supplier relationship (Van Weele & Rozemeijer, 2022).

OTIF performance can also be visualized to certain suppliers, orders and delivery terms. This enables larger overview of the supplier performance, which allows the current suppliers to be evaluated depending on the wanted outcome. This can be done by combining delivery terms such as DAP, FCA and CPT in order to see which one stands out the most. Van Weele and Rozemeijer (2022), mentions the importance of considering contractual conditions when evaluating supplier performance, which is highlighted in the procurement process.

From a supplier relationship management perspective, the dashboard has both development and monitoring of the supplier performance which visually allows for follow-up discussions with suppliers, and the tables create a clear understanding of the expectations. This is in line with the management phase, but also that it creates the base for the develop phase, where historical performance is used to drive improvements (Van Weele & Rozemeijer, 2022). Unfortunately, there can still be issues with the validity of data, if the data is misplaced in the ERP system with will be transferred to the Power BI. Another factor that may intersect with the development phase is if the Power BI model is accidentally changed without noticing, by for instance misplacing filters resulting in wrong analysis of the data.

The weaknesses with the developed Power BI are primarily the detail in the underlying reasons for the delivery deviations. The dashboard identifies whether deliveries are classified as NOTIF, due to incorrect quantity or timing. It does not provide insights into the underlying causes of the particular order deviation. Van Weele and Rozemeijer (2022) mention that performance measurements should not only focus on the outcomes but also integrate continuous improvement, which can be done through the identification of root causes. The ability to map down causes such as supplier related issues, transportation delays or internal handling errors is not possible with the current version of the Power BI. A possible way to address this limitation is to complement the Power BI with a structured input of root cause data. This could be done by introducing a standardized Excel file, where planners or responsible functions manually register the underlying cause of each deviation, linked to the purchase order number. By integrating the file in the Power BI, it would be possible to achieve more detailed root cause information. However, this would require changes in the current working practices as well as clear guidelines to ensure consistent and reliable data input.

Another weakness is the limited flexibility. The Power BI is programmed in a specific way to be able to show certain chosen things of interest. If other aspects want to be shown in the developed Power BI, it will probably have to be reworked which can be a potential weakness with the existing model. On the other hand, it remains focused on logistics related KPIs such as delivery precision. According to Guarnieri and

Trojan (2019), supplier evaluation should have in consideration environmental, societal and ethical criteria. The Power BI model does not keep track of sustainability related indicators and therefore provides a limited view of the total supplier performance.

5.3.1 Incoterms

In Figure 4.3.2.4, a clear variation in delivery precision is shown depending on the applied incoterm. Suppliers' operation under DAP achieved an OTIF level of 84,3%, while suppliers with FCA only reached 22.7%. This represents a difference of more than 60 percentage points, which indicates that the delivery terms have an impact on the measured delivery performance. This variation can be explained in how incoterms allocate control over logistical processes and how the responsibilities are delegated (ICC, 2020; Stojanovic & Ivetic, 2020).

With FCA, the supplier is only responsible for handling the goods to a carrier at a specified location. From that point, the buyer assumes responsibility for transportation and delivery (ICC, 2020; Stojanovic & Ivetic, 2020). This means that the supplier has limited control over the logistical operations, including potential delays during handling or transportation. Since the delivery precision in this study is measured only based on the final goods receipt date, these deviations downstream are still reflected in the supplier's performance. This misalignment between measurement and reasonability provides a potential explanation for the lower OTIF performance for the FCA-suppliers. A large share of NOTIF deliveries may therefore be caused by factors outside the supplier's direct control, such as internal warehouse processes or transportation delays.

5.4 Supplier importance

The supplier importance is approximated using the share of total order lines, as presented in the Power BI dashboard. It should be noted that this classification is based on an approximation. According to Kraljic (1983), supplier positioning should be based on an evaluation of both profit impact and supply risk, but due to limitations the information could not be obtained for each supplier in this thesis. Therefore, the supplier importance has been approximated using the total share of order lines, and the supply risk has been interpreted based on delivery performance and logistical structure.

Suppliers with a higher share of deliveries are considered to have a larger operational impact. This since the disruptions from these suppliers can have a larger impact on the inbound flow. Supplier A, represents a large share of the total deliveries, which indicates a high level of importance for maintaining stable operations. This is in line with the procurement theory, where suppliers that contribute significantly to operational continuity are considered to have a higher profit impact (Van Weele & Rozemeijer, 2022).

Supply risk is interpreted based on a combination of delivery performance (OTIF) and logistics structure (Incoterms), according to Figure 5.4. As previously mentioned, suppliers that operate under incoterms such as FCA and EXW have lower levels of control under transportation. This may therefore increase the exposure to delivery

deviations (Stojanovic & Ivetic, 2020). Accordingly, supply risk is not only related to supplier capability, but also to responsibilities within the logistics processes.

Based on this classification, several patterns can be identified. Suppliers with high OTIF-performance and high delivery volumes, particularly those that operate under DAP are positioned in the leverage category (Kraljic, 1983). These suppliers have high operational importance with relatively low supply risk, which indicates reliable and stable performance. From a theoretical perspective, leverage suppliers can be managed through efficient contracting and performance optimization, since it favours conditions for efficiency and cost improvements (Van Weele & Rozemeijer, 2022).

On the other hand, suppliers with low delivery volumes demonstrate a lower OTIF performance and operates under FCA and EXW terms. These suppliers have been categorized as bottlenecks suppliers, since they have limited operational impact with higher supply risk. Despite their lower volumes, these suppliers may still cause challenges due to their delivery instability. This is in line with Kraljic's (1983), mentioning that bottleneck suppliers require careful monitoring due to their potential to disrupt the supply chain. From a sourcing strategy perspective, the bottleneck suppliers also illustrate the trade-offs described by Jenoui and Abouabdellah (2016), where supplier decisions should be based on delivery performance, cost and supply risk and not rely on a single criterion.

Suppliers identified with high operational importance, but varying delivery performance are positioned as strategic suppliers (Kraljic, 1983). This since the suppliers have a lower OTIF and operate under incoterms with reduced logistics control. These suppliers require more attention, due to the high profit impact in combination with high supply risk. This is also in line with supplier relationships management theory, where strategic suppliers require closer collaboration and follow-ups (Van Weele & Rozemeijer, 2022). This is also in line with Zeng et al. (2023), arguing that closer supplier relationships may increase coordination and stability in the supply chain, although it may increase the dependence.

Suppliers with low operational impact and stable delivery performance are categorized as non-critical suppliers. These suppliers have limited influence on the operations and can be managed through standardized processes. This reflects the recommendation to simplify procurement processes for routine products in order to reduce complexity and transaction costs (Kraljic, 1983; Van Weele & Rozemeijer, 2022).

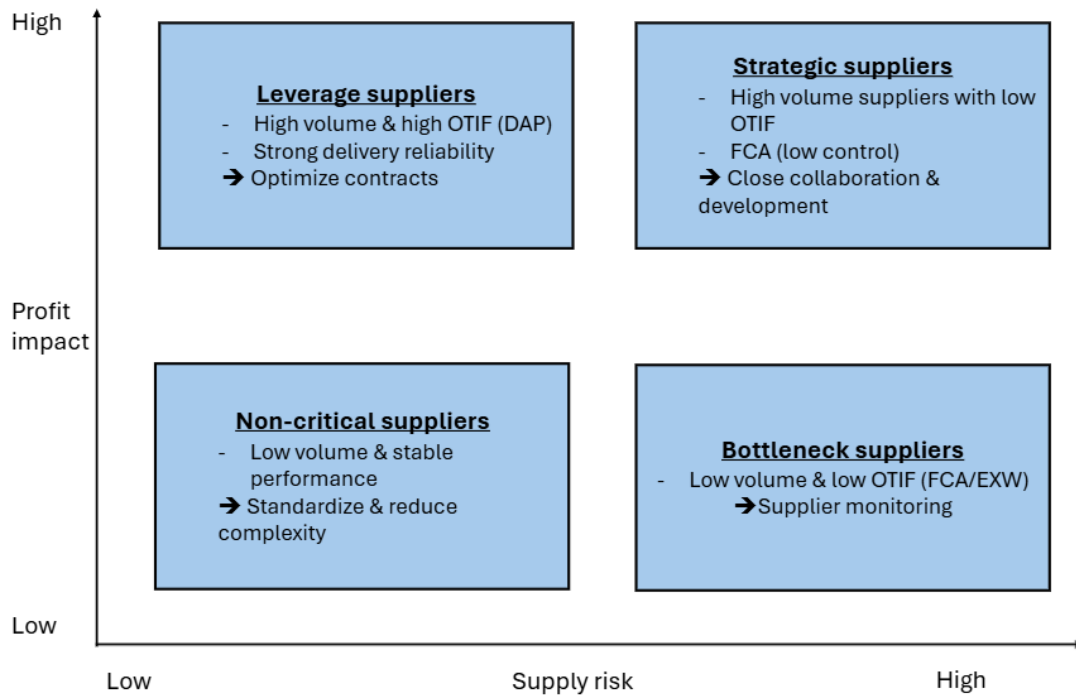


Figure 5.4: Supplier segmentation based on Kraljic (1983).

Different sourcing strategies may be appropriate across multi supplier categories. Suppliers with high-risk exposure may require a broader multi criteria sourcing, where delivery reliability is considered alongside cost and other operational factors (Jenoui & Abouabdellah, 2016). The identified differences in supplier importance and performance highlights the role of the supplier relationships. According to McQuiston (2001), sustainable supplier relationships are built on core values such as open communication, shared goals, trust and mutual commitment. These are particularly important for suppliers categorized as strategic, where close collaborations are mandatory in order to ensure high performance. Suppliers with high operational importance and varying levels of delivery precision, may therefore benefit from a more structured communication of expectations. Delivery terms, conditions and performance targets should be clearly defined to reduce the misalignments between how delivery dates are interpreted.

Since Wellspect mainly apply a single sourcing strategy for critical suppliers and components, it may increase dependency and supply risk according to Van Weele and Rozemeijer (2022). This is mainly due to the regulations and operational requirements within the med-tech industry, and it was mentioned during the interviews that supplier changes come with long qualification processes and strict validation activities. This makes the ability to change suppliers difficult, since it requires both time and resources. Instead of reducing the risk through multiple sourcing strategies, Wellspect manages the risks through safety stock levels, long term supplier relationships and close collaboration with the suppliers. This is mainly done through supplier meetings, and continuous communication. This is in line with McQuiston (2001), emphasizing communication and trust as two important factors.

6. Conclusion and recommendations

The purpose of this study was to re-evaluate and try to improve measurements of delivery precision for inbound deliveries. To achieve that, the goal was to increase the visibility of the causes of delivery deviations by developing a reliable OTIF KPI in a Power BI dashboard. By analysing Wellspect's current way of measuring delivery precision and comparing it to theory regarding successful supply bases, several useful insights have emerged.

The study shows that delivery precision for inbound deliveries is currently measured in a structured way, but that the existing approach has important limitations. Although the current Excel measurement provides a general overview of supplier delivery performance, it does not fully capture the complexity of inbound logistics. Particularly, it does not differentiate between internal process inefficiencies, transport-related deviations and supplier related problems.

The findings further show that NOTIF deliveries are caused by a combination of internal and external factors. Internal causes include inaccurate ERP parameters, planning deficiencies, delays in internal communication and inventory inaccuracies. External causes include supplier capacity constraints, production delays, transport disruptions, customs issues, documentation errors and other logistical deviations. These causes are often interconnected and influence the final delivery outcome.

The study shows that the developed Power BI with OTIF KPI improves transparency and enables a clearer monitoring of supplier delivery performance. By visualizing on-time and in-full performance at order line level, delivery term level and supplier level, the dashboard provides a more structured and accessible base for follow ups, compared to the previous Excel approach. At the same time, the study shows that the current version of the dashboard remains limited in its ability to identify deeper root causes, as it mainly analyses deviations in quantity and timing rather than the underlying reasons behind them.

The analysis from the usage of the developed Power BI also shows that incoterms have an influence on measured delivery precision. Suppliers operating under DAP showed higher OTIF performance than suppliers operating under FCA. This indicates that delivery performance is not only affected by supplier capability, but also how the logistical responsibilities are allocated between the parties. In cases where the supplier loses control over the transport process before the goods arrive at the warehouse, the current KPI may show deviations that are not caused the supplier. This shows the importance of interpreting delivery precision in relation to the delivery terms.

Finally, the study shows that supplier performance should not be interpreted linearly. It should be by combining OTIF performance, delivery volumes and incoterms, in order to differ the suppliers based on their operational importance and supply risk. Some supplier may require closer collaboration, while others can be handled through more standardized processes.

6.1 Answers to research questions

RQ1: How is the supplier delivery precision for inbound deliveries to the warehouse currently measured?

The study shows that supplier delivery precision is currently measured through data extracted from the ERP system M3 and manually analysed in Excel, mainly through the monthly purchased per supplier report. The measurement is based on comparing the requested delivery date with the actual goods receipt date, with the tolerance of +/- 1 day. However, the analysis shows that the measurement is primarily based on the outcome and does not reflect the complexity of the inbound delivery performance or causes of deviations.

RQ2: What are the main underlying causes of deliveries not being on time and in full (NOTIF), and how can these causes be categorized in order to improve performance follow-up?

NOTIF deliveries are caused by a combination of external and internal factors. External causes include supplier delays and transport-related disruptions, while internal causes include planning inefficiencies and inaccurate ERP parameters.

RQ3: How can an OTIF KPI be developed to increase supply delivery precision transparency while accounting for root causes of NOTIF deviations?

An OTIF KPI can be developed by combining delivery timeliness and delivery completeness into a KPI that measures whether deliveries are both on time and in full. This provides a more informative performance indicator compared to the current approach. However, in order for the KPI to support continuous improvement, it should be complemented with reasons that enable analysis of the underlying causes of deviations.

RQ4: How can the supplier delivery performance and NOTIF causes be visualized in a Power BI dashboard?

The Supplier delivery performance can be visualized in a Power BI dashboard using OTIF, filters, order number tracking and visual colour coding for basic NOTIF reasons. This enables continuous monitoring of supplier performance and efficiently visualizes delivery outcomes. Further development is required to integrate detailed root cause information to fully support root cause analysis.

6.2 Recommendation

Develop the OTIF KPI by integrating more detailed root cause data

The OTIF KPI should be complemented with a structured root cause data to improve analytical parameters. By introducing standardized reason codes linked to each delivery, the company can better differentiate between internal, supplier-related and transport-related deviations. This would enable more accurate supplier evaluation and support improvement actions. However, this would require changes into existing reporting processes and could therefore be dependent on both technical and organizational changes.

Use the Power BI dashboard as a proactive decision tool

The Power BI should be integrated into the monthly and annual supplier evaluations in order to support proactive management of inbound deliveries. With the Power BI as a supportive tool which applies continuous monitoring and identification of deviations, the company will more likely be able to improve planning accuracy and supplier evaluations. This will help to increase the delivery precision and move towards the aim of 95% OTIF inbound deliveries.

Different supplier management approaches based on importance and risk

Supplier performance should be interpreted in relation to both operational importance and supply risk. By differing suppliers based on OTIF performance, delivery volumes and logistics structure, the company can apply different management practices. Strategic and high-risk suppliers should be managed through closer collaboration and structured follow-ups, while non-critical suppliers can be handled through standardized processes.

6.3 Further research

This study has identified areas for further research in the area of OTIF deliveries in the inbound logistics.

First, future research could develop a more detailed structure for categorizing root causes of NOTIF deliveries. A more detailed classification system could improve both supplier evaluation and internal work.

Secondly, further research could explore how supplier performance evaluation can be developed beyond operational KPIs and incorporate sustainability related indicators. This would provide a broader view of supplier performance.

Finally, future studies could investigate how the developed dashboard can be further automated with direct integration with the ERP system. This would reduce manual work and strengthen its role as a real time tool for decision making.

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Appendix A

Below are the two interview guides used in the study in order to collect empirical data.

A.1.1 Interview Guide 1: Supplier-facing

1. Introduction

- Can you describe your role and your main responsibilities?
- Which suppliers do you mainly work with?

2. Delivery challenges

- How do you assess the risk of delivery deviations?
- What types of issues typically arise from the suppliers' side (external factors) that lead to deliveries not being OTIF?
- What types of issues typically arise internally at Wellspect that may cause suppliers not to deliver OTIF?

3. Preventive work

- How do you work to ensure that suppliers deliver OTIF and meet agreed delivery requirements?
- How does Wellspect work to remain resilient when suppliers do not deliver OTIF?
- How do you maintain communication with suppliers?
- Do you have regular meetings with suppliers, or is communication more ad hoc?
- What type of information does suppliers typically share with you?
- Which Incoterms are used with your suppliers? (Alternatively, is it possible to access procurement documentation?)

4. Supplier development

- Do you have any collaboration programs or similar initiatives with suppliers to improve performance together?
- How do you perceive the following aspects in supplier relationships: shared goals, mutual dependence, open communication, trust, mutual commitment, and consideration for each other's profitability?

5. Sustainability

- How do you approach the integration of sustainability in supplier relationships (social, ethical, and environmental aspects)?

6. Sourcing strategy

- What phases are included when contracting a new supplier? (Procurement process)
- Which suppliers are you most dependent on? (e.g., single vs. multiple sourcing)

7. Supplier evaluation

- How do you evaluate collaboration with your suppliers?
- How are these evaluations used to improve performance over time?
- Are the evaluation results shared with the suppliers?

- Are the evaluation results shared with the party responsible for transportation (e.g., third-party logistics providers)?

A.1.2 Interview Guide 2: OTIF dashboard to customers

1. OTIF dashboard functionality

- How does the existing OTIF dashboard (customer-focused) function?
- Which KPIs are included in the dashboard?
- What are the advantages of the dashboard compared to how it was used previously?

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