HOW TO MEASURE AND IMPLEMENT PULL-DRIVEN SUPPLY CHAIN CONCEPT?

Lappeenranta–Lahti University of Technology LUT

Master of Science in Economics and Business Administration, Master's Thesis

2026

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Examiners: Professor Jukka Hallikas, Associate Professor Mika Immonen

ABSTRACT

Lappeenranta–Lahti University of Technology LUT

LUT School of Business and Management

Master's Degree Programme in Supply Management

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How to measure and implement pull-driven supply chain concept?

Master's thesis

2026

57 pages, 6 figures, 10 tables, and 2 appendices

Examiners: Professor Jukka Hallikas, Associate Professor Mika Immonen

Keywords: Pull-driven supply chain, Supply chain implementation, Key performance metrics

This master's thesis tries to find information regarding the pull-driven supply chain and directly answers the main research question of how to measure and implement the pull-driven supply chain concept.

The pull approach process begins only when a customer places an order with the company. In a pull approach, products are not made ready for stock, they are manufactured only in response to a customer's order. In this way, the company can avoid unnecessary inventory accumulation in the warehouse. A pull-driven supply chain has various advantages but also disadvantages, which are discussed in this master's thesis.

This master's thesis was carried out for a case company that has partially changed its internal supply chain processes. The purpose of the work was to identify metrics for measuring the pull-driven supply chain and its functionality. The work also covers the entire implementation phase, including how the pull-driven supply chain has been built within the company and the process changes it has required.

TIIVISTELMÄ

Lappeenrannan–Lahden teknillinen yliopisto LUT

LUT-kauppakorkeakoulu

Hankintojen johtamisen maisteriohjelma

Sara Hietanen

Miten mitata ja implementoida pull-ohjautuvaa toimitusketju-konseptia?

Koulutusohjelmasi ja tutkielmasi: Kauppatieteiden pro gradu -tutkielma

2026

57 sivua, 6 kuvaa, 10 taulukkoa ja 2 liitettä

Tarkastajat: Professori Jukka Hallikas ja Apulaisprofessori Mika Immonen

Avainsanat: Pull-ohjattu toimitusketju, Toimitusketjun implementointi, Suorituskykymittarit

Tämän pro gradu -tutkielman tarkoituksena on etsiä tietoa pull-ohjautuvasta toimitusketjusta ja vastata tutkielman pääkysymykseen: miten pull-ohjautuvaa toimitusketju-konseptia mitataan ja implementoidaan.

Pull-ohjautuvan toimitusketjun lähtökohtana on, että koko prosessi lähtee liikkeelle vasta, kun asiakas on tehnyt tilauksen tuotteesta, jota yritys valmistaa. Pull-ohjautuvassa toimitusketjussa ei tehdä varastoon valmiiksi tuotteita, vaan ne valmistetaan ainoastaan asiakkaan tilausta vastaan. Tällä tavoin yritys pystyy välttämään turhien inventaarioiden kertymisen varastoon. Pull-ohjautuvalla toimitusketjulla on erilaisia hyötyjä, mutta myös haittoja, jotka tulevat esiin tässä pro gradu -tutkielmassa.

Kyseinen pro gradu -tutkielma on toteutettu yritykselle, joka on osittain muuttanut sisäistä toimitusketjuansa. Työn tarkoituksena oli löytää erilaisia mittareita siitä, miten yritys pystyy mittamaan pull-ohjautuvaa toimitusketjua ja sen toimivuutta. Työhön on myös sisällytetty koko implementaatiovaihe, eli miten kyseinen pull-ohjautuva toimitusketju on rakennettu yrityksen sisällä ja minkälaisia eri prosessimuutoksia se on vaatinut yritykseltä.

ACKNOWLEDGEMENTS

I want to thank my thesis supervisor, Jukka Hallikas from LUT University, for all the valuable information that I have received for my thesis. Thanks to my thesis supervisor, Eero Plathin, and my manager, Tea Berg, at the case company, who helped me a lot during my writing process. Also, I want to thank all the interviewees from the case company who shared valuable information and their opinions on the new project within the company. Lastly, I want to thank all my friends and family for supporting me throughout the journey, always being there, and encouraging me.

Turku, May 2026

Sara Hietanen

ABBREVIATIONS

Abbreviations

BOM	Bill of Materials
ERP	Enterprise Resource Planning
KPI	Key Performance Indicators
PDSC	Pull-driven Supply Chain
SCM	Supply Chain Management
VMI	Vendor-Managed Inventory

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DECLARATIONS

AI-Usage

The author of this thesis, Sara Hietanen, used the following AI tools during the writing process of this thesis:

1. **ChatGPT**
   a. Purpose of use: ChatGPT was used to support the author in brainstorming topics for this thesis and to help understand concepts related to the work.
   b. Explanation of the use of the tool: to understand certain topics related to the thesis and brainstorm what could be included in the thesis.
2. **Grammarly**
   a. Purpose of the use: Grammarly was used to check the correct grammar.
   b. Explanation of the use of the tool: to identify grammar errors in the thesis.

Responsibility

The author, Sara Hietanen, takes full responsibility for the content of this thesis and has reviewed and edited the content generated by the possible use of AI tools.

1. Introduction

This thesis aims to answer the main question: how to measure and implement a pull-driven supply chain. The purpose of this thesis is to determine the usefulness of, and how to measure, the pull-driven supply chain process in a case company. The company's current supply chain process is being carried out with two different approaches. The first approach is more related to the push approach, and the other to the pull approach.

The main idea of this thesis project is to compile a manual for a company that outlines their implementation phases and the metrics they can use to measure a pull-driven supply chain. This manual covers prior research on the pull-driven supply chain. The main part of this thesis covers the implementation steps taken by different departments to build a pull-driven supply chain. Also, an important aspect is developing a measurement package to assess the pull-driven supply chain. In this way, the company can obtain valuable and necessary information about how changes affect its operations.

To understand the topic of this thesis, it is required to explain to the reader what the pull supply chain means. In a pull supply chain, goods are manufactured only when customers place orders. The opposite of a pull supply chain is a push supply chain, in which production processes are linked to forecasts (Fowler, Kim & Shunk, 2019, 1).

In the previous studies, it has not been clearly investigated how a pull-driven supply chain should be measured. In various research articles, measurement focuses on key performance indicators (KPIs), which are either supply chain management-focused or demand-driven. That was one of the challenges for this thesis, especially because it seeks to answer how to measure a pull-driven supply chain. Various challenges and benefits have been raised regarding the pull approach, but there are no clear metrics. To answer measurement questions, I used these challenges and benefits to turn them into metrics. For example, Erozan & Erozan (2025) and Wu & Xiao (2025) have argued that one benefit of a pull-driven supply chain is lower inventory levels. With this example, it is easy to use inventory as a metric for a pull supply chain. Other metrics, as reported in the literature, are presented later in the chapters.

Since there is no clear framework for measuring the pull-driven supply chain, this thesis also offers new perspectives on the existing literature. Most of the metrics identified in this thesis are suitable for other companies operating with the pull approach.

1.1. Research objectives, questions, gaps and methods

The main objective is to determine how to measure and implement a pull-driven supply chain within the factory in Finland. One of the objectives is also to identify the measurable benefits and the most functional measurement package for a pull-driven supply chain concept. With the help of functional measurement packages, the company can receive valuable information about what metrics tell. By receiving information from metrics, the company can respond to deviations in them. Thus, the thesis tries to answer the main research question, which is:

- How to measure and implement the pull-driven supply chain concept?

The main question has two supportive questions, which are:

- What are the success factors and limitations of a pull-driven supply chain within the company?
- Which measurement factors/metrics are the most important to the company in a pull-driven supply chain?

As a method of selection, qualitative data were selected for this thesis. For this thesis, two semi-structured thematic interviews were conducted with employees from the factory. The first semi-structured theme interview was conducted as part of a pull-driven project, in which 14 employees were interviewed. The second interview focused on the project's implementation phases and included interviews with 13 employees.

A research gap related to this thesis can be identified. Previous research on the pull-driven approach has mainly focused on its benefits and challenges. Also, existing research on supply chain management, demand-driven supply chains, and how to measure these approaches can be found, but not on how to measure the pull-driven supply chain. Similar

metrics used in supply chain management and demand-driven supply chains can also be applied to a pull-driven supply chain, but need to be clarified better. Thus, it is important to develop an exact measurement package for the pull-driven supply chain to capture the factors most critical to the approach. Defining the exact metrics for the pull-driven approach helps the case company and other areas recognize the critical aspects to focus on and monitor.

1.2. Conceptual framework

The conceptual framework, based on the literature review, is shown in Figure 1. The conceptual framework introduces the main topics of this thesis, with the pull-driven supply chain as the primary concept, followed by pull-driven concepts and metrics, based on the literature review. Since the company is undergoing major changes in its supply chain operations, change management is a good addition. Lastly, the pull-driven implementation gathers perspectives from stakeholders across the factory on their contributions to advancing the project.

All the areas described in the conceptual framework are linked to one another. For the reader to understand, it is important to clarify which areas a pull-driven supply chain belongs to. Various concepts can be used in a pull-driven supply chain. The pull-driven approach needs to be measured as well. The choice of concepts for the pull-driven approach might also affect the measurement result. Change management in supply chains is addressed in this thesis because the case company is undergoing a major change in its supply chain operations and requires effective management. Not forgetting the implementation phase, all the above-mentioned areas are directly linked to it.

All the areas described in the conceptual framework are linked to one another. Based on the literature review, different metrics were identified as being linked to the implementation phase that the case company has built. Using metrics, the entire implementation phase can be measured to determine whether the right decision has been made.

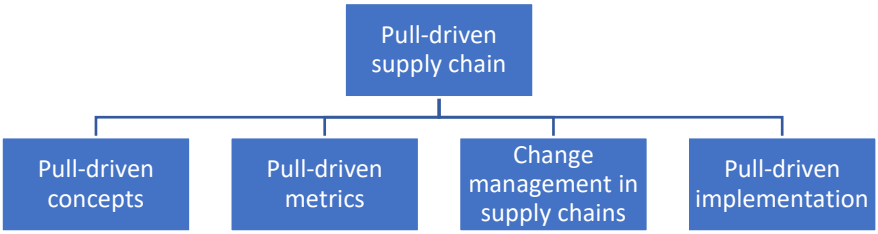

Figure 1: Conceptual framework if the thesis

1.3. Background and key concepts

This research study has been conducted for a European manufacturing company operating in the mining industry and manufacturing a range of mining equipment. The company operates in several countries and has a complex supply chain. This thesis focuses on one of the factories located in Finland.

Currently, the factory's supply chain and manufacturing operations are being operated with a push-driven approach. The factory started a new project in 2025, in the spring, focusing on two different mining machine models and adopting a pull-driven approach. The rest of the mining machine models will continue to be manufactured with their current models. The idea for the factory is that it will operate under two different models. The future will show whether the pull-driven approach proves successful. If so, other mining machine models may be manufactured using it.

The idea of doing a thesis on pull-driven supply chain implementation and building a measurement package gives valuable information for the company. If the company decides in the future to expand its supply chain operations using a pull-driven approach, it can easily identify all the required implementation steps. Since this thesis covers all the risks and benefits of implementing a new working model, it will be helpful in the future.

1.4. Structure of the study

The study's structure comprises six main topics, as shown in Figure 2. The thesis begins with an introduction to the topic, followed by a theoretical framework for the pull-driven supply

chain. After the theoretical framework, the methodology and data collection are explained. The empirical study begins by gathering data on pull-driven supply chain implementation and key performance indicators/metrics related to the new working model. Lastly, the results, recommendations, and conclusions are presented.

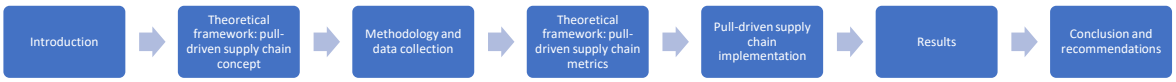

Figure 2: Structure of the thesis

1.5. Limitations

The focus of this thesis is to find out and answer how to measure and implement the pull-driven supply chain model within the factory. It is important to clarify at the outset that the project's implementation is still ongoing within the company while the research/thesis is being conducted. This research does not include specific results on how the pull-driven supply chain concept/implementation works for these two specific mining machine models within the company. Since the company is implementing a new work method for two specific mining machines during the writing of this thesis, there will not be clear results on how the pull-driven approach affects the factory, as the project has not yet finished. Thus, there will be limited data on how different metrics or KPIs related to the new approaches are affected. During the writing process, the benefits and challenges of this new working model have been identified, and metrics are being proposed to measure it. All the results are at the end.

2. Theoretical framework

To understand the topic of this research, it is important to define basic concepts related to work. Researchers have said that the supply chain was developed to address duplication and responsiveness issues (Skjott-Larsen et al., 2007). Over the years, companies have come to recognize the importance of cooperation with suppliers and customers in their operations. This angle is also known as SCM (supply chain management). SCM can be seen as a strategic approach that connects logistics planning and operations (González-R, Framinan, Ruiz-Usano, 2013).

Push and pull approaches are two main concepts associated with the demand-driven supply chain. Mendes (2011, 11-12), referring to Harrison (2003), states that strategies related to demand can be found, namely push-based, pull-based, and hybrid push-pull strategies, which companies can utilize in their supply chain. In the push-driven approach, all the decisions related to production and distribution are based on demand forecasting. Since a push-driven approach counters predictive forecasting, supply and demand can be hard to match, leading to difficulties. In the pull-driven approach, production and distribution are based on customers' true demand. Since, in a pull-driven approach, companies eliminate inventory levels, this approach can be difficult to execute when lead times are long, which negatively affects the company's capability to react to demand. Since pull-based and push-based approaches offer benefits and challenges, hybrid push-pull approaches have been developed to help companies achieve the best outcomes from both. In the hybrid push-pull approach, the initiative phase is carried out with a push-driven approach, and the remaining phases with a pull-driven approach.

The manufacturing supply chain can be seen as a complex system in which various stakeholders and companies influence the outcome of orders. Commonly used methods in manufacturing industries can have disadvantages, such as poor production performance, which negatively affects competitive advantage. Studies have shown that a push-based production approach can lead to a decline in output. Thus, it is recommended to adopt a pull-based approach. This approach helps manufacturing companies fulfill customers' needs at the right time. Studies show that companies that respond to customers' needs at the right

time can have more customers than those that do not. This is the main element of the pull approach (Otieno & Odari, 2017, 1560).

2.1. Pull vs push approaches

Doubts about customer requirements and changes in manufacturing and distribution lead times can be challenging to manage in a multi-state supply chain. To monitor production and distribution schemes, there are three primary approaches which are push, pull, and push-pull, also known as hybrid. The push approach is based solely on forecasting distribution and production operations. Distribution and production operations in the pull approach are initiated only when a customer order is placed (Mahapatra, Yu & Mahmoodi, 2012, 4699).

In supply chain management, the push approach can be described as goods being pushed from production to retailers, including distribution handling. Companies need to predict production levels and volumes based on historical data and past customer ordering patterns. This affects demand adjustment, requiring more time to make changes. Another negative impact which can occur in the push approach is that stock levels grow more and delays occur (Minculete & Olar, 2016, 166)

In a pull approach distribution, purchasing and production are driven by demand. In this way, all the functions correspond to real customer orders. One of the key considerations in the pull approach for companies is to remember the relationship between suppliers. In the pull approach, different suppliers get involved in the main company's stock management. The main company informs its suppliers of actual demand and the status of its inventory levels. Information received from the main company to suppliers enables suppliers to fulfill stock for the main company. With this method, a positive economic impact is achieved, including reductions in total costs and the production cycle (Minculete & Olar, 2016, 166).

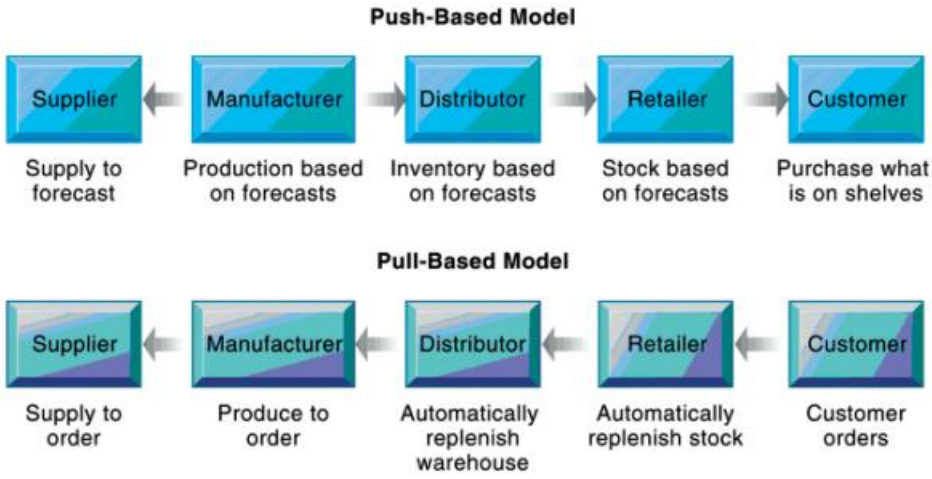

Figure 3. Example of push-based and pull-based models (Minculete & Olar, 2016, 167)

Challenges that companies face are deciding which strategy, pull-approach, push-approach, or hybrid push-pull approach is the best supply chain strategy for their products. A push-approach strategy is proposed for goods with low demand uncertainty, since forecasting adjusts what to manufacture and how to manage inventory. On the other hand, a pull approach is proposed for goods with high demand hesitancy and insignificant economies of scale. Lastly, a hybrid push-pull strategy is proposed for goods where doubts regarding demand are high, and economies in scale play a significant part in decreasing manufacturing and delivery costs (Mendes, 2011, 13)

In today's world, competition is fierce, and businesses need to become more powerful and focus on production by lowering costs. It is important that production systems can adjust the required levels and standards. When these aspects are considered, large inventories can be avoided, thereby reducing costs and waste. A pull system benefits the company by avoiding overproduction and the need to store excess goods. In this case, risks are minimized (Díaz-Reza, García-Alcaraz, Morales García, 2022, 19).

2.2. Pull-driven concepts

One of the main goals of companies is to increase their profits without increasing the prices of the goods they sell. This can be achieved by focusing on productivity and minimizing

waste and costs in the production process. To ensure companies can succeed in the above areas, a philosophy called Lean Manufacturing (LM) can be helpful (Diaz-Reza et al., 2022, 1).

With the help of Lean manufacturing, companies can manufacture goods at lower prices and with better quality. This also helps companies minimize resources compared to standard mass production. Lean manufacturing for companies aims to remove waste. Thus, companies can respond better to customer demand and gain a competitive advantage. The company's efficiency is improving because LM can minimize internal and external variability. This also has a positive effect on information waste and production flows by reducing them. Waste in lean manufacturing philosophy is everything other than the minimum required to produce, such as labor time, materials, and equipment (Diaz-Reza et al., 2022, 1-2).

Different tools and activities are being used together in the lean manufacturing approach. As shown in Figure 2, these tools are divided into three categories: production flow, first-time quality, and manufacturing systems. In the fundamental concepts section, these tools are meant to support other tools mentioned in three categories. When companies use LM tools independently or together in their manufacturing operations, this approach benefits them in many ways, such as producing high-quality goods, reducing delivery time, and manufacturing at lower prices (Diaz-Reza et al., 2022, 2-3).

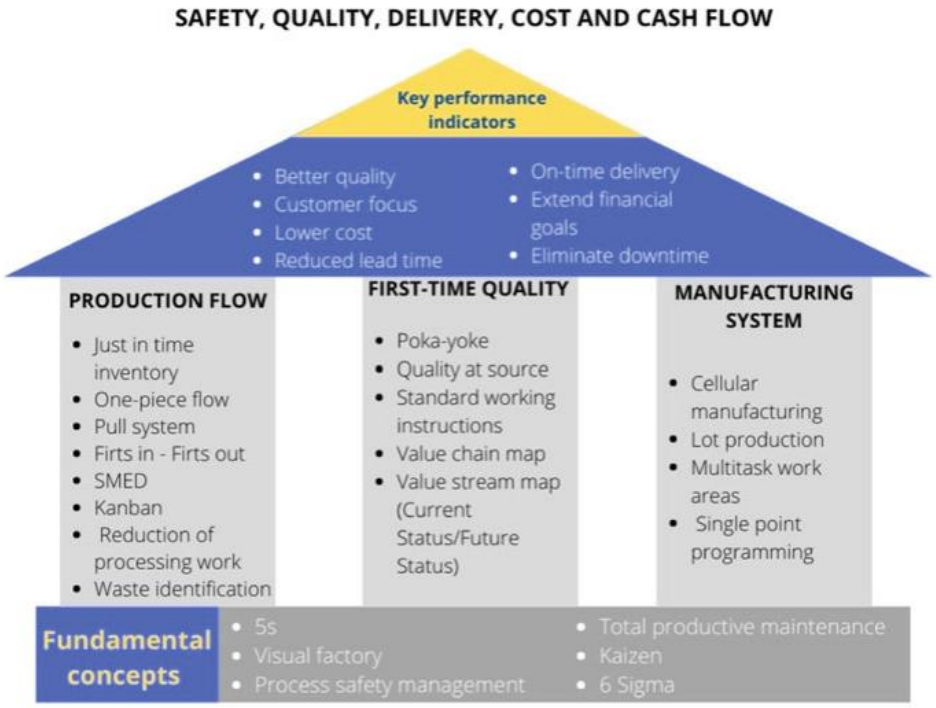

Figure 4. Best practices in lean manufacturing: a relational analysis. Diaz-Reza et al. (2022)

Just-in-time (JIT) is a common notion used in the manufacturing industry. The idea of JIT focuses on removing waste during the production process, thereby decreasing costs. In this control approach, manufacturing procedures are integrated, and demand data for the final product inventory are sent to earlier workstations using specially designed cards. There are several card styles, but the most used in a pull approach is Kanban (Erozan & Erozan, 2025, 1208).

Toyota is the company behind the kanban system since it originally developed it for its own production system. The kanban system aims to distribute information across workstations using physical kanban cards. With the help of these cards, workstations know the right quantity and what and when to produce goods (Papadimitropoulou et al. 2023, 71).

Even though the kanban pull approach offers many benefits in manufacturing, it has its disadvantages and might not be the best option. The Kanban approach is not usually able to process changes in product type and capacity. Studies have shown that if orders require major foundations or production time is very short, the kanban method is ineffective. If the environment is stable and product types and volumes are known, the kanban method has potential (Erozan & Erozan, 2025, 1208-1209).

2.3 Benefits and challenges of the pull-driven approach

One of the benefits of the pull system is that it provides better control over production processes. The pull system technique ensures that overproduction does not occur across different workstations. A pull system benefits production and the goods themselves by preventing delays or saturation. Also, risks related to accidents, lack of space to work, and damage to goods can be avoided (Díaz-Reza, García-Alcaraz, Morales García, 2022, 17-18).

As mentioned earlier, in the pull-driven supply chain, production and allocation needs are defined by existing demand. In a pull-driven supply chain, there is no need to lean on predictive data for planning. With this method, companies can reduce inventory levels, reduce demand variability, and enhance service quality (Wu & Xiao, 2025, 579).

There are many benefits to the kanban pull approach, such as reducing inventory and costs, decreasing customer lead times, reducing resource waste, and decreasing overproduction. (Erozan & Erozan, 2025, 1208).

While a pull-driven approach offers distinct benefits, it can also present challenges. The Kanban pull approach offers many benefits in manufacturing, however, it has its disadvantages and might not be the best option. The Kanban approach is not usually able to process changes in product type and capacity. Studies have shown that if orders require major foundations or production time is very short, the kanban method is ineffective. If the environment is stable and product types and volumes are known, then the Kanban method has its potential. Although the Kanban method is an efficient approach, it can present technical barriers. The supply network for the pull approach is highly sensitive to certain environmental factors. Pull-approach logistics negatively affects various problems, such as pandemics, wars, and economic crises. The above-mentioned problems can negatively affect JIT production (Erozan & Erozan, 2025, 1208-1209).

Even though many companies use kanban methods effectively, they sometimes find that the desired results are not being achieved. This flags certain questions about Kanban's effectiveness. Economic factors reflect demand and production. Economic factors such as inflation and exchange rates affect the pull approach in supply chains. A recent study investigated the relationship between high inflation and its effects on the kanban pull

approach. In the study, this was verified, and high inflation certainly negatively affects the kanban pull approach (Erozan & Erozan, 2025).

Implementing lean manufacturing is not easy, and challenges arise, especially when different tools are used together. Many times, managerial approaches, especially their absence, negatively affect the achievement of desired results in lean manufacturing. Examples that have a negative impact on achieving desired results from a management perspective include missing commitment and leadership and poorly defined roles, which directly affect teamwork and motivation (Diaz-Reza et al., 2022, 6).

2.2 Change management in supply chains

Change management can be described in a way where company's transformation from current state is being changed to desired state with the help of systematic and planned management. This is key area especially when implementing new systems such as supply chain management systems as the change has a broad impact on the whole company (Park & Koh, 2014, 96).

Supply chain management (SCM) can be described in a way where different business activities are coordinated systematically and strategically within a certain company. The main desire is to develop the whole supply chain and its performance in a longer perspective. Before the supply chain management scheme, companies were mainly concentrating on their in-house operations such as production, logistics, and sales. After the supply chain management started expanding, companies have started to gain more focus on optimizing and reasoning their whole supply chain. With the help of supply chain management, companies have informed positive impact on their inventory management and production competence (Park & Koh, 2014, 94).

Companies are no longer competing only with each other, nowadays competitions have also changed into supply chains as well. Things that affect the supply chain competition are, for example, cost pressure and growth of customer selections. This is the reason why supply chain functions within the company need to be modified and match with external actors to get through in today's competitive markets (van Hoek et al, 2010, 230).

Studies on the timing of changes vary among researchers. Some believe that change should be made quickly because it creates resistance to change, while others believe that change should be made over time because many different things affect it. It is also important to consider the order in which way things are changed. Here too, researchers disagree. Some say that changes should happen first in high-impact areas, while others say that changes should start at the edges (van Hoek et al, 2010, 232).

The need for supply chain professionals is all the time. It is important that these supply chain professionals understand different business models and can look at the supply chain holistically. Forecasts indicate that there will be a shortage of good experts in the supply chain management field in the future. The shortage of managers in SCM who have the skills needed to match with demand can be explained by the fact that most companies put priority on cost reductions and enhancing the relationship between customers than elaborate employees to accomplish supply chain management objectives. Research shows that ideation for new tasks happens at a practical level. This kind of innovation usually does not reach higher management, and management does not usually support this kind of innovation. Research shows that supply chains need innovative people who have skills to drive business forward (Ellinger & Ellinger, 2013, 119).

3 How should a pull-driven supply chain be measured?

Existing literature has not defined specific metrics for measuring the pull-driven supply chain concept. In many literature reviews, metrics are based only on demand-driven supply chain or supply chain management, not specifically on pull-driven concepts. To determine the exact measurements for a pull-driven supply chain, it is useful to compare how the literature defines supply chain management and the pull approach.

The global supply chain management concept depends on the types of products and services the organization offers and the size of the company. Supply chains within companies are complex, which brings different challenges to organizations. Companies need to audit and supervise their supply chain operations regardless of the products or services they provide or their size. Thus, it is important that performance metrics also include key performance indicators (KPIs) for auditing and supervision within the organization. In supply chains, performance metrics need to audit material, cash, and information flows. Using various metrics, organizational management gains a better understanding of how the company is performing at specific times (Senol, Bakhsh, & Elshennawy, 2021, 90-91).

When companies want to ensure the effectiveness of supply chain management, they should focus on measuring three areas: time, cost, and quality. The above-mentioned areas provide the company with an understanding of the benefits and disadvantages of its operations. It is important to use continuous development methodologies to achieve success in changing supply chain environments. To achieve progress in this area, it is recommended that companies focus on global supply chain performance metrics rather than relying solely on company-specific measurement tools, which can limit progress within the company. Research also recommends that companies track performance measures to identify areas for continuous improvement (Senol, Bakhsh, & Elshennawy, 2021, 93).

Time is a broad concept, and it can be measured using various metrics. As Senol, Bakhsh, & Elshennawy (2021, 93) note, time is one area in supply chain management that should be measured. Lead time is one of the most important factors in the manufacturing industry for ensuring overall performance. In the manufacturing industry, lead time can be reduced through Lean and JIT (just-in-time) principles (Singh, Sohani & Marmat, 2013, 37). In SCM, and the pull-approach time in different aspects is an important metric. Time, especially the

lead time, is more detailed in the pull approach than in overall supply chain management. Even though the time has been determined slightly differently in SCM and the pull approach, it remains a crucial metric for both.

There are many metrics for measuring supply chain performance. In addition to performance metrics, financial metrics should also be recognized. There are plenty of financial metrics for companies to measure their supply chain activities and monitor areas where these affect them (Rahiminezhad & Mokhatab, 2022). The use of the Kanban pull approach should reduce the company's inventories and costs (Erozan & Erozan, 2025, 1208). As we can see in supply chain management and the pull approach, financial metrics are important. In overall supply chain management, there is a wide range of financial metrics, but in the pull approach, the focus is more on the inventory side.

3.1 Pull-driven supply chain metrics

In pull-driven supply chains, various metrics provide the company with valuable information about how the supply chain works. Various metrics, such as lead time, inventory levels, delivery reliability, financial metrics, and collaboration, are suitable for a pull-driven supply chain.

One of the benefits of using a kanban pull approach is that customers' lead time decreases (Erozan & Erozan, 2025, 1208). There has been a research study on how it affects the company when production is changed from a push-driven to a pull-driven approach, and what results can be found. This study confirms that the change from a push-driven to a pull-driven approach has enabled the company to reduce lead time by around 40% (Vasconcellos, Sampaio & Fonseca, 2022). Based on Vasconcellos, Sampaio & Fonseca's (2022) study, lead time is a suitable and recommended metric for the pull-driven approach. It gives the company valuable information on how these two approaches affect the company's production.

As I mentioned, one of the benefits of the pull-driven approach is that there is no need to rely on predictive data for planning in a pull-driven supply chain. With this method, companies can reduce inventory levels, reduce demand variability, and enhance service quality (Wu & Xiao, 2025, 579). Inventories are a crucial part of the logistics chain that

companies cannot bypass. The main idea for inventories is to keep them at minimal levels. When it comes to controlling inventories, there are three aspects: maximum stock, minimum stock, and average stock. Inventories are being managed in different ways in companies. The approach companies use to manage inventory varies based on the types of materials and production processes they use. For the pull approach, the most used method is Kanban. The most beneficial aspect of managing inventory with a pull system is that it can reduce inventory levels by 30%-60%. Hereby, inventory turnover increases and exempts the commitment of financial capital (Szentivanyi, 2013, 1-5).

One of the key considerations in the pull approach for companies is to remember the relationship between suppliers. In the pull approach, different suppliers get involved in the main company's stock management. (Minculete & Olar, 2016, 166). The above-described function can also be described as vendor-managed inventory (VMI). This can be described as an action in which the supplier issues purchase orders on behalf of the customer, based on the demand information the customer has provided. In the VIM process, the supplier oversees the order process and decides how much and when to order (Yu et al., 2015, 268). If the VIM process is being used, it should be closely monitored and measured to ensure it is workable for both parties. If the process does not work effectively, many problems may occur and negatively affect production.

Delivery performance is an important factor, and factors such as delivery mode, warehouse location, and transportation scheduling affect it. It is possible to positively affect delivery performance by choosing the right aspects that influence delivery. One of the major considerations is on-time delivery. This measurement assesses whether delivery has been carried out well (Gunasekaran, Patel & Tirtiroglu, 2001, 77).

The above-mentioned metrics are all suitable for a pull-driven supply chain. Companies need to recognize how a pull-driven supply chain works so they can focus on the right metrics and monitor the whole chain. The management needs to commit to different metrics and make it clear to all employees how these metrics affect work and how they should be monitored. It is better to have a few clear metrics that the company monitors regularly, preferably weekly, than to have multiple metrics and lose focus.

Pull-driven supply chain metrics:
Lead time metric
Inventory level and turnover metric
Vendor-managed inventory metric
Delivery performance / On-time delivery metric

Table 1. Pull-driven supply chain metrics (2026)

4 Methodology and data collection

For this thesis, a qualitative method was chosen. Two semi-structured thematic interviews were conducted to investigate the project and collect data.

Qualitative research is a broad term that encompasses different techniques and philosophies. Qualitative research allows for the auditing of people's experiences. These can be found through various interviews and observations. One of the special strengths of qualitative research is the ability to analyze different challenges from the perspective of research participants. It is possible to use qualitative research for various purposes, such as understanding new challenges and subjects (Hennink, 2020, 10).

Qualitative research methods suit this thesis well, especially when the focus is on gathering different information/observations regarding how the project has been implemented, and the best way to do this is through semi-structured thematic interviews.

All the data for the empirical part of this thesis have been gathered through two different semi-structured themed interviews. Both interview rounds were arranged via Teams and recorded. After each interview, I wrote notes on what was discussed. In this way, it was easy to return and review what each interviewee had mentioned. After all the interviews were done, there was a lot of information to analyze. I started the analysis by categorizing all interviewees into streams based on where they attended. After that, I wrote down what each interviewee had done in order to make a pull-driven supply chain workable. Regarding the metrics, which are a major part of the thesis, I categorized them into categories suggested by interviewees and the literature as suitable for this concept. All the people in the empirical part have been described from P1 to P14.

In the first round of interviews, I interviewed 14 people. In the second round, 13 people were interviewed. Most of the people were the same in both interviews, but some only attended 1 interview. People who attended these interviews are working in different roles within the company. Participants for these interviews were selected based on the streams each person attended. It was necessary to interview all the streams to gather the required information on what needed to be done to make this pull-driven supply chain workable within the company. People who were working in these streams have different roles within the company. These

roles are listed in the table below. At the end of this chapter, I have compiled a table listing the people/streams who attended the interviews.

To obtain all the necessary information, it was necessary to arrange 2 separate interviews. Since the first interview rounds were held at the end of 2025, the project was still unfinished. During that time, it was not clear to all streams what arrangements and changes they needed to make to get a pull-driven supply chain working within the company. It was decided that an implementation interview should be held later to obtain more accurate information. This was the right decision, even though the project is still ongoing. Two semi-structured theme interviews were arranged, with the first covering basic knowledge of pull-driven supply chains and key performance indicators/metrics related to the project. Based on this first semi-structured theme interview and literature review, I have compiled a list of suggested metrics for the company to measure pull-driven supply chain performance. The second semi-structured theme interview included questions about the implementation of a pull-driven supply chain project, in which different streams/departments described how it was carried out from their perspectives. Based on the second interview, all implementation phases have been gathered and described, detailing what each stream has needed to implement to make the pull-driven supply chain workable within the company. All the questions from both interviews are in the appendices.

Function:	**Roles in the company:**	**Interview round:**
Management	Supply Director & Supply Development Manager	1 & 2
Production Planning	Production Planning Manager, Master Planner, Supply Planning Manager, BOM Specialists, Production Unit Manager	Both interview rounds or only one of them
Sourcing	Sourcing Manager, Sourcing Professional	1 & 2
Logistics & Delivery	Logistics Manager, Delivery Manager	1 & 2
Purchasing	Purchasing Manager	1 & 2
Support functions	Sales Support Manager, Production Controller	1

Table 2. Summary of the interviews

5 Pull-driven supply chain implementation

Chapter 5 is the empirical part of the thesis and focuses on the company's pull-driven supply chain implementation and key performance metrics. A big part of the company's operational functions needs to change due to the pull-driven supply chain implementation. The company is using a so-called 'gate model' system for its operational functions, where different tasks at different gates need to be handled by different departments/people. To understand how the pull-driven approach is done within the company, the gate model needs to be explained for the reader. Currently, the company operates with two gate models: the pull-driven gate model, which includes two mining machine models, and the normal gate model, which is still used by the remaining mining machine models.

5.1 Gate models

The company has built a gate-model system for its operational functions, in which each gate requires specific actions. The company is currently using a forecasting-based gate model, also known as the normal gate model, which is intended for most machine models, while two other mining machines operate using a pull-driven gate model.

In this normal gate model, which is based on forecasting, six gates are present, numbered 0, 1, 2, 2.5, 3, and 4. In every gate, there are different tasks for different departments/people.

Gate 0 starts with the demand-supply process. In this gate, units are being added to the production plan based on the monthly demand-supply balance process. A general forecast for the bill of materials needs to be visible in the ERP system. The total quantity per month is being discussed alongside sales territories and the number of machines needed. In this gate, production location and resources also need to be checked. The unit also receives a personal ID number.

At Gate 1, all units need to have region codes if there is no reservation for the unit.

When the unit reaches gate 2, customer specifications and the bill of materials must be available and entered into the ERP system. Long-lead-time components are being ordered at this point, too.

Gate 2,5 can be described as a ‘sales gate’. At this point, the company should have received an order from the customer. If there is no order at this point, it needs to be checked whether the machine's timing is correct, and an internal manufacturing decision made to proceed through the gate.

At gate 3, a material availability check is being done, and this gate can be called the ‘production gate’. The unit is open for work, and the production schedule is frozen.

At the last gate point, gate 4, the final material, resource, and capacity checks are being done. This is the last checkup, during which various things are checked to start the work. It needs to be ensured that all materials arrive at the correct stage of the work. This stage is also known as the ‘work start permit’ gate. Once the final material, resource, and capacity checks are confirmed as fine, the work begins on a mining machine.

Now that the normal gate model has been introduced, we can move on to the new gate model designed for the pull-driven supply chain. In this new pull-driven supply chain model (PDSC), the gate meanings remain the same as in the normal gate model; only the timings differ. Region codes no longer predict pull-driven as in the ‘old’ model; instead, the units have a percentage prediction. The prediction and the program are compared, and a percentage prediction is made using its output, for example, how many engines are needed for stage 5 and tier engines. Below, all the different gates for the PDSC model are explained.

0,5 gate is new in this PDSC model. From this gate, when the unit comes through with an order, the structured process should be completed until the unit is done, regardless of how far or close the unit is.

1,5 is also a new gate for the purchasing department. A material availability check is being done at this point by the purchasing department. Safety stock is built for this. Changes can still be made at this point; for example, automation can be added for the unit, or the engine can be changed.

Gate 1 is also present in the new PDSC model. In this model, if a unit arrives at gate 1 with an order, the structure handler has the last chance to create a structure for the unit. This applies only to units that have an order, not to other units.

Gate 2,5 is also included in the normal model. This means that at gate 2,5 the order needs to be available for the company from its customers. If the order does not reach this point, a decision will be made whether to manufacture the unit and, if so, with what specifications, or to let the unit go through at all from the gate. If the decision is not, the unit must be removed from the program. The unit's specification is handled here.

In the normal gate model, gates 2, 3, and 4 are handled separately, but in the new PDSC model, they are combined. At this point, structure processing needs to have structure available for the unit in the system. There are 3 weeks left from the joint gate before the work starts.

Comparing these two gate models reveals similarities. The differences between these two gates are that the timing differs, 2 extra gates have been added to the PDSC gate model, and 1 gate has been combined into the joint gate. The normal gate model is based on forecasting, while the PDSC gate model shifts the control to customer orders. Below, I have combined a table that shows the differences between these 2 gate models.

Gate:	**Meaning:**	**Normal gate model:**	**PDSC model:**	**Key differences:**
Gate 0:	Demand & supply process	Based on the forecast	Based more on actual demand	Forecasting decreases
Gate 0,5 – 1,5:	Structure creation & material availability check	Gates are not included in the normal gate model	New gates enable order-driven design & material checking	More flexibility & responsiveness
Gate 1	Basic specification	For all units based on the forecasts	Only for units that have an order	Order determines whether the spec is done or not
Gate 2 – 2,5	Specifications & order decisions	Specifications before ordering, orders are not always certain	To have a customer order before proceeding	Decision-making moves closer to the customers
Gate 3 - 4	Preparation & production start	Material, resource & capacity checks	Combined phase – 3 weeks before production start	Faster & more streamlined process

Table 3. Comparison of 2 gate models.

5.2 Implementation steps

When the company's pull-driven supply chain project began, multiple streams needed to be built to address the various considerations required to bring it into use. In total, there were 9 different streams from different departments within the company. All the streams needed to start thinking about the changes they would need to make to adapt to the new pull-driven

working method. At the end of this chapter, I have compiled a table that includes all the streams, the key changes required, the challenges, and their impact on operations.

Set-based component stream: In this stream, people implemented how set-based components will be ordered for work, in this case, for the unit. They also reviewed the set parts for all machine models manufactured with the PDSC model and what needs to be done for these machines. A decision was also made regarding which components will remain set-based and which will be changed to profile parts. The way of working in logistics also needs to change due to the new PDSC model. A new pallet-based picking method was developed and defined within the unit's structure in the ERP system. In this case, people know what needs to be collected for the unit once the work starts. This stream needed to free up more storage space, but it has caused minor problems because there is not enough of it. Stream has had conversations with the assembly department about when they need certain components, ensuring those components are delivered at the right time for production and for when the units need them. Also, conversations with suppliers need to identify which suppliers can deliver components with shorter lead times. Based on this information, it was decided which parts could be changed to set-based components and which parts would remain as profile parts. (P1)

Purchasing management stream: One important aspect was defining the minimum stock levels for each component, including pull-driven units. The purchasing department controls different options through minimum stock levels that can be chosen for the units. To control minimum stock levels, this stream needs item listings for all pull-driven components. A Power BI report was made to clarify which components are included for this project. This stream needed to start ordering components in autumn 2025, since some have long lead times. Set-based components and cabins are partly included for the purchasing department. Cabins are purchased as standard from the suppliers. Also, changes are needed to the ERP system to help identify which components are reserved for pull-driven units. Also, the minimum stocks need to be checked once a quarter. The key change for the purchasing department is that they need to predict minimum stock levels for different options. (P5)

Delivery office: The biggest change for this department has been that the specification is prepared for the unit only after the order has been received. Under the normal process, specifications can be done without an order, but not under the new PDSC model. This is the key change for this department, which should bring more flexibility to everyday work, since

there should be no changes to the specifications. The team needed to adapt to new ways of working and wait until the order had been received. (P6)

Forecast stream: The main change implemented related to forecasting units. The forecasting process was changed to a model that predicts certain options with percentages, so that each machine can become any other machine based on those percentages. The sales department has an important impact on forecasting units, since, based on sales data, predictions are made about what each machine will become and be produced. New worksheets need to be implemented as well. The forecast process is still in progress, but it will be very comprehensive in the future. (P11, P7)

Scope stream/change management stream: The target in these streams was to manage different changes related to the pull-driven supply chain model. In the scope stream, the focus was on discussions with the executive team on various topics related to a pull-driven supply chain. In the change management stream, the main change was to create an escalation process for certain problems with the pull-driven units and to define how to react to changes. A mandatory team has been formed comprising people from different departments. The escalation process has been defined but not yet tested. (P10)

Cabin stream: The main target for the cabin stream was to standardize the cabin components across both units, as included in the pull-driven model. The biggest change for cabins is that suppliers no longer produce specific cabins, instead, cabins are standardized, and variations are made in-house. Thus, the key change in the cabin stream was fewer supplier-specific variations and more custom assembly within the house. Challenges for the cabin stream are that the change across the various cabins does not reach the suppliers well. Also, the production department needs to do more work since the suppliers no longer install different variations into the cabins. (P9)

Bill of materials stream (BOM): The biggest change in the BOM stream was that the timing of actual structure creation for pull-driven units shifted. Also, it was decided which types of machines the structure will be created for, and at what point the structure needs to be created and made available in the ERP system. Various worksheets have also been tested and implemented. One of the challenges for the BOM stream was that the changes needed to the ERP system had not been implemented as desired. (P3, P7, P8)

Gate model stream: The key change at the gate model stream was to define new control logic for the entire process. At the gate model stream, a new gate model for pull-driven machines needed to be built. This new model was built based on information received from other streams. The locations and criteria for the new gates were defined. The pull-driven gate model has been described above and what kind of changes needed to be added, and how has the model changed compared to the normal gate model. (P4)

Supplier lead time reduction stream: In this stream, the sourcing and purchasing departments have been in contact with various suppliers and have negotiated ways to reduce lead times for different components so that the company's pull-driven supply chain can be made workable. The biggest challenge in streaming has been the lead time for dumb boxes. Lead time is very long, and suppliers have not been able to respond effectively to reduce it. Some improvements have been made to the lead time, but the improvement is still ongoing. Purchasing practices and working methods with suppliers have been changed as a result of this project. (P12 & P13)

Stream:	**Key changes:**	**Challenges:**	**Impact on operations:**
Set-based components:	Change into set-based components picking & defining components	Lack of warehouse space & suppliers' lead time	More proactive logistics & closer cooperation
Purchasing:	Components minimum level management & predictive ordering	Long lead times & forecasting for components	Continuous inventory monitoring & forecasting
Delivery office:	Specification created after the order is received	Change in the method of operations	Fewer changes, more flexibility
Forecast:	Percentage-based forecasting model	Unfinished & complex process	More data-driven forecasting
Scope/change management:	Escalation & change management model	Lack of process testing	Clearer response to changes
Cabin:	Standardization & internal variation	Cooperation with suppliers & additional work in the production	More assembly work
BOM:	Change in structure creation time	ERP deficiencies	New timing for structure management
Gate model:	New process control model	Dependence on other streams	Clearer control
Supplier lead time reduction:	Reducing lead times	Long lead times	Closer supplier cooperations

Table 4. Summary of the implementation phase

5.3 Pull-driven key performance metrics

The first interview round for the pull-driven supply chain focused on overall knowledge, implementation, and project-related metrics. The interview was organized to gather valuable information related to the project and to gather different perspectives to compare how the project has impacted, or will impact in the future, employees' work. Regarding the key performance indicators that should provide valuable information to the company, many interviewees mentioned similar metrics they would like to see. Many of the metrics mentioned in the interviews already exist within the company but need to be adapted to the pull-driven supply chain approach. For this key performance part, I have collected different metrics from interviews and literature that the company should focus on and maintain, as well as those related to the pull-driven supply chain.

The first question related to metrics/KPIs was 'What metrics/KPIs should a company use to measure the benefits/disadvantages of a pull-driven operating model?' Several interviewees mentioned that they would like to see metrics related to storage goods and to how inventory turnover will be affected by pull-driven models: '*What is the inventory turnover under the new model?' (P1), 'On the purchasing side, monitoring the minimum inventory and turnover rate of items to be stored. Are there any items that stay in stock for a long time, or that do not even stay in stock for long? (P4), 'Will our inventory grow too much because we need to stock items more with this new model?' (P6), 'Days in inventory.' (P7), 'Tied-up capital in inventory, if the capital can be circulated faster, can the freed-up capital be used for something else useful?' (P8), 'Net working capital and inventory turnover, what to monitor. The new model increases inventory, but that does not matter if the inventory is rotated well.' (P10), 'The inventory turnover rate metric is important.' (P11), 'Inventory turnover and inventory values.' (P14)*

As we can see from the answers, many interviewees want to know how the new pull-driven working model affects factors such as inventory turnover, minimum inventory levels, whether inventory levels will grow too high, and tied-up capital in inventory. These are all critical aspects that the company should pay attention to and develop the above-mentioned metrics. Since inventory turnover and levels affect the company's entire supply chain, they should be monitored regularly, preferably weekly. In this way, the company can find valuable information on whether operations are working well or need to be changed.

Several interviewees mentioned that they would like to see how customers react to the new pull-driven operating model: *'It would be good to see how sales and the customer side behave with the new operating model. Will the customer place the order using the old model or the new model, i.e., a couple of weeks before the work starts?' (P1), 'Will the customers' order point be moved closer to the start of work?' (P2), 'The customer's perceived lead time is reduced, a measurable thing.' (P3), 'Delivery time from the customer's perspective is getting shorter. We should be able to analyze how this affects sales.' (P10), 'How does the customer's delivery time affect it? How does pull-driven shorten this?' (P12).*

Customer satisfaction is an important aspect of the company; thus, it is recommended to develop metrics to monitor and maintain it. Since a pull-driven approach should decrease lead time, this is one of the recommended metrics to monitor. Also, if customers are accustomed to ordering mining machines the usual way, how long does it take them to get used to ordering in the 'new' way? It can be confusing for customers ordering different machine models. With only two mining machines now being produced under the new operating model, will there be confusion between the ordering processes for pull-driven machines and the rest of the machines, which are still being produced in the old way? This is important to track and help customers adapt to the new way of working, since it also helps them decide later which mining machine model they prefer. An important aspect is how the pull-driven model will affect sales, since customers ordering two machine models in this group should receive their mining machines faster, with shorter delivery times. If the company monitors these metrics carefully, it can uncover valuable insights, and if any bottlenecks arise due to increased lead time, it should be able to address them. It may be that not all aspects have been considered, and with the help of these metrics, unconscious problems can be identified.

The gate-model process and specification list and metrics related to it were mentioned by a few interviewees: *'How does the specification behave? If the specification changes, the work is done twice. Is it wise to do specifications in advance, even if they are available?' (P1), 'I wish there were data available on what percentage of our machines are delivered to different gates in relation to the order.' (P2), 'It would be nice to know how many machines will be in the new gate 2 when the machine is open for work, and the sets are ordered so that they do not already have a customer.' (P4), 'The benefits and challenges could be measured by how many changes are made when a specification is made with the pull-driven model for*

the first time before it reaches gate 2.' (P5), 'It would be good to measure how many structural changes are reduced with this new operating model. Will the new operating model achieve that?' (P6).

It is extremely important that the new gate model be reviewed and monitored. All the above-mentioned suggestions related to metrics are things the company should consider as it builds metrics that show all related information. If the gate model does not work, the metrics need to show it.

Topic related to the suppliers was also brought up: *'How much inventory do we have, and how much do suppliers have in stock? Suppliers' flexibility: how is it measured? (P9)*. Suppliers are extremely important to the company, as they supply all the goods needed to produce mining machines. Suppliers' performance and flexibility should be monitored weekly, if not daily. If suppliers are not performing well enough, something needs to change.

During the interview, many excellent ideas were raised about how to measure the company's pull-driven supply chain model and which metrics are useful. Below, I have gathered suggested metrics based on the interviews.

PDSC metrics:	Purpose of the metrics:	Source:	Measurement frequency:
Inventory turnover Minimum/maximum stock levels Inventory levels Tied-up capital in inventory	To monitor inventory levels and inventories	Wu & Xiao, 2025, Erozan & Erozan, 2025, Szentivanyi, 2013,	Every week
Customer's order point > how does it change? Reduced lead time How does the decreased lead time affect sales?	To monitor how the new PDSC gate model works	Vasconcellos, Sampaio & Fonseca, 2022, Gunasekaran, Patel & Tirtiroglu, 2001, thesis interviews	Every month
How does the gate model behave with the new model? How many structural changes are reduced with this new operating model?	To monitor how the new PDSC gate model works	Thesis interviews	Every month
Suppliers' performance Suppliers' stock	To monitor suppliers and their performance	Minculete & Olar, 2016, Yu et al., 2015, thesis interviews	Every week

Table 5. Summary of PDSC metrics

One of my supporting questions in this thesis was: Which measurement factors are most important to the company in a pull-driven supply chain? Based on the literature review and interviews, I have identified several measurement factors that the company can use. Above, we can see various categorized metrics. The table helps the reader visualize why these

metrics are crucial for the company, where metrics are taken, and how frequently they should be measured.

The first category concerns the inventories. Inventories are a crucial part of a company's operations, and they need to be monitored well. Inventories cannot be too low, nor can they be too high. Thus, I have gathered four metrics to monitor this area: inventory turnover, minimum & maximum stock levels, inventory level, and tied-up capital in inventory.

The second area the company should monitor and measure is the new gate model (PDSC). With the new gate model, customers' order points move closer to the start of unit work than in the normal gate model. It is recommended that the company monitor how this change is being implemented for customers. Also, with the new PDSC gate model, the lead time should decrease significantly. That is why it is recommended to monitor its impact on customers. Is the company able to increase sales since it can deliver units faster than before?

The third area is also focusing on measuring the new gate model. Since the company has used the normal gate model for a long time, it takes time for people to adapt to new ways of working. Also, the company should monitor how the new PDSC gate model performs within the company and whether any issues arise that require attention. Thus, it is recommended to monitor/measure how the gate model behaves with the new model. Also, the structural changes should be significantly reduced with the new gate model, since customers have more time to decide what kind of unit they want. Also, no further changes should be made once the order has been received. That is why the company should measure how many structural changes are reduced with this new operating model.

The last area focuses on measuring the supplier's performance and stock. Since the company has many suppliers and components to purchase, it is extremely important to monitor supplier performance and ensure they can deliver all components on time. If suppliers are not performing well enough and delays occur, it can negatively affect the company's manufacturing processes, as it may need to wait for certain components to arrive.

6 Results

In this chapter, results from the pull-driven supply chain process will be presented. Chapter 6 will start with different findings. These findings are based on two interviews conducted with participants in the pull-driven project. Regarding the findings and areas for improvement, I have brought up observations from various areas. After each area, a table has been added presenting key findings. All the observations that I have made are based on the interviews.

6.1 Findings and areas for improvement

After two interviews with people who worked closely on this project, many observations were made regarding the pull-driven project. The people I interviewed for this thesis project responded in quite similar ways. Many people shared similar thoughts, observations, and ideas about the project. Some of the people brought more detailed observations to the interviews than others. People managed to identify various risks the project might pose. The benefits the project will bring were identified, but some of the interviewees' benefits are unclear. Different concerns emerged among the people. Below, I have gathered findings from different areas that emerged in the interviews.

Implementation of the project: The project was implemented well overall. Many interviewees said they were content with how the implementation was handled within the streams and how the streams collaborated well. One of the questions in the interview was 'How successful do you think the implementation of pull-driven supply chain has been overall?' Many interviewees gave similar answers: *'So far so good from my perspective. Real impacts from production are yet to be seen.' (P1), 'This has not been tested in practice at all. It is not seen, except in theory, to work well. The biggest thing here is whether we have enough material, whether the material buffers are defined correctly, and whether the supplier will keep up. However, it has progressed well.' (P2), 'The implementation will be seen at the point when the first 10 machines have been delivered on time. The whole picture will only be seen in a year.' (P4), 'Fine, monitored very closely in weekly meetings. Not a*

single machine has gone into production, and when the machines are finished, we will see how things have worked out in terms of materials.' (P6), 'It is off to a good start, but the implementation still needs to be run before we see any challenges. The time frame is still short.' (P8).

As the interview results show, most interviewees are satisfied with how this project was implemented. The biggest challenge right now is that the implementation and real impacts are not yet visible in the bigger picture. There isn't much data available on how the pull-driven supply chain will work within the company. Predictions and forecasts have been made, but real information/data is still missing, as the project is still in a very early stage. As has been brought up multiple times in the interviews, the bigger picture of how the implementation works will only be available in 6 months to 1 year. Then, the results, such as the benefits and challenges of PDSC, will become clearer, and the improvements needed can be made. Obviously, there can already be challenges and benefits, but since the process is still at a very early stage, it will take more time to see the operation's real impact.

During the implementation phase, a few workshops were organized, and all the streams were attended. In these workshops, valuable information must be shared with participants. Some of the interviewees said they would have liked more workshops arranged, and that would have made communication easier, since all the streams were attended at the same time. This is one of the areas for improvement I would suggest considering in the future. Especially if the company is expanding the PDSC concept to other machine models, it is important to restart the project and define new objectives and targets. It is easier to communicate and share information and considerations in workshops than to discuss topics separately in different streams.

Some of the participants mentioned that the project has not been well documented or communicated within the company: *'There could be better tools in place to document development projects; things are listed, but it could be done more systematically.' (P8).* When multiple development projects are underway in a company, each project must be clearly documented. If documentation is done poorly, it can cause a lot of issues and misunderstandings for the company in the future. Especially if the company wants to expand development projects into other mining machine models in the future. If there is no clear documentation, how can those developments be remembered? This is one area that should be improved. If the company expands the PDSC model to other mining machines, it is

recommended that more effort be devoted to the overall documentation process. It also provides valuable information to the company, enabling them to determine what kind of implementation and changes are required and how they affect specific procedures.

One of the biggest observations that I made during the interview was that answers regarding the question 'PDSC is currently focused on two machine models. If the company wants to expand the PDSC operating model to other machine models in the future, can it be expanded in the same way as it is now, or will the implementation need to be adapted, and changes made for other machine models? It varied a lot. Some interviewees said yes, it can expand as it has been done now, but others said it cannot be expanded as it has been done now and provided more detailed information about what needs to change and be considered. It may be that, for some streams, the workload/implementation was easier than for others, and some people are not aware of the changes needed in those streams to make the PDSC concept work. I want to raise a few good examples from the interviews, why the PDSC concept should not be expanded as it has been now: *'If you want to expand, you must start the project over and redefine the starting point. These machine models have been the easiest options, good pilot machines. Other volume machines have different options, such as different numbers of buckets and platforms in dumpers. There is certainly a lot that can be utilized, but you must not underestimate the amount of work that awaits you if you start expanding. You must start from scratch, given where you are with the machines. Where are the pain points of the new machines? You must reflect, are the streams the same, and are new streams needed?' (P4), 'Change management is more difficult the smaller the volume of machines. Certainly, other machine models may require structural changes. A large part of the cabins has different structures, requiring structural updates.' (P9), 'More focus is needed, as variations increase, more work needs to be done with the product line and design to standardize the structure more and have fewer options/standard options.' (P10), 'No, the cabins are challenging. That means we would have to build a cabin equipment cell in production. If we put all the options in the cabin just to be safe, the price would go up a lot.' (P5)*

The above-mentioned withdrawals are great examples of what the company should consider if it wants to expand the PDSC model to other mining machine models. Since there are many variations among machine models, this PDSC model, designed for two specific units, might not work with new models. Since other models require different implementation paths,

maybe new streams need to be added for the project. One observation I started thinking about is the variations/options for models. Is it necessary to offer all options/variations to customers, or are there certain options/variations that could be reduced? Is it possible to standardize machines and sell certain types of units to all the customers? Since all customers have specific needs for the units, this might not be possible. If the whole model cannot be standardized, is it possible to standardize some components? In this case, the cabin has been standardized.

Observations:	**Effect on the PDSC model:**	**Recommended developments:**
Implementation of the project	The project is still ongoing, and the results cannot be seen fully yet	Wait at least 6 months to 1 year to see how PDSC has been implemented
Organized workshops	Project not documented well enough	The project should be documented better, especially if an expansion project happens
PDSC model expansion	PDSC model developed for 2 mining machines	PDSC model should not be copied as it is for other machine models > need to be started over

Table 6. Summary of the results

Materials/purchasing: Many interviewees brought up concerns regarding whether the material buffer has been calculated and defined correctly for the PDSC model: *'The biggest thing here is whether we have enough goods, whether the material buffer is defined correctly.' (P2), 'None of the machines have gone into production yet, and when the machines are finished, we will see how things have worked out in terms of materials.' (P6), 'Have sufficiently large minimum stocks been built?' (P4), 'Material risk, whether it is a risk or not, whether the prediction was correct or whether there was a calculation error.' (P7).*

Forecasting all materials linked to the PDSC machines is an important aspect of the overall PDSC model. If materials have been forecast incorrectly, such that material buffers have too much or too little, different issues can occur. Material availability directly affects production. If the company lacks sufficient materials, machine production is delayed, and customers will

receive machines later than expected. Based on the interviews, a lot of work has been done to implement the material forecasting process, and the calculations appear to be correct for now. Since the PDSC model has not been active for a long time and some PDSC-related processes are not yet fully implemented, material availability/forecasting may still bring surprises later. As mentioned earlier, the full implementation of the PDSC concept and its different impacts can be seen within 6 months to 1 year. This also applies to forecasting materials and to any related issues.

Observations:	**Effect on the PDSC model:**	**Recommended developments:**
Material forecasting	Are there enough materials available for units?	Monitor carefully, preferably on a weekly basis the material availability

Table 7. Summary of the results

Supplier lead time: The company has many suppliers that supply different components for PDSC machines. Since one of the benefits of the PDSC concept is that the entire lead time for producing mining machines can be reduced, it also directly affects suppliers. This has been a concern in the interviews as well: *'Will the suppliers keep up?' (P2), 'Can suppliers provide shorter delivery times?' (P1).* All suppliers need to be monitored closely, and open communication between the main company and its suppliers is a must. If suppliers are experiencing lead-time issues, they must communicate immediately so the case company can prepare for delays and make the necessary changes. One of the biggest considerations right now is the dump boxes and delivery time for them*: 'We have tried to get dump boxes with a shorter delivery time. Compromises were made on time, but still unfinished with the dumb boxes.' (P13).* The biggest observation I made regarding the dumb boxes is: what happens if suppliers cannot reduce delivery time? How does it affect production? It might be that there is no straightforward answer to this topic right now, but once the PDSC model has been in operation for 6 months to 1 year, we may know more.

Observations:	**Effect on the PDSC model:**	**Recommended developments:**
Suppliers' performance	Suppliers must perform well to be able to manufacture units on time	Monitoring suppliers' performance, preferably every week
Components	Units might be delayed if dump boxes cannot get there on time	Monitor how suppliers can supply the dump boxes

Table 8. Summary of the results

Other areas: One of the important aspects for the PDSC model is the options outside the scope, such as the ejector box, which was brought up in the interview: '*Are those options that should be outside the scope identified in time, such as the ejector box. The sales must ask about this. Identifying these is a risk.' (P6), 'There were some special features outside of pull-driven, which we do not have in stock, and these go according to the normal Gate-model and process. Is it clear to sales which options are such that they do not assume they will go with the pull-driven model, for example, ejector boxes? (P2).* This should be checked, and everyone should have a clear understanding of which options are not included in the PDSC model. If this is not clear to everyone, mistakes can happen, and the machine takes much longer to produce what the customer expected. Recognizing these options, which are outside the PDSC model, should not be the responsibility of a single person. Perhaps it would be possible to link these options to the ERP system so that it recognizes them automatically.

Because of the PDSC model, new working methods need to be developed. Different departments need to adapt and switch to a new weekly-based work method. Certain work needs to be done on a certain day. This has raised concerns among employees about how new methods will work without being person-dependent. Since all cross-departmental work must be completed on time for machines to be delivered to customers, the company must ensure there are enough people to do the work. People need holidays, and if someone gets sick, work cannot wait, someone else needs to do it. Everyone needs to understand how the new model works, and if someone is out, others need to cover for them. If the workload for certain departments gets too high, more personnel need to be hired.

One of the considerations that was brought up in the interview was that in other factories, this PDSC model has been developed as well, but in a different way than in Finland: *'There should not be a different PDSC model for different factories, but rather a unified model and not site-specific models.' (P6).* The company should have clear instructions for each site on how the PDSC model should be arranged and on uniform operating methods. If sites operate differently, it can cause difficulties and confusion among employees. It can cause problems related to the production schedule, too. With coherent instructions across all sites, there should be no confusion.

Observations:	**Effect on the PDSC model:**	**Recommended developments:**
Options outside the scope	Which options are not included in the PDSC model	Make a clear list available for everyone, which options belong and which do not belong to the scope
Enough employees	New ways of working and workload increases	The company needs to make sure that there are enough personnel
Divergent PDSC model among sites	The divergent PDSC model causes issues and confusion among people	Having an equal PDSC model between all the sites

Table 9. Summary of the results

6.2 Key success factors

One of the most important observations from the interviews was that almost everyone said collaboration across different streams has worked very well. Different streams have recognized not only their own challenges but also those of other streams, as well as what should be done to address them. As a thesis worker who has not been involved in implementing new working methods within the company but instead writing about how the implementation process has been carried out, I am very pleased to observe that collaboration within the company works well. Effective, workable collaboration in a large company is not always guaranteed, but in this case, it works well.

Because of the PDSC model, a new material-forecast model had to be built. For the purchasing department, this has also been a long-awaited improvement: ‘This project has forced us to build a material forecast model that was previously desired, but no *driving force has been found before this project. A better and more accurate forecast is obtained.’* (P5). It is great to observe that, because of this PDSC model, long-wanted improvements can be made, and material forecasting is improving within the company. This also positively affects the company’s stock levels by enabling better, more accurate material forecasting.

Another success factor of the new PDSC model is that different processes can be more agile than before: *‘We have opportunities elsewhere to make the process more agile and streamline a certain process, for example, work lists.’* (P4). In many cases, companies tend to leave development processes out because they are used to working the way things have always been done. Often, there is a reluctance to change. In this case, it is beneficial to note that there is an opportunity to change processes that directly affect different departments' work and can bring many benefits, such as more flexible and easier processes.

Shortened delivery times and reduction in specification changes bring a lot of benefits to the company and customers: *‘Shortened delivery times. When you do not make reservations, it also helps, and you do not eat up the best delivery times with reservations. When specification is made only against order, you start to see that you do not need to make as many changes.’ (P6), ‘Positive feedback from the customers for having more time with the specification.’* (P3). From the customer’s perspective, shorter delivery times and more time to decide on specifications are very important factors that positively influence purchasing decisions. The company can win more deals because customers can get mining machines faster than they can from competitors. Customers’ decision-making regarding the specification can be made later, which is helpful because they can truly think about what kind of machine they need and want. There is no rush to decide.

Key success factors:
Effective & workable collaboration within the streams
Long-awaited improvements have been made because of this project
Processes can be more agile than before
Shortened delivery times and reduction in specification changes

Table 10. Summary of key success factors

6.2 KPI metrics

Based on the metrics I recommended for the company, a Power BI report has been created covering them. These Power BI reports give valuable information for the company and make it easier to monitor how different metrics behave. It should be noted that, at this point, in-depth analysis of what can be seen in Power BI reports should not be conducted, as the PDSC model has not been used for long within the company. Data from the past two years are available, but they are not fully aligned with the PDSC model. As has been pointed out in a few areas, the PDSC model needs to be in use for 6 to 12 months before the bigger picture becomes clear. This also applies to the Power BI report/metrics. More accurate data in the Power BI reports can be found much later.

First, we have a lead-time and spec-changes report. From this report, we can see how lead time and specification changes are shifting. In this report, data have been collected from July 2024 to April 2026. As mentioned, lead time and specification changes should be measured carefully, and attention should be paid to how these vary over time. There are not many variations in lead time and specification changes from July 2024 to April 2026. This can also be explained by the fact that the PDSC model has not been in action that long, and the overall picture is still to be determined. Some improvements in the specification changes and lead time are evident in the report. Both metrics have declined, and the future will show whether further reductions are still possible.

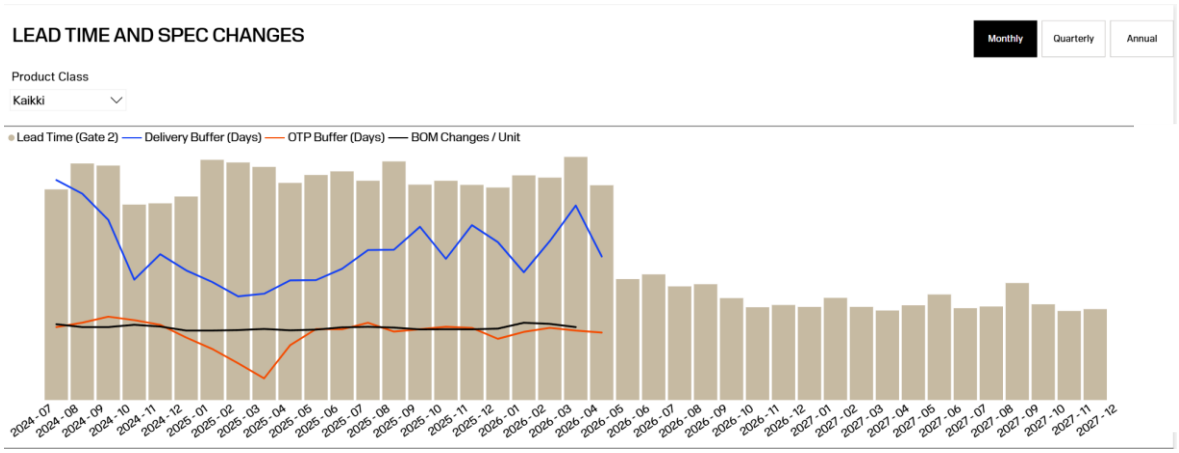

Figure 5. Lead time and spec changes

In the inventory values and DII (days in inventory) report, data has been collected from July 2024 to March 2026. From this report, we can see that the fluctuations between months and values have been quite large. A closer look at the comparison of inventory value and raw material inventory usage shows an improvement. As mentioned earlier, different components needed to be ordered early enough to ensure they arrived in time before the unit's work started. At the end of 2025, the chart shows that the inventory value exceeded the raw material inventory usage. In February 2026, this changed, and raw material inventory usage exceeded the inventory value. The future will show how these values will change.

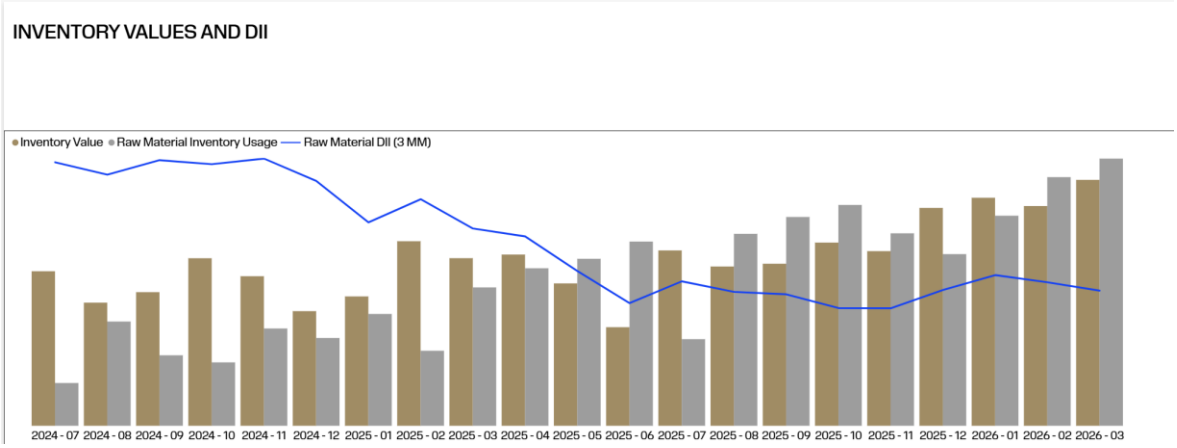

Figure 6. Inventory values and DII (days in inventory)

7 Discussion

This study aimed to find out how to implement and measure a pull-driven supply chain. The discussion chapter will begin by answering all the research questions. In this chapter, theory and empirical study will be compared to identify similarities and differences. Lastly, I will discuss whether the pull-driven supply chain is suitable for the mining industry.

7.1 Comparison of theoretical and empirical

The thesis aimed to find an answer to the question '*How to measure and implement a pull-driven supply chain?'* Based on the literature review and interviews within the company, a clear answer can be provided to this research question. First, I will cover the measurement area.

As mentioned in the theoretical section, there has been little research on measuring pull-driven supply chains. Different research areas, such as the benefits and challenges of the pull approach, have been investigated, but not exactly which metrics a pull-driven approach should have. This raised some issues in determining the key metrics for a pull-driven supply chain. Given the different challenges and benefits a pull-driven approach can bring to companies, I started developing metrics by combining these factors and quantifying them. These metrics, which are grounded in theory, are well-suited for companies that use a pull approach in their supply chains. The metrics I developed for the case company are also suitable for other companies, but a few are based on the case company's own supply chain and cannot be used as described in the metrics.

Based on various studies, with the help of the Kanban pull approach and a shift from a push approach to a pull approach, companies can reduce lead time (Erozan & Erozan, 2025; Vasconcellos, Sampaio & Fonseca, 2022). Because of the reduced lead time, it is a suitable and recommended metric for a pull-driven supply chain. The company can certainly reduce the lead time of these two specific machine models. At this point, it is difficult to see how much, but as shown in the Power BI report, lead time is already decreasing.

Inventory levels and demand variability should be reduced, and service quality should be enhanced through a pull-driven approach. With Kanban in a pull approach, companies can reduce inventory levels by 30%-60%. Hereby, inventory turnover increases and exempts the commitment of financial capital (Wu & Xiao, 2025; Szentivanyi, 2013). As we can see from the Power BI report, the beginning of 2026 inventory value and raw material inventory usage have been quite high, but this can be explained by the need to perform premature work related to component ordering, as reflected in the charts. Even though these areas have risen, raw material inventory usage is higher than the inventory value, which is the target.

Based on the interviews and the theory section, different metrics for the company were developed. In addition to the theory-related pull-driven metrics, four additional pull-driven metrics were found for the case company, which is focusing on its new pull-driven operating model. These metrics are: customer's order point > how does it change? How does the decreased lead time affect sales? How does the gate model behave with the new model? And how many structural changes are reduced with the new operating model?

Regarding the second part of my main research question, which focuses on implementing the pull-driven supply chain. Based on the second interview, which focused on the implementation itself, different streams/departments were able to describe what has been done and how their work has changed due to the new pull-driven operating model. Through the implementation interviews, valuable information about each stream and its work was gathered. If the company wants to expand its pull-driven operations to other machine models, the implementation steps for each stream have been documented, making it easier to identify which additional requirements to consider for the expansion project.

As it was brought up in the interviews, if the company wants to expand this project into other machine models, this project should be started over and check what the needed steps are that can be implemented in a way that has been done for this project, and what aspects need to be built from the beginning. The implementation framework for the pull-driven supply chain is in place, but the expansion project needs to be treated as a new project. A lot of already existing information from implementation phases can be utilized in the new project, but expansions need to be handled as a new entity. Thus, we can answer the main research question: *How to measure and implement a pull-driven supply chain?* In the following way, a pull-driven supply chain can be measured using proposed metrics grounded in the theoretical background that combine various challenges and benefits. A pull-driven supply

chain can be implemented by dividing departments into streams and building new working methods to support it. Some of the new metrics are based on the newly implemented working model, which should also be measured to understand how the pull-driven supply chain operates within the company.

Regarding my other supportive questions for this thesis, '*Which measurement factors/metrics are most important to the company in a pull-driven supply chain?* At the beginning of this chapter, I explained how different metrics affect the company's pull-driven supply chain. There is no need to choose only the most important metrics for the company, since all suggested metrics affect the functionality of the pull-driven supply chain. It is recommended to monitor all the metrics built for the company, rather than a single metric. One metric does not tell the whole picture of the company's situation. These metrics affect one another and should be monitored jointly.

My final supportive question in this thesis was: *What are the success factors and limitations of a pull-driven supply chain within the company?* Different success factors and limitations have been discussed in Chapter 5. Success factors such as effective collaboration, improvements to working methods, and shorter delivery times are key success factors to a pull-driven supply chain within the company. Regarding the limitations of a pull-driven supply chain within the company, several types can be identified. Examples such as the expansion of the PDSC model to other machine models can be a limiting factor. It is not excluded that the PDSC model could not be expanded, but it needs a different approach than has been taken so far. When moving to other machine models, there are different requirements than in this model, since PDSC has been designed for specific machine models.

7.2 Is the pull-driven supply chain model suitable for the case company?

Throughout the writing process, I began to consider whether the pull-driven supply chain model was suitable for the case company. I finally concluded that the pull-driven supply chain model might not be the most suitable for the case company. Instead of having a pull-driven supply chain, I can recommend a hybrid push-pull model to the company. As a reminder, Mendes (2011) notes that in the hybrid push-pull approach, the initiative phase is push-driven, and the remaining phases are pull-driven. A hybrid push-pull strategy is

proposed for goods with high demand uncertainty, where economies of scale significantly reduce manufacturing and delivery costs.

There are a few reasons why I think the hybrid push-pull model would be better than the pull-driven model for the case company. In a certain way, the company is already operating with a hybrid push-pull model, but it should be made clear within the company how to call this new working method. One observation I made was that some components needed for these two machine models have very long lead times. For some, this can be 6 months or even 1 year. To manufacture machines with shorter lead times, these components need to be in-house before the manufacturing process begins. This means that purchasing work needs to be done in advance.

In a pull approach, the distribution, purchasing, and production are driven by demand. In this way, all the functions correspond to real customer orders. Distribution and production operations in the pull approach are initiated only when a customer order is placed (Mahapatra, Yu & Mahmoodi, 2012; Minculete & Olar, 2016). As previous sources mention, purchasing and production are driven by demand. For the company, this does not fully apply, since some purchasing functions need to be arranged early enough to ensure on-time production. Also, the company needs to forecast what certain sales areas are planning to order. Since, in the pull approach, there is no need to make any forecasts, the term "pull-driven supply chain" might not be the most suitable name.

Since mining machines require many different components with highly variable lead times, and forecasts need to be made to avoid manufacturing machines that are left standing in the yard because they have not been sold, pull-driven concepts are not recommended for the company as they are. If the company were to use the pull approach as described in the theory, it would face many issues. These issues are related to the components, as they have long lead times. If certain critical components have a 6-month to 1-year lead time, the production process would be halted due to missing components. If all the components had very short lead times, then the pull approach could work within the company. Thus, the recommended and more suitable working method for the company would be a hybrid push-pull approach. Certain predictions and forecasts in this industry are mandatory because machines are expensive, and companies should avoid producing unnecessary machines. That is why the hybrid push-pull approach is also better, since the machine only starts working when orders come in.

Erozan & Erozan (2025) investigated the relationship between high inflation and its effects on the kanban pull approach. In the study, this was verified, and high inflation certainly negatively affects the kanban pull approach. Because of this study, I started to wonder how inflation will affect the company's pull-driven concept. Since inventory levels should be kept quite low, will it be workable in the end if inflation rises? If inflation rises significantly, suppliers need to raise their prices, and the company needs to pay more. The case company also needs to raise the price of the mining machines to cover its expenses. If mining machines become much more expensive than they are now, will customers still order the same number of units, or will orders drop? It remains to be seen how inflation and the pull-driven supply chain concept within the case company will work.

8 Conclusion and recommendations

The aim and objectives of this thesis were met. To the main research questions, I was able to find an answer that the literature and interviews support. A functional measurement package for the pull-driven supply chain concept was defined, and the implementation phases of the entire PDSC project were described in detail.

As I mentioned at the beginning of this thesis, the project is still ongoing within the company, even though much work has already been done. The Power BI report, built for the company based on the measurement packages I suggested, is already in use and provides valuable insights into how different functions work within the company. Although data is available for a few months, it is insufficient to determine whether the PDSC model is workable within the company. Data should be analyzed critically, and the model should be used for at least 6 months to 1 year to ensure full results are visible and any challenges that arise can be addressed.

Regarding the pull approach, as described in the literature versus how the case company uses it, there are differences. The company should consider whether the pull-driven supply chain is the right definition for the project. As suggested in the discussion part, I would define this project as a hybrid push-pull supply chain concept. A hybrid push-pull supply chain would suit the company better and how they are working.

Overall, it can be said that the project has been implemented professionally and well. All the employees who were part of this project have done an excellent job and have been committed to it. It has not been an easy path for any department to adapt and develop new working methods. The suggestions I have gathered for this thesis can help the company improve the PDSC model and make it more workable.

8.1 Managerial implications

Regarding the managerial implications, I have a few suggestions. The measurement packages built for the case company should be monitored closely. The company should consider the optimal measurement frequency for each metric to obtain the necessary

information. For some metrics, the measurement frequency should be every week, for others, it could be done once a month. The main aspect here is that metrics are in use and data is monitored.

Since in a pull-driven supply chain, suppliers have a big impact on how the concept works, their performance needs to be monitored carefully, especially how well they deliver components on time. If suppliers deliver components late, it directly affects the production schedule, and the risk of delivering finished units to the customer increases. When suppliers' performance and on-time delivery are being monitored, there should be no surprises.

Documenting the project is one area where more effort should be put in. Since the project is extremely large and different big decisions have been made, it cannot be the case that documentation is being left out. People who have been involved in the project might not remember what has been agreed and done in a few years. Also, if people leave the company to work elsewhere and everything is only in one person's memory, what is the company supposed to do after that? Clear documentation helps with this matter.

Since the company is now operating with two different gate models, employees have had to adopt new work methods. This concept has also increased employees' workload, since both gate models need to be remembered. The company should carefully monitor how all employees handle their workloads under these two gate models, especially during the holiday seasons or when employees are sick. The work should not stop because the employees are on holiday or get sick. If it looks like certain departments have a lot of work to do, new employees need to be hired to help.

The expansion of the new PDSC model was brought up during the interviews and has raised concern among the people. If the case company wants to expand this PDSC model into other mining machine models, it should not be copied straight as it was designed for these two mining machine models. The expansion project should be treated as a new project focused on the selected mining machine models. A lot can be utilized from the existing PDSC model, but expansion needs to be handled as a separate project. If the expansion project is copied, it might not include all the aspects these new mining machine models require, leading to issues later.

8.2 Limitations and future research

In this thesis, metrics are limiting factors that other companies should consider carefully. Since this thesis was written for a case company, the measurement package that was designed specifically for them might not be the most suitable for other companies. As mentioned earlier in this thesis, other companies can utilize some of the proposed metrics in their internal measurement, but metrics focused on the new gate model are designed only for the case company. Metrics related to inventories are universal and can be utilized in other companies as well.

As for future research, I would suggest that the company carefully investigate which other mining machine models could be included in the PDSC model, and whether those models are suitable for the new concept. The case company should not make rushed decisions regarding the expansion project and should closely monitor and analyze data from the two specific machine models included in the PDSC project. As mentioned, the recommended time frame for analyzing data from these two models is 6 months to 1 year to capture the big picture and gather data across different functions. In this way, it would be more valuable to the company to tackle different issues that might arise from the metrics and could be avoided during the expansion.

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Appendices

Interview questions, part 1:

1) Company's current supply chain state:

    - What is your role and responsibilities in this company?
    - Can you briefly describe how the company's current supply chain model works from your department's perspective?
    - Can you describe the benefits and challenges of the company's current supply chain model and how it relates to your own work/department?

2) Pull-driven supply chain knowledge:

    - How do you understand the differences between the current and future supply chain models?
    - Do you/your department use pull-driven supply chain modeling tools in your work (JIT, Kanban, Lean)?

3) Measuring pull-driven supply chain & KPI's:

    - What kind of metrics/KPIs should a company use when measuring the benefits/disadvantages of a pull-driven operating model?
    - What kind of new metrics/KPIs are required for your work when the operating model in the company changes?
    - Which different processes do you think require continuous monitoring with the new operating model so that the company can ensure the functionality of the new operating model?
    - What should different metrics/KPIs aim for?

4) Collaboration & communication between departments:

    - How do you feel about communication between different departments regarding the implementation of the new operating model?
    - What things are important from your department's perspective to ensure the successful implementation of the new operating model?

5) Impact of the new operating model on mining machines

    - The new pull-driven supply chain model currently focuses on 2 specific machine models. Do you believe it could be expanded to additional machines in the future? If not, what are the limiting factors?
    - What kind of challenges occur related to mining machines because of the change to the pull-driven concept?

6) Development & Implementation:

    - How have you had to change/will you have to change your working methods in the future due to the new operating model?
    - What kinds of things have not been done/implemented in this project, but are important to consider in the future?
    - What are the key issues from your/your department's perspective that the company should consider when implementing a new operating model?
    - What kind of challenges/benefits will the new operating model create for your department's work?
    - Do you feel that in the future, the challenges you mentioned in the previous question can be turned into benefits/opportunities?

Interview questions part 2:

1) General questions about implementation:

    - How successful do you feel the pull-driven supply chain implementation has been overall?
    - At this point, have you already formed an understanding of the risks and benefits regarding the PDSC model?
    - Do you feel satisfied with how the PDSC operating model is implemented in the company? If not, why?

2) Stream-specific questions:

    - What has your stream/department done regarding the pull-driven supply chain implementation?
    - How do you feel that the implementation steps in your department/stream have impacted the company’s new pull-driven supply chain operations?
    - Are there any things that you think were left undone regarding your department’s implementation? If so, what?

- If the PDSC concept is expanded to other machine models in the future, can your department/stream use the new operating model/implementation you have already created, or will your department need to consider something else that has not been included in the PDSC implementation?

3) Machine-specific questions:

- PDSC is currently focused on two machine models. If the company wants to expand the PDSC operating model to other machine models in the future, can it be expanded in the same way as it is now, or will the implementation need to be adapted and changes made for other machine models?
- Is there anything in the PDSC operating model that cannot be directly implemented for other machine models but must be done differently?