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Evaluating the Impact of Deployed Material Requirement Planning (MRP) Tools on Operational Efficiency in Manufacturing and Order Fulfilment Environment: A Case Study Approach

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TIIVISTELMÄ:

Tämä pro gradu -tutkielma arvioi käyttöönotettujen automatisoitujen materiaalihallintatyökalujen (MRP) vaikutusta operatiiviseen tehokkuuteen tuotantoon ja tilaustenkäsittelyyn keskittyvässä ympäristössä. Tutkielma luotiin käyttäen yksittäistä, kuvaavaa tapaustutkimusta. Tutkielma laadittiin organisaation yksittäiselle toimipisteelle, joka toimii kansainvälisesti teknologia-alalla ja sijaitsee Suomessa. Ennen materiaalihallintaprosessien käyttöönottoa, toimeksiantajayrityksellä oli käytössä manuaaliset materiaaliennuste-, materiaalinhallinta-, sekä hankintaprosessit. Yrityksellä oli visio ottaa käyttöön automatisoidut MRP työkalut hyödyntäen nykyistä Oracle toiminnanohjausjärjestelmää (ERP). Kirjallisuuskatsauksessa perehdyttiin operatiiviseen tehokkuuteen sekä liiketoimintaprosessien uudelleensuunnitteluun käsitteinä, sekä kuvattiin mitä materiaalinhallinnan suunnittelu pitää sisällään ja miten automatisoituja työkaluja voitaisiin hyödyntää materiaalien ennustamisessa, tarvesuunnittelussa, sekä hankinnoissa. Tutkimuksessa arvoitiin kuinka MRP:n käyttöönotto vaikutti materiaalinhallintaprosesseihin ja operatiiviseen tehokkuuteen vertailemalla prosesseja ennen ja jälkeen MRP työkalujen käyttöönoton. Tutkimus toteutettiin käyttäen monimenetelmätutkimusta, jossa laadullinen data oli kerätty prosessikaavioiden, yrityksen sisäisen dokumentaation ja palaverimuistioiden, sekä loppukäyttäjiltä saatujen palautteiden perusteella. Tilastollisen tutkimuksen osio perustui yrityksen asettamiin keskeisiin suorituskykymittareihin (kiertoaika, datan oikeellisuus, automaatioaste, ja varastonkierto). Tulokset osoittivat että uudet käyttöönotetut MRP työkalut paransivat operatiivista tehokkuutta lisäämällä automaatiota, vähentämällä manuaalisia työvaiheita, ja parantaen materiaalinhallinta- ja ostoprosessien standardisointia sekä läpinäkyvyyttä. Materiaalinhallinta- ja ostoprosessien kiertoajat olivat lyhentyneet, ja ostokehoitukset luotiin pääosin automatisoitujen MRP- ja min-max-työkalujen avulla. MRP:n käyttöönoton tuomina hyötyinä nähtiin varastonhallinnan näkyvyyden ja materiaalitarvesuunnittelun parantuminen. Datan oikeellisuus parantui huomattavasti sillä järjestelmä hoiti pitkälti suunnitteluprosessin manuaalisten työvaiheiden sijaan. Jatkuvan parantamisen mentaliteetti oli vaatimus ydindatan laadun ylläpitämiseksi, sekä MRP:n säännöllisen käytön varmistamiseksi. Loppukäyttäjiltä saatujen palautteiden perusteella voitiin todeta että MRP:n käyttöönotto nähtiin lisäarvoa tuottavana, päätöksentekoa tukevana työkaluna, vaikkakin MRP:n käyttöönottoprojektin aikana sekä sen jälkeen työkuorma lisääntyi loppukäyttäjillä hetkellisesti. Kokonaisuus arvioiden, tutkielman johtopäätöksenä voitiin todeta että MRP:n käyttöönotto oli operatiivisesti onnistunut, mutta sen tehokkuus perustui pitkälti loppukäyttäjien halukkuuteen osallistua muutosprojektiin, ydindatan ylläpitämiseen sekä jatkuvaan parantamiseen perustuvaan projektin jälkeiseen prosessikehitykseen.

AVAINSANAT: materiaalihallinto, operatiivinen suunnittelu, tuotannonohjaus, toimitusketjut, prosessijohtaminen, tapaustutkimus

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ABSTRACT:

This master's thesis evaluates the impact of implemented automated material management tools (MRP) on operational efficiency in an environment focused on production and order fulfilment. The study was conducted as a single-case, explanatory case study. It was carried out for a specific case company site located in Finland. Site operates globally in the technology industry. Prior to the deployment of material management processes, the case company site relied on manual material forecasting, material management, and procurement processes. The case company site had a vision to deploy automated MRP tools using its existing Oracle E-Business Suite Enterprise Resource Planning (ERP) system. The literature review examined operational efficiency and business process reengineering as concepts, and described what material requirements planning entails and how automated tools can be utilized in material forecasting, requirements planning, and procurement. The study evaluated how the deployment of MRP affected material management processes and operational efficiency by comparing processes before and after the implementation of MRP tools. The research was conducted using a mixed-method approach, where qualitative data was collected from process flowcharts, internal company documentation and meeting minutes, as well as feedback from end users. The quantitative analysis was based on key performance indicators defined by the company, including lead time, data accuracy, level of automation, and inventory turnover. The results showed that the newly deployed MRP tools improved operational efficiency by increasing automation, reducing manual work steps, and improving the standardization and transparency of material management and procurement processes. Cycle times in material management and procurement processes were reduced, and purchase requisitions were primarily generated through automated MRP and min-max tools. The benefits of MRP deployment included improved visibility in inventory management and enhanced material requirements planning. Data accuracy improved significantly as the system largely replaced manual planning processes. A continuous improvement mindset was identified as essential for maintaining master data quality and ensuring the regular use of MRP. Based on feedback from end users, the deployment of MRP was perceived as a value-adding and decision-supporting tool, although workload temporarily increased for end users during the implementation phase and after the stabilization period. Overall, the study concludes that the implementation of MRP was operationally successful. However, its effectiveness largely depended on end users' willingness to participate in the change project, maintain master data, and engage in continuous post-implementation process improvement.

KEYWORDS: materials handling, operational planning, production planning, supply chains, process management, case study

Contents

Figures

Tables

Abbreviations

ASCP	Advanced Supply Chain Planning
ASL	Approved Supplier List
ATP	Available To Promise
BOM	Bill of Materials
CM	Contract Manufacturer
DOI	Days of Inventory
BPR	Business Process Reengineering
DTF	Demand Time Fence
ERP	Enterprise Resource Planning
FDS	Fixed Days of Supply
FLM	Fixed Lot Multiplier
FOM	Factory Order Management
IODM	Instrument Outsourced Demand Management
KPI	Key Performance Indicator
LOB	Lines of Business
MAD	Mean Absolute Deviation
MAPE	Mean Absolute Percentage Error
MFE	Mean Forecast Error
MOQ	Minimum Order Quantity
MPS	Master Production Schedule
MRP	Material Requirements Planning
NPI	New Product Introduction

OPRD	Oracle Production Instance
PPRD	Oracle Planning Instance
PTF	Planning Time Fence
PTO	Pick to Order
RTF	Release Time Fence
SRT	Supplier Response Time
WIP	Work in Progress

1 Introduction

Thesis is conducted with a case study approach for a specific site in a globally operating technology company located in Finland. In early spring 2023, company site had a vision to deploy automated material requirements planning (MRP) tools into use in current Oracle E-Business Suite Enterprise Resource Planning (ERP) system to help streamline planning processes, eliminate or reduce manual forecasting and purchasing processes, and optimize inventory levels with successful transition while minimally impacting site's daily operations (Company internal document, 23.10.2023 [restricted availability]). As-is and to-be pre-study for the MRP deployment was conducted between February 2023 and October 2023. Actual MRP deployment project was conducted between October 2023 and May 2024.

1.1 Background of the case company

Case company for the thesis study wanted to remain anonymous. Therefore, the company name is not mentioned anywhere in the thesis. Site in Finland is considered as medium-sized company with R&D, production, and order fulfilment operations. Site has two product lines, which are introduced as Product Line A and Product Line B in the thesis to maintain anonymity. The primary focus in the research study is on Product Line A. Mass production operations for Product Line B was transferred during MRP deployment from Finland to another geographical region, so therefore the process to deploy automated MRP tools for Product Line B and its operations in Finland was not seen urgent and highly required. Some study analyses were still performed also for Product Line B regarding e.g. MRP usage, and improvement in planning processes.

Before the MRP deployment in 2022, case company site had manually handled the sales forecasting process, and therefore it had been time-consuming to go through all process steps which lead to possible errors in every step due to missing visibility. Commodity managers had been worried that they did not have visibility to see the actual demand in a component level which had effect on global agreements and costing. Due to completely manual forecasting processes, many spreadsheet documents had been used. Process had required monthly inputs from several stakeholders including sales, product management, operations, and purchasing (Company internal document, 5.5.2023 [restricted availability]).

In addition to forecasting process, purchasing processes had also been handled fully manually in both product lines with many different phases where the possibilities for errors were present. There had e.g. been mismatches with the actual demand and requirements due to human errors, and inaccuracy between on-hand balances and demand. Product structures were seen complicated which required manual analysis of the on-hand inventory regarding the availability of lower-level components (Company internal document, 5.5.2023 [restricted availability]).

As of writing the thesis, case organization's global infrastructure and operations had a vision and goal to prioritize operational efficiency and productivity across procurement, planning, and manufacturing by improving processes, cycle times, sourcing, and automation, and reducing inventory levels with better control and optimized planning (Company internal document, 6.11.2025 [restricted availability]). This global vision and case company site's specific needs for improving planning processes makes thesis study relevant and valuable for the case company.

1.2 Research questions and objectives

Automated MRP tools have been in use in the case company site since MRP deployment in May 2024. Case company site wants to learn with further post deployment study what impacts have deployed MRP tools brought regarding operational efficiency. Case company site is especially interested in results concerning MRP usage and automation rates, and possible improvements in process cycle times, data accuracy, and inventory turnaround. Additionally, end user feedback post deployment is seen valuable to assess continuous improvement and development in MRP usage.

Research question is the following:

> "*What impact did deployed MRP tools have in the case company site's operational efficiency?"*

Objective of the study is to analyze how automated MRP tools improved planning processes in the case company site compared to the as-is and to-be pre-study, evaluate the impact on operational efficiency post MRP deployment by measuring relevant key performance indicators (KPIs), and provide recommendations for further MRP process improvements and future development based on the findings.

1.3 Structure of the thesis

The thesis is divided into six chapters. Chapter 1 introduces the case company, and defines the research objectives and questions, and structure of the thesis. Chapter 2 provides the theoretical background, covering operational efficiency, process improvement approaches, and key concepts related to Material Requirements Planning and Oracle planning tools. Chapter 3 presents the research methodology. Chapter 4 describes the MRP system deployment project in the case company by presenting the design, testing, training, and deployment phases.

Chapter 5 presents the results. It includes comparative evaluation of the pre- and post MRP deployment processes, KPI analysis – focusing on cycle time, data accuracy, automation, and inventory turnaround – and summary of the user feedback related to the deployed MRP tools. Chapter 6 concludes the thesis by summarising the key findings and offering suggestions for future development and research. Appendices include the presented interview questions to collect data for the study analysis related to benchmarking and end user feedback.

2 Literature review

This chapter gives brief insight on what are the core elements in measuring organization's operational efficiency in modern supply chain operations, how to utilize business process reengineering approach in change project, and what is material requirements planning and its benefits and challenges when considering implementing it into use.

2.1 Strategies to measure efficiency in modern supply chain operations

Operational efficiency is widely researched topic across different industries, especially due to the progressive increase and evolution of automation and digitalization. The most recent studies and guides within the last decade focusing on manufacturing and supply chain management context, indicate the strategies how to improve and measure operational efficiency in an organization.

Malsam (2022) defines operational efficiency as a metric used to reduce waste and excess material inventory by streamlining processes. This is achieved by investigating organization's resources, production, inventory management, and supply chain. It is seen important to ensure cost-efficient ways of working. Some of the strategies to improve operational efficiency in an organization include identifying, mapping, and streamlining business processes, communicating with the employees, generating value and eliminating waste, and establishing key performance indicators (KPIs). JuzSolutions (2026) identify e.g. lead times, production cycle time, on-time delivery, inventory turnover, and level of automation as relevant KPIs for measuring efficiency in supply chain operations.

Kumar & Harms (2002, p. 662) indicate that manufacturing companies have faced continuous need to seek new ways to improve their operational efficiency to remain in strategic position in the market. Matonya & Budai (2025, pp. 1–2) outlines that the manufacturing industry is feeling pressured to respond rapidly to global competition, shorter product life cycles, custom-focused customer demand, and evolution of digitalization. Mashaba & Emwanu (2025, pp. 1–2), Al-Abahneh et al. (2025, p. 769) & Shaik (2023) emphasize that for organizations to integrate supply chain operations in optimal way can be achieved by utilizing advanced technologies and collaboration between different parties. Automated tools, such as artificial intelligence (AI), machine learning (ML), and advanced data analytics improve accuracy, automation, visibility, and efficiency especially for predictive forecasting, and data-driven procurement, inventory handling, and production planning activities.

Outdated systems, disconnected databases, and lack of innovative data analytics are the reasons for many businesses for considering completing digital transformation within the organization. However, it is crucial to acknowledge that technology alone is not the success factor without paying attention to standardized data governance and development of employee's knowledge and skills. Organizations must be strategically ready for integrating digitalization in their operations (Mashaba et al., 2025, p. 2).

Al-Abahneh et al. (2025, pp. 770, 777), Malsam (2022) & Shaik (2023) reminds organizations to embrace the mindset of continuous improvement and digital way of thinking in the corporate culture and adopt the internal processes to new ways of working for employees to be prepared with appropriate training before transformation project is executed. Kohli & Malik (2025, p. 251) also highlight the importance of readiness and resource allocation for digital transformation. When digital tools are integrated into supply chain operations, e.g. efficiency and transparency are improved by enhancing collaboration between stakeholders and data-driven decision-making.

Shaik (2023) outlines that employee productivity can be maximized when processes, workflows, and tools are streamlined. Employees can focus on tasks that create more value for the organization and eliminate unwanted repetitive processes. Streamlined processes with smooth access to needed tools help with the collaboration. Enterprise Resource Planning (ERP) systems centralize the needed data in one location which streamlines tracking, administrative work, and increase operational efficiency.

Both Malsam (2022) and Shaik (2023) emphasize that work efficiency can be enhanced with the help of data-driven operations. KPIs need to be measured for continuous progress tracking and visualizing the possible changes needed in processes. KPIs can be monitored and tracked with suitable metrics to understand the processes and where to improve to gain operational efficiency. User feedback is valuable and should be collected so that employees can raise possible concerns and suggest ideas to improve processes. For employees to be responsive to organizational changes, data quality needs to be improved by ensuring it is current and up to date.

According to Shaik (2023), data-driven decision-making gives businesses a better opportunity to track the performance, forecast future trends, and utilize data analysis to optimize operational strategies. Data visualization tools are useful when complex information needs to be presented clearly for further actions. Predictive analytics help to forecast market trends and to be aware of possible issues in early stage.

Mashaba et al. (2025, p. 6) have created a conceptual model in their research study which shows proposed framework for integrated supply chain planning. There are five core elements in the model which are in alignment with the reviewed literature: demand forecasting and planning alignment, technological integration, cross-functional collaboration, operational efficiency and performance metrics, and strategic decision-making and resilience.

Forecast accuracy and demand alignment synchronizes planning and reduces out of stock situations and inefficiency. Technological integration and data visibility are related to taking AI, ML, and data analytics tools into use to improve transparency, and response times. Cross-functional collaboration within teams in different departments strengthens the alignment in processes, and operational functions. Operational efficiency in planning systems is the key success factor for reducing lead times, improving order accuracy, and lower costs. Strategic decision-making and resilience rely in assessing continuous feedback to maintain necessary ongoing capabilities (Mashaba et al., 2025, p. 7).

According to Malsam (2022), it is fundamental to gain familiarity in organization's operations to be able to improve it. When utilizing business process mapping, it helps to acknowledge the business processes related to operations. This leads to measuring efficiency for these individual processes by using performance metrics analysis to investigate the possible waste and find bottlenecks for further improvement. Once the process mapping is completed, action points for improvement needs to be addressed. Waste in operational activities need to be eliminated to improve generating value.

Shaik (2023) concludes that there are still challenges seen in businesses when attempting to increase operational efficiency. It is central to avoid mistakes that effect on making progress. It is vital to not rely too much on automation since it might cause systems to be inflexible and unchangeable. When unnoticed errors occur, it might in worst scenario cause failures in processes, damage the company reputation, and affect on customer satisfaction. If feedback from employees is ignored by the company, there is no valuable insight gotten to improve processes, and small issues will easily grow into big issues. Companies might get stuck in the current ways of working due to being too resistant to change. Uncertainty caused by the lack of training, misinformation, and preference for the outdated routines will eventually cause inefficiency, unproductivity, and lack of innovation to seek potential modern ways of working.

2.2 Utilizing process re-engineering in managing a change project

Business process improvement is an essential element in operations and supply chain management. Business process reengineering (BPR) can be defined as a useful strategic process management method to be utilized when major business process is planned to be dramatically improved (Bozarth & Handfield, 2013, p. 94). BRP has played a significant role e.g. in system deployments. Success of system deployment depends on the achieved benefits of the BPR methods that have been utilized (Samaranayake, 2009, p. 505). Several researchers and authors within the field of operations and supply chain management indicate that in especially technology-driven environment, where outdated processes decrease performance, organizations are feeling pressured to reassess their current practices and solutions to be more up to date (Adesola & Barnes, 2005, p. 37; Oakland, Oakland & Turner, 2020, pp. 229–230, Bozart & Handfield, 2013, p. 114).

When defining what BPR is, it can be seen as extreme redesign of a business process, structure, and its related systems. Main goal is to align and restructure work processes with the desired requirements to gain long-term improvement. Managers need to reevaluate how to improve current ways of working and commit to certain processes. When BPR is utilized, many organizations have found significant improvements regarding e.g. customer satisfaction, lead times, productivity, and profitability along with less human errors during the process (Oakland et al., 2020, pp. 230–231; Tripathi & Gupta, 2020, p. 444).

When business process is reviewed, it requires cross-functional redesign teams to share the insights. In addition of going through the process steps, it is critical to identify the responsible process owners, and what is the current level of communication between different parties within the process. Process owners need to ensure that all the employees are aware of how individual work process affect to business and what value it adds to the process. Even though technology and digitalization help with the transformation of the business process, it is vital to thoroughly acknowledge the current process before reengineering the future potential processes by redesigning them with the help of process mapping and flow charts. Process mapping provides a baseline for further measurements in improvement, and it gives managers a full picture of the process flow (Bozarth et al., 2013, pp. 94, 95, 98; Oakland et al., 2020, pp. 231–232).

Adesola et al. (2005, p. 39) outlines that many organizations that are going through a BPR project are trying to find answers to questions “how to do it?”, “what do we do next?” and “what methodology to follow?”. Based on the literature authored by Bozarth et al. (2013, pp. 100, 103) and Oakland et al. (2020, pp. 234–235) and article authored by Tripathi et al. (2020, p. 444), it is shown that for organization to success in change project, it is integral to focus on results in process performance. It is important to carefully select the methods and measures to be used in each case. There are several ways to measure process performance, such as productivity, efficiency, and cycle times. Especially managers are interested in these metrics in strategic decision-making. Other performance indicators such as quality, delivery, productivity, and efficiency must be well-performed to be able to reduce cycle times. Benchmarking is seen as another useful tool in several BPR projects since it aims to identify goals and reshape the strategy by comparing similar processes in other businesses or within the same organization.

BPR process begins by identifying the issue, or unwanted outcome and what would be the desired outcome. This can be modelled by using as-is and to-be analysis. Business need must be assessed by the redesign team including related processes, scope, and requirements. Redesign team of 5-10 people should consist of the following members: senior manager, steering committee, process owner, team leader, and other redesign team members who are working within the process. Some organizations also utilize outsourced consultants to give the company valuable insights (Bozarth et al., 2013, pp. 100, 103; Oakland et al., 2020, pp. 234–235; Tripathi et al., 2020, p. 444).

As-is analysis consists of evaluating and documenting the current processes (Tripathi et al., 2020, p. 444). Process mapping and flow charts are used to gather the current ways of working to be able to further measure, analyse, test, and improve them. When measuring the added value in each of the process tasks, it is necessary to collect supporting data, e.g. from benchmarking. Process mapping shows the possible bottlenecks in the process, which helps to identify the root causes behind them, and what would be the potential fixes to improve and streamline the process and eliminate unwanted bottlenecks. When continuing with the redesign and innovation in the to-be analysis, same mapping techniques can be utilized to investigate each sub-step in the current process until the desired outcome has been identified (Oakland et al., 2020, pp. 235–236).

Once redesign is completed, changes need to be tested and validated before proceeding with deploying the changes into use, and immediate feedback needs to be gathered to utilize the results in possible finetuning before deployment. New processes and operations involve reorganization and retraining employees to key processes to ensure successful deployment. Top management need to also be involved in supporting and committing to the deployed change (Oakland et al., 2020, pp. 235–236; Tripathi et al., 2020, p. 444).

Post-deployment phase includes continuous improvement which consist of measuring and monitoring the new process and its tasks. When organization returns to normal routines with the new process, business must acknowledge that it is a long-term commitment to improve the process further and not try too radically make several process changes in a short period of time (Oakland et al., 2020, p. 236). Tripathi et al. (2020, p. 445) conclude that measuring performance of the new process and possible achieved improvement in the change project will provide insight whether deployment has been successful in comparison to the desired result.

According to Dey (2001, p. 394), inefficient materials management affect negatively on productivity and material costs. Common issues that are faced in material management are e.g. material receivals without any requirement, delays in material receivals at the required time, and management of the excess inventory. Tripathi et al. (2020, p. 452) indicates that after process reengineering, transactional procurement functions are mostly automated, which prevents delays in the process. When manual transactions, and delays in communication and operational tasks are eliminated, it reduces procurement cycle time radically and optimizes resource allocation. Importance of data availability and up to date kept data are seen crucial in supply chain planning. If collaborative information system is not established, it causes uncertainty. Trust between both internal and external stakeholders improves when sharing, visibility, and transparency of the data is secured.

2.3 Material Requirements Planning

Material requirements planning, or better known as MRP, is a commonly utilized planning system for production and inventory management in organizations (Shamsuzzoha & Jaakkola, 2024, p. 3). Automated MRP tools integrated into ERP system aim to improve planning processes by creating planned orders for the purchased parts and components based on the master production schedule (MPS). With MRP, organization can manage the flow of raw materials and components based on dependent demand or production of an item (Bozarth et al., 2013, p. 386; Mabert, 2006, p. 346). In this chapter, MRP will be introduced more closely with its benefits and challenges, and how MRP tools support automation in common demand and supply chain planning, focusing on usage in Oracle ERP system.

2.3.1 Introduction to Material Requirements Planning

According to Trebilcock (2009, p. 26), supply chain management systems help with transferring information in real-time and give a visible insight to the activities across the supply chain. Enterprise Resource Planning (ERP) system is the core for automated and integrated business processes, commonly shared data and practices with real-time accessibility. Supply chain planning (SCP) system focuses on order management: what orders are to be manufactured, picked, and shipped to the end customer, and it shows the availability of capacity, materials, equipment, and resources. MRP is part of the ERP and SCP systems.

Traditional MRP systems have been use in the organizations for decades (Milne et al., 2012, p. 1566). Especially in early 1990's, MRP deployments exploded worldwide. Many companies utilized third party software, and others developed their own system. MRP logic has developed over time with new approaches towards more demand-driven MRP (DDMRP) and it continues to be an essential part of operations management also in the future (Mabert, 2006, pp. 346, 355; Shamsuzzoha & Jaakkola, 2024, p. 2).

Material requirements planning consists of bill of material (BOM), backward scheduling, and BOM explosion. Bill of material can be determined as a list of all the assemblies, parts, and raw materials that are needed with the required quantities to produce an assembly. Planning lead time is the timeframe from creating a purchase order for the shortage material until it is received to inventory. Basic MRP logic is based on backward scheduling, where records are built backwards from the planned completion date for the finished good. MRP performs scheduling and monitoring based on five inputs: master production schedule, routings, bills of materials, inventory, and purchase and production orders (Bozarth et al., 2013, pp. 386–388; Plenert, 1999, p. 92).

Literature shows that there are several benefits in utilizing MRP in planning processes. MRP is a central part of ERP systems, since it gives valuable information regarding production scheduling, shipments, and inventory planning. MRP takes the planning data from master production schedule (MPS), and based on the data, it determines the correct timing and quantities for the material requirements (Bozarth et al., 2013, p. 393). Samaranayake (2009, p. 509) enumerate MRP output as a mix of planned orders, dependent requirements, and purchase requisitions (PR). MRP includes several planning, control, and execution steps within the process, and each of the processes entail master data governance, regarding e.g. material data, BOM, routings, and cost centres. Transactional data include the planned orders and production orders.

MRP helps reducing the manual management of dependent demand inventory by lowering inventory levels to meet the set targets. Managers and planners can follow-up purchase orders to quickly assure that material shortage is received on time without impacting to master production scheduling. If there are delays in material deliveries, managers and planners can easily investigate, how the delay affects to production (Bozarth et al., 2013, p. 393).

Bozart et al. (2013, p. 393) acknowledge that despite MRP systems are computerized, it requires regular maintenance and understanding of the functionalities from the organization. Data in the MRP system, including MPS, BOM, inventory balances, and planning lead times, must be up to date and accurate to ensure successful MRP deployment. If there is any inaccuracy or outdated information, it has a huge effect on planning processes. Purchase orders will not be processed at the correct timing, or in the correct quantities. Some crucial components might be fully missed to be ordered.

Uncertainty causes adjustments to planning lead times, and safety stock levels. If buffering is commonly used, it will show as an increase in the inventory levels. For organizations to reduce the excess inventory and uncertainty, reliable suppliers and processes are selected. When MRP deployment is considered, it is fundamental to acknowledge that if there is even a small change performed in the bill of materials, such as to requirements for upper-level items, it might have a noticeable effect also on the material management of the lower-level parts (Bozarth et al., 2013, pp. 393–394).

2.3.2 Introduction to Demand Planning and Forecasting

A forecast can be defined as a close approximation of the future level of the variable, such as demand, supply, or price. Forecasting is needed when organizations are planning their long- and short-term operations, such as capacity, and supply chain (Bozarth et al., 2013, pp. 167). Lansdowne (2010, pp. 5–6) outlines that demand plan represents a systematic prediction of future supply chain requirements over a defined period, and it is derived from a demand forecast. Forecasts look for seasonal patterns, and other factors, which are reported as a demand curve that highlights trends and the impact of exceptional fluctuations. Production and capacity planning utilize these forecasts and demand plans, and are automatically transferred, or reported from, ERP systems.

To achieve consensus across the organization, demand must be presented in a single, aligned view to enable effective planning. Demand signals must be collected and integrated, secure access for owners need to be provided for forecast inputs and reviews, and forecast data need to be reported in appropriate formats for decision-making, such as regional value-based or unit-based forecasts by production or shipping location (Lansdowne, 2010, pp. 5–6).

Managers are expected to have full knowledge of the demand, but predicting demand is not seen easy. Many organizations have found forecasting products or services in groups more accurate compared to the individual items, since there are multiple factors that have an influence on forecasting each item. There are several forecasting techniques to be utilized depending on each case. Some of the important approaches are based on human judgments, historical data, and statistical modelling (Bozarth et al., 2013, pp. 270–271, 273).

Bozarth et al. (2013, p. 271) indicate that demand forecasting can be divided into market demand and organization-level demand which businesses are equally interested in. Supply forecast is as important as demand forecast, since missing supply affects on the process to deliver the goods or services to end customer. Supply forecast focuses on presenting e.g. the number of suppliers, supply inventory, and possible technology and political trends.

Special interest is to forecast prices for the key purchased components and services. Forward buying is seen as a cost-effective strategy when commodity prices are going up. Then, larger quantity orders are placed, which are kept in the inventory for possible future demand. Another way to ensure the supply, is to sign legal agreement - futures contract - where a commodity can be bought or sold with a fixed price during the agreement. In case prices begin to drop, materials are suggested to be bought regularly in small batches. However, before purchasing strategy can be decided, price forecast should be assessed (Bozarth et al., 2013, p. 271).

Lansdowne (2010, p. 6) indicate that while demand uncertainty cannot be fully eliminated, forecast accuracy can be improved through statistical analysis, quantitative models with qualitative judgment, and continuous performance monitoring. Reducing the cycle time of the demand management process is particularly important, as longer cycles increase forecast error, extend the prediction horizon, and limit forecast frequency. Shorter cycles are enabled through advanced analytical tools and automation, allowing organizations to focus on exceptions rather than manual processing.

In successful forecasting and demand planning, historical quantitative data needs to be accurate, available, and measurable. Once this is in alignment, demand planners can utilize predictive quantitative forecasting modelling to generate forecasts. In case the data is not available or reliable, qualitative forecasting methods must be utilized, which are based on human intuition or opinion (Bozarth et al., 2013, p. 273).

Expert judgment is utilized when qualitative forecasting methods are used, especially in cases where historical data is unavailable or limited. The Delphi method and panel consensus are one of the qualitative forecasting methods. Both forecasting methods utilize the knowledge of experts for generating forecasting. However, they have a differentiation on how the alignment is achieved. Panel consensus forecasting is handled by arranging joint meetings between the experts, where forecast is discussed and developed. On the other hand, in the Delphi method, forecasts are done individually by each of the expert, which are afterwards shared within the group of other experts. Once forecasts are reviewed, experts can adjust them until alignment is reached. Even though both methods require time and costs, results will be highly accurate when deployed in an appropriate manner (Bozarth et al., 2013, p. 274).

There is another qualitative approach called the life cycle analogy method, which is typically utilized in New Product Introduction (NPI) forecasting. In this method, product follows a life cycle including introduction, growth, maturity, and decline phases. Forecasting concentrates on the overall demand level, in addition to the duration and intensity of each phase. Historical demand data from comparable product is used when the NPI product is a new revision of an existing product, or targets a similar market (Bozarth et al., 2013, p. 275).

Quantitative forecasting models utilize statistical techniques and historical data for generating forecasts. Categorization into time series and causal models is common, and there are formal rules to be followed. Time series forecasting focuses on data observations in certain time frame, where chronological order and numerical values are essential. These will help to analyse the trends, seasons, and variation. Trend can be determined as long-term directional movement, and seasonality shows the recurring patterns that are pointing to specific periods, e.g. months or quarters (Bozarth et al., 2013, pp. 275–276).

Quantitative forecasting methods may be seen as complex in business environment due to large masses of data and requirements for computerized solutions. This gives organizations pressure to take computer-based forecasting systems into use for more efficient forecasting process. When historical demand data is available, forecasting system can automatically find a suitable forecasting method and model, and track the forecast accuracy with key performance indicators, such as mean forecast error (MFE), mean absolute deviation (MAD), and mean absolute percentage error (MAPE). Forecasting software can also generate and compare multiple forecasts for a single item, which can be assessed individually or as a combination to enable better accuracy (Bozarth et al., 2013, p. 298).

2.3.3 Oracle Demand Planning

Oracle ERP has a web-based demand management system called Demantra which performs the demand planning and forecasting. System is tailored to each organization's specific needs. Oracle Demantra demonstrates the historical sales data, returns, and other hierarchical data. Demand planning process usually begins by investigating historical sales data and predicting future demand based on the data. Goal is to meet customer demand in a timely manner and fulfil the material and production requirements for each of the product (Lansdowne, 2010, p. 5).

Oracle Demand Management is developed to support organizations in generating forecasts for future demand and transform them into operational and strategic plans. Data is collected from multiple sources, and system performs aggregation and analysis between several dimensions such as item, product family, region, time horizon, and organizational unit. The effectiveness of Demand Management is based on achieving organizational consensus, improving forecast accuracy, and reducing process cycle time (Lansdowne, 2010, pp. 5–6).

Demand Management system operates as a recurring process (see Figure 1, p. 25), which is typically conducted on a weekly, biweekly, or monthly basis. The process includes the extraction of relevant data from enterprise systems, generation of a forecast, analytical review and adjustment by demand analysts, approval by a forecast owner, and the upload of the approved forecast back into the ERP system (Lansdowne, 2010, p. 6).

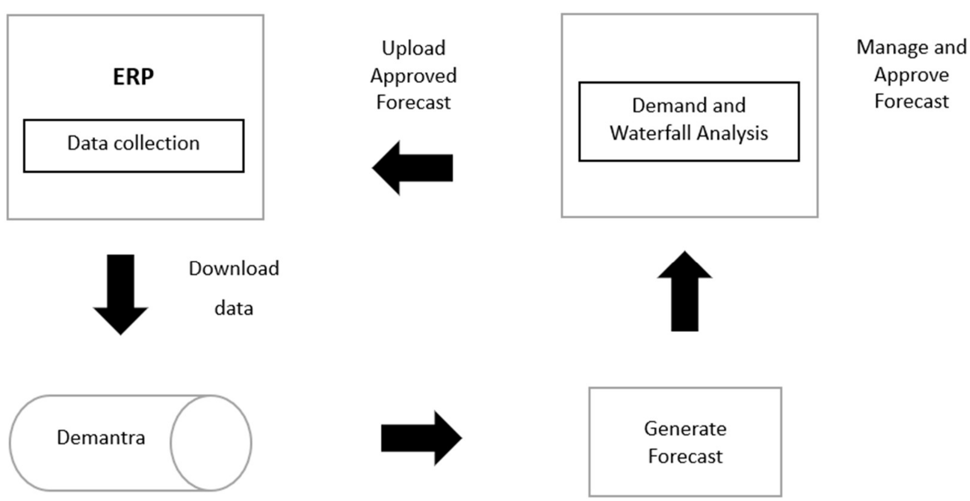

Figure 1. Demand Management Process (adapted from Lansdowne, 2010, p. 6).

During each planning cycle, demand-relevant data are extracted from source systems such as ERP systems, legacy platforms, or advanced planning modules, including supply chain planning, inventory optimization, order promising, or collaborative planning tools.

These data are loaded into the Demand Management system to support the generation of demand forecasts (Lansdowne, 2010, p. 6).

Once the data are available, system administrators ensure that planners have appropriate access rights. Planners are generally assigned responsibility for specific areas, such as product lines or geographical regions. While broader visibility may be granted, planners are typically permitted to modify only the demand data within their scope. After data has been loaded, the forecast is generated either manually by an administrator or automatically by the system, and the approval process is initiated. Upon successful forecast generation, relevant users are notified and provided to analytics view with access to forecast results, metrics, and demand information (Lansdowne, 2010, p. 6).

The approval workflow is commonly structured around two primary roles: Demand Analysts and Demand Administrators. During system implementation, Demand Administrators configure the approval hierarchy by assigning final approvers for each analyst group. Demand Analysts are notified at the start of each cycle and review forecast data using standardized analytical worksheets that support analysis across product categories, items, organizations, and regions. These tools enable analysts to examine e.g. historical demand, customer orders, and inventory levels. Based on the analysis, analysts may adjust the forecast and run simulations to evaluate the impact of changes before submitting updates for further review (Lansdowne, 2010, p. 6).

Submitted forecasts are then assessed by one or more approvers. Approval responsibilities may be assigned at regional or product line level, and while standard systems typically support a single approval layer, additional levels can be implemented through workflow customization. Final approvers may lock the forecast once accepted, after which the demand forecast is released for planning processes, such as advanced supply chain planning systems (Lansdowne, 2010, p. 6).

Lansdowne (2010, p. 6) introduces also an option to generate differentiated forecast for organizations with multiple lines of business (LOBs). Variations may arise regarding e.g. planning cycles, calendars, forecasting precision, or business-specific requirements. Each LOB usually has a defined scope for demand planning, limiting the forecast to relevant products, locations, customers, or sales channels. Demand data are assigned to specific analysts accordingly, and once individual forecasts are reviewed and approved, a master approver validates the final forecast across all lines of business.

2.3.4 Oracle Supply Chain Planning

Murray & Myers (2016, p. 8) introduces Oracle MRP as a supporting tool for generating and managing material requirements in complex supply chains by converting gross demand into net requirements. Netting uses the key planning inputs, such as MPS, BOM, on-hand inventory, receipts, lead times, and order modifiers. System produces time-phased recommendations to release, re-schedule, or cancel planned orders with defined quantities and due dates. Logic is based on infinite capacity assumption which is validated by utilizing separate functionality for capacity planning.

Planning framework in Oracle is based on policies. Item and planning attributes determine how demand is planned and how supply is generated. Item management can be processed either via Master Production Scheduling (MPS) or via MRP planning. MPS is used for independently demanded or business-critical items that require tighter control. MRP planning is used for dependent demand and demand items that are derived from master demand schedule. Inventory planning methods such as Min-Max and Reorder Point planning can also be applied to support inventory control and more automated order execution (Murray et al., 2016, p. 8).

The process in Oracle MRP begins by the planning engine to explode requirements through the bill of material to generate component demand, relevant item and BOM parameters e.g., engineering changes, lead times, yield, and safety stock (Murray et al., 2016, p. 8). In below Table 1 (p. 28), different planning attributes are introduced what can be utilized in MRP and supply chain planning, and in which cases each attribute needs to be selected.

Planned order quantities are gathered by the lot-sizing logic and modifiers, allowing alignment with procurement and manufacturing policies. Time fence controls help with plan stability and execution (planning, demand, and release time fences), which disable near-term changes, prioritize actual demand within defined horizons, and can automate order release (Murray et al., 2016, p. 8).

Table 1. MRP system attributes (adapted from Murray et al., 2016, p. 9).

Category	Parameter	Description
MPS Planning	Items for Master Production Schedule (MPS)	Items with independent demand, business-critical items, and items that control critical resources
MRP Planning	Items for Material Requirements Planning (MRP)	Items with dependent demand, including items that do not require individual manual control
Inventory Planning	Min–Max Planning	Defines minimum and maximum on-hand inventory levels. Restocking is triggered when inventory falls below the minimum level, while stock is prevented from exceeding the maximum level.
	Reorder Point Planning	Enables automatic order execution when predefined inventory is reached
Order Sizing	Lot-for-Lot	Generates planned orders based on net requirements for each planning period
	Fixed Order Quantity	Creates orders for a predefined fixed quantity
	Fixed Lot Multiple	Generates orders in quantities that are multiples of a predefined standard quantity
	Minimum and Maximum Order Quantity	Places orders ensuring quantities are not below the minimum or above the maximum allowed order size
	Fixed Days Supply	Creates orders covering requirements for a predefined number of days
	Rounding Order Quantities	Adjusts calculated order quantities by rounding fractional values according to defined rules
Item Attributes	Make or Buy	Determines whether item requirements are manufactured internally or purchased externally
	Build in WIP	Defines whether the item is manufactured using work-in-process jobs
	Purchasable	Indicates whether the item can be ordered through purchase requisitions or purchase orders
	Safety Stock	Specifies the quantity of inventory held to protect against demand or supply variability
Safety Stock Methods	MRP Planned Percent	Calculates safety stock using defined percentages
	Mean Absolute Deviation (MAD)	Determines safety stock based on statistical demand variation
	User-Defined	Calculates safety stock using user-specified time periods and average monthly demand
Time Fences	Planning Time Fence	Defines a period during which planning does not change the current material plan or master schedule
	Demand Time Fence	Specifies a period during which forecast demand is ignored when calculating actual demand
	Release Time Fence	Automatically releases planned orders as work-in-process jobs within a defined execution window

Oracle Supply Chain Planning enables material requirements across multiple interconnected organizations with supply and demand netting. Planners review exceptions, pegging relationships, and inventory status using decision support tools, such as Planner Workbench, which also enable scenario simulation and implementation of recommendations into execution in manufacturing and purchasing. Web-based Oracle Advanced Supply Chain Planning (ASCP) improves the above-mentioned capabilities by providing end-to-end planning for capacity planning, configuration optimization, exception management, planning recommendations, and comparative simulations (Murray et al., 2016, p. 9; Myers, MacLean & Westgate, 2011, p. 5).

2.4 Linkage to research topic

The concepts of selected theories in the literature review are heavily related to the research topic. The literature review links business process reengineering, automated material requirements planning, and operational efficiency as key theories for the thesis. Business process reengineering provides the theoretical framework for redesigning e.g. existing material management and procurement processes, particularly in environments where manual operations limit performance. MRP tools are the technology used in the transformation project with the support of demand-driven planning, inventory control, and procurement automation.

As a result, the implementation of MRP influences process structures, reduced manual work, standardized and improved ways of working, and enhanced data-driven decision-making. These together has an effect to operational efficiency, which in this study is measured through key performance indicators such as cycle time, data accuracy, automation rate, and inventory turnover. The theoretical framework enables the evaluation of how MRP process transformation impacts operational efficiency in a real-life manufacturing and order fulfilment environment.

3 Research methodology

In this chapter, research methodology is introduced by providing overview and justification for the selected research method, details to how data was collected and analysed, and what methods and tools were used. Additionally, the methods how reliability and validity were established are explained.

3.1 Research design

According to Mills, Durepos & Wiebe (2010, p. 371), case studies focus on investigating a certain phenomenon. Design and data collection methods vary based on the phenomenon and needs of the case study. Research method for the thesis can be identified as a single case, embedded, explanatory case study using mixed methods. Research question focuses on understanding a real-life organizational change process and its effects within a single company. Explanatory case study is used when the goal is to explain causal relationships and understand how or why something happens in a real organizational setting (Yin, 2018, p. 80). According to Gray (2014, p. 2), case study approach is typically used to study contemporarily phenomena, such as process improvements, system deployments, and supply chain transformations.

Although there is prior research available that discusses MRP principles, supply chain planning systems, and benefits of automation and digitalization, there is limited empirical evidence on the real operational impact of automated MRP tools in manufacturing and order fulfilment environment. Very few studies examine what happens in a real organization setting when automated MRP tools are deployed, how planning processes and efficiency change in a single site’s daily operations, and what measurable outcomes are achieved using key performance indicators. This gap highlights the need for a case study that links as-is and to-be process changes with real operational KPI outcomes, which this study aims to address.

This study research focus on examining how processes were improved which require an explanation, and evaluating what impact the change had which requires understanding causal effects. Because the focus is in one company, the design is a single case study. However, the research consists of multiple units of analysis including planning processes, user experiences and operational metrics, which concludes the study to be a mixed method.

3.2 Data collection and analysis

As shown in below Table 2 (p. 32), data collection methods include both qualitative and quantitative data. Qualitative data help to understand how processes changed, what bottlenecks were removed from the processes, and how automation affected workload, cycle times, and decision-making. Qualitative data included semi-structured interview meetings and email discussions, in which the general feedback was collected from planners, buyers, managers and production schedulers during years 2025 and 2026, own observations of the process before and after MRP deployment, and document analysis of process maps and several reports.

Qualitative data in this study was analysed using a thematic analysis approach using data collected from interview transcripts, internal documentation, and user feedback. Cycle times and data accuracy were analysed by collecting feedback in March and April 2026 from end users (4 planners, 1 operations manager, 1 buyer) via email following by additional own observations. The analysis process involved identifying similar patterns and grouping them into themes which were related to process efficiency, automation, data quality, and user experience. In addition, pattern matching was utilized to compare observed changes with theoretical framework. Process analysis further supported the evaluation by comparing pre- and post-implementation workflows, allowing the identification of removed bottlenecks and improved process standardization.

Quantitative data analysis in this study is based on comparative KPI analysis between pre- and post MRP deployment processes. Before-and-after comparison is performed to evaluate changes in operational efficiency. Monthly and quarterly trend analysis was performed to demonstrate the MRP usage post deployment.

Automation and MRP usage rates were analysed based on collected data from Jira Kanban board workflow reports, and Oracle ERP system between the time horizon from April 2024 to January 2026. Data was analysed by creating visual charts via Excel from the exported raw data documents. Analysis for inventory turnaround was based on data received from the case organization's financial department for the same time horizon, and additional comments were collected in April 2026 from the purchasing team, and operations manager via email. Data analysis was conducted by familiarizing with the received raw data and comparing it with the industry averages. Received comments via emails were also analysed and summarized into the thesis by finding the common patterns in the replies.

Table 2. Data Collection Methods.

Objective	**Data Sources**	**Methods**
Process improvement	• As-is and to-be process maps • Interviews and email discussion • MRP workflow logs	• Document analysis • Semi-structured interviews • Observation
Operational efficiency	• ERP/MRP system data, internal material • KPI dashboards	• KPI extraction • Before-after statistical comparison
Recommendations	• Findings	• Root-cause analysis • Thematic analysis

3.3 Reliability and validity

Construct validity was ensured by collecting both qualitative and quantitative data from multiple sources, such as interviews, email communication, internal documentation, process maps, and ERP system data. This strengthened the credibility. Sources and selected KPIs provided evidence for success in MRP deployment to support the theoretical concepts and conclusions.

This case study identified causal relationships, which supports internal validity. Key methods used were the pattern matching, time series analysis, and before-after comparison. Pre- and post MRP processes were compared, and KPI changes were analysed post deployment. Gathered end user feedback confirmed the observed improvements. Findings can be somewhat generalized, even though the case study was performed for a single case company site and was seen as a limiting factor. Results may be generalizable to similar manufacturing or order fulfilment environments, and to organizations which are implementing MRP systems in their supply chain operations. This supports the external validity but with limitations, which is seen as typical in case studies.

Reliability was heavily dependent on internal data that had restricted availability since the material was not publicly available for others outside the company. Data was gathered from internal documentation, ERP database, and end users. Data analysis was performed in transparent and consistent way to enable others to follow the structure of the study. There were repeatable analysis methods, such as KPI comparison, and trend analysis used. Case company site's management has reviewed the thesis to validate the given information to be accurate and reliable.

4 Managing MRP system deployment project in a case company

Case company site's MRP system deployment project began with a pre-study in February 2023 and continued in August 2023 with design, testing, training, deployment, and stabilization phases. Go-live for the MRP system and post-stabilization began in May 2024. Deployment was initiated for both product lines simultaneously. In this chapter, project phases are introduced step by step to gather overall knowledge how the project was conducted from start to finish.

4.1 Design

Pre-study included project design phase where benchmarking was done with other company sites that already utilized MRP in their operations. Current state analysis was conducted where current applications and tools, system parameters, and processes were defined. Additionally, first impression feedback was collected from the project team members and end users concerning benefits and challenges in taking MRP into use. In below sub-chapters, different analysis methods used and results in the pre-study are introduced.

4.1.1 Benchmarking

Benchmarking was done in February 2023 by arranging internal meetings with other company site employees and managers located in few different geographical regions and studying internal material sources that demonstrate the globally used processes in the case organization. Meeting participants for the interview were from procurement and production planning teams. Questions that the case company site was especially interested to get answers were sent to the interviewees before the meeting (see Appendix A, p. 93).

MRP has been in use in other company sites since the beginning of Oracle implementation in year 2004. Goal of the meetings was to find out how other sites utilize MRP in daily operations and get an idea if those same MRP tools would be beneficial to case company site's needs. General advice and feedback from the other company sites was to assess current processes in case company site and customize those to site's own needs (Company internal document, 28.2.2023 [restricted availability]).

Case company site should have a dedicated demand planner who is able to check the current model option bill of materials (BOM) and what can be done in MRP. BOMs need to be completely accurate before deployment. Some new tools need to be setup for the case company site that has not been currently in use (Company internal document, 28.2.2023 [restricted availability]). In below chapters, processes used in the benchmarking sites regarding production planning and supply chain planning are introduced more thoroughly. In the end of the chapter, benchmarking findings on MRP usage in other company sites are summarized (see Table 3, p. 39).

4.1.1.1 Production planning

Production planning tools are used for placing purchase orders and releasing production orders and discrete jobs. Production planners use a Job Release Tool in reporting instance which shows the work orders, part numbers, if it's a planned order and clear to build (CTB), fixed order quantity, start date, due date, lower-level components, and on hand quantity. CTB status needs to be shown as green to proceed with work orders. In case the CTB status is shown as red, planner must work with the buyer for releasing the shortage lower-level material. If all lower-level materials are not available, work orders are not released. Release happens in Oracle OPRD (Planning) instance. Reporting instance also has a shortage report for buyers to check what items are late and what need to be ordered. Report shows purchase order numbers, supplier details, order due dates, and quantities (Company internal document, 14.3.2023 [restricted availability]).

Overall, there has not been much automation in production planning in the benchmarking sites since data is seen not reliable concerning lead times, suppliers, and regular order quantities. However, job close tool in Oracle is automated. Once discrete jobs are completed, they will be automatically closed, and purchase orders (PO) will be auto-closed once fully received and invoiced (Company internal document, 14.3.2023 [restricted availability]).

Oracle Advanced Supply Chain Planning (ASCP) instance that is globally used across the case organization, uses MRP inputs and supply chain networks and multi-organization information to generate one global plan for all organizations. ASCP provides global visibility of the requirements and faster demand propagation of inter-organization requirements. ASCP generates recommendations for discrete jobs or purchase orders. Planners and buyers use the same plan. Discrete jobs and purchase orders can be automatically created from a planning release by planners. Recommendations to reschedule in or out, or cancel are also generated to minimize inventory (Company internal document, 15.8.2016 [restricted availability]).

There are two standard solutions in the case organization regarding Available-To-Promise (ATP) for global order promising. ATP rules are set up for each option, and the combination of ATP rules and lead times determine the scheduled ship date (SSD). Scheduled ship dates are determined based on the availability of the products or components, and lead times determine the SSD. ATP using Rules is simple to use and manage and it provides consistent results and Supplier Response Time (SRT). ATP using Plan is more complex, results are based on the ASCP plan, and SRT is variable depending on availability of items. This causes potential higher inventory turns because ATP can look at on-hand, WIP, and planned orders to schedule new sales orders. If building to stock, order fulfilment cycle times are reduced (Company internal document, 15.8.2016 [restricted availability]).

4.1.1.2 Demand planning

Based on the benchmarking meetings, other sites have faced similar challenges than case company site regarding demand planning. Common material base is ordered in advance, accessories are set in min-max inventory planning, and configuration-specific material is ordered in later time frame which means that forecasting happens in a higher level. All products are customized, so the shipments are always different. Customers have several product options to choose from (Company internal document, 28.2.2023 [restricted availability]).

Demand planners work in Demantra environment which is used all over the company globally. All the forecasting takes place in Demantra. There is an interface, which transfers the data from Demantra to Oracle. The data includes all the sales data from the sales orders, interim orders, statistical base line, and error analysis. Statistical baseline is a tool that makes proposals for future forecasting based on the sales order history. Quarterly business goals are setup to the tool. There is also an option to set preliminary forecasting for new product introductions (NPI) such as demo units and first production units which help in early stage to get visibility on the material (Company internal document, 28.2.2023 [restricted availability]).

Demand planner knows what kind of volume the factory is planning to sell and ship to customers. Every site has a dedicated demand planner, which cooperates with the sales team and the factories. Demand planner helps to get the forecasting and planning process automated. Without demand planner, it requires more manual work. Marketing team (including product managers and sales) work with product lifecycle, so they know what is coming in the sales funnel, are in contact with customers, and do promotions. Order fulfilment takes care of the backlog, surprise deals and pre-book requests, material shortages, capacity limitations, and technical issues. Collaboration between different parties makes forecasting more accurate (Company internal document, 28.2.2023 [restricted availability]).

There is one global demand planner for each division or business unit that reports to marketing. Demand planner is responsible for generating 18-month baseline forecasts in Demantra and managing the Collaborative Forecast Review with Marketing, Manufacturing and Planning. Forecasts are managed at the PTO Models and then exploded to the Options via planning percentages. Planning percentages are typically reviewed on a quarterly basis. Forecasts for specific configurations, purchased, or assembly parts are entered manually into Forecast Sets (Company internal document, 15.8.2016 [restricted availability]).

Final Order Forecast is converted to delivery of the product. Preliminary Demand Plan includes booked deals, strategic bias, NPI, and non-trade (internal sales orders and interim orders). Strategic bias can be defined that if there is already more known capacity during a month and factory wants to over plan due to buffer, there is a possibility to put strategic bias to the forecast. These together form a Final Demand Plan (Company internal document, 28.2.2023 [restricted availability]).

Final Demand Plan is published once a week from Demantra to Oracle on PTO (pick to order) level. Off-Cycle Adjustments are also published every week. Forecast explosion to option level happens during weekends based on the option split set via planning percentages in model option BOM. During weekend run, lower-level material and assemblies will be published in Oracle Advanced Supply Chain Planning (ASCP) tool for further purchasing actions (Company internal document, 28.2.2023 [restricted availability]).

There is also an option for contract manufacturers (CM) to see the demand online through supplier portal which is integrated to Oracle. Demand is automatically pushed once a week. Forecast is pushed to CMs for their own planning purposes. For other suppliers, forecast is sent from separate data view and reporting tool instance. Tool can setup automated rules to send the forecast which is pushed to supplier monthly. Reporting tool instance is used to check inventory quickly. There is full visibility to CM stock on hand from the tool (Company internal document, 28.2.2023 [restricted availability]).

In the reporting tool, there is a possibility to do simulations for customer orders and material shortages and set automated reporting for field engineers and demand planners. Reports can pull quotes to see in what stage those are (proposal, negotiation, etc.) and make a proposal how many quotes will be converted in a later stage to sales orders. Reports are used especially in big deals with high amounts of configurations in case advance purchasing is needed (Company internal document, 28.2.2023 [restricted availability]).

Table 3. Summary of benchmarking findings on MRP usage in other company sites.

	Benchmarking from other company sites	Conclusion for case company site
Demand planner	Each site has a dedicated demand planner responsible for maintaining forecasts and reviewing BOM structures	A dedicated demand planner is required for effective MRP usage
Bill of Materials (BOM)	BOMs must be fully accurate to enable correct option-level planning	Master data accuracy is critical before deploying MRP
Production planning tools	Production planners use a Job Release Tool	CTB (Clear-to-Build) status affect job release decisions
Production planning release	Jobs are released only when all lower-level materials are available. Shortages require coordination between planner and buyer.	Communication between planning and procurement is required
Advanced Supply Chain Planning (ASCP)	System generates recommendations for discrete jobs and purchase orders, including reschedule and cancel suggestions	ASCP supports inventory optimization and coordinated decision-making
Available-to-Promise (ATP)	Two models: ATP using Rules (simple, consistent SRT) and ATP using Plan (ASCP-based, variable SRT)	Choice of ATP model affects inventory turns and delivery performance
Demand planning	Customized products and varying configurations make forecasting complex	Forecasting occurs mainly at higher (model) levels
Forecasting tool	Demantra is used globally for all forecasting and is integrated with Oracle	Centralized demand planning platform supports alignment
Forecast inputs	Forecasts include sales history, interim orders, statistical baseline, error analysis, NPI, and strategic bias	Forecasts combine quantitative and managerial inputs
Forecast explosion	Forecasts are published weekly to Oracle and exploded to option level based on planning percentages	Accurate planning percentages are essential for procurement
Contract manufacturer (CM) forecast	Forecasts can be shared automatically via Supplier Portal, CM inventory visibility is available	Enables better coordination with external manufacturing partners
Simulation & reporting	Reporting tools support order and shortage simulations, quote analysis, and scenario planning	Simulation capability supports purchasing for big deals

4.1.2 Process mapping

Current forecasting and purchasing process steps were mapped in August 2023 and reviewed in October 2023 with the project team to get a full review of what was the current state in each process, what was the desired future state, and were there any gaps to resolve before deployment. As a first task, purchasing team created updated process flow charts regarding current purchasing (see Figure 2, p. 41) and forecasting processes (see Figure 3, p. 42 & Figure 4, p. 43) for the whole project team to understand what the starting point for the MRP deployment project design was.

Product line A and B had similar purchasing processes so there is only one common process flow chart for the as-is process (see Figure 2, p. 41). Sales orders were processed by the factory order management (FOM)/logistics team, where they checked the current on-hand inventory balance for the lower-level materials included in the order. If there was enough on-hand inventory for the materials, those were ready for picking, packing, and shipping for the sales order. In case there were shortage materials that needed to be purchased to inventory against the sales order, demand requirement was input into Jira Kanban board for buyers to process further. Buyer created purchase requisition manually in Oracle ERP and updated the status in Jira Kanban board that requisition has been created. Purchase requisition was manually sent to 1st level manager for approval. If approval limit exceeded, it went to upper-level managers for additional approval.

Once purchase requisition was approved by the manager(s), buyer created purchase order manually based on the approved purchase requisition in Oracle. Generated purchase order number was added to open Jira Kanban board ticket. Purchase order and terms and conditions were sent manually to supplier via email in PDF format. Supplier confirmed purchase order via email, and buyer updated Jira Kanban board ticket accordingly with the estimated ship or arrival date and possible available tracking details for the shipment. Once material was received from the supplier, logistics performed incoming inspection. If inspection was passed, warehouse coordinator updated Jira Kanban board by adding the receival date, marked the ticket as completed, and performed goods receival in Oracle against the purchase order. Received goods were moved to warehouse.

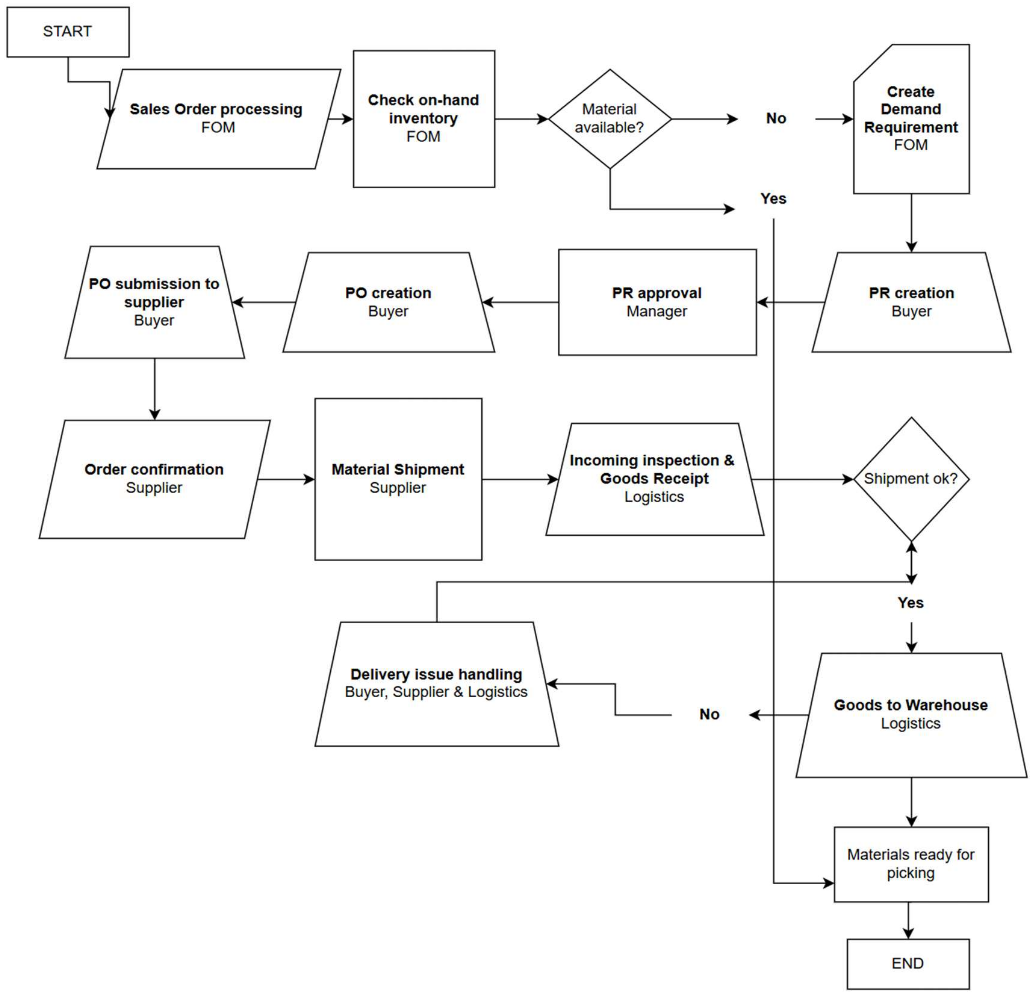

Figure 2. As-is purchasing and material management process pre MRP deployment (adapted from company internal document, 24.5.2023 [restricted availability]).

Forecasting process differed slightly between Product lines A and B. Forecasting for Product line A (see Figure 3, p. 42) began with manual reviewing of multiple Excels which included order negotiations and opportunities, on hand quantities, and data from sales orders and open purchase orders. Review and hardware plan was performed by the operations and purchasing. Hardware plan was updated into Excel file manually and reviewed with product managers in a separate meeting.

Demand requirements were adjusted based on the meeting and a second draft of the plan was created and reviewed with the management in another review meeting. Once second draft of the plan was approved by the management, it was transferred to final version of the Excel file. Procurement prepared monthly Excel forecast for the contract manufacturer (CM) and submitted it via email. If CM acknowledged the received forecast, the demand was input into Jira Kanban board by the purchasing team for the purchasing process. In case CM did not confirm the forecast accordingly, the created monthly forecast was re-reviewed and submitted again for confirmation.

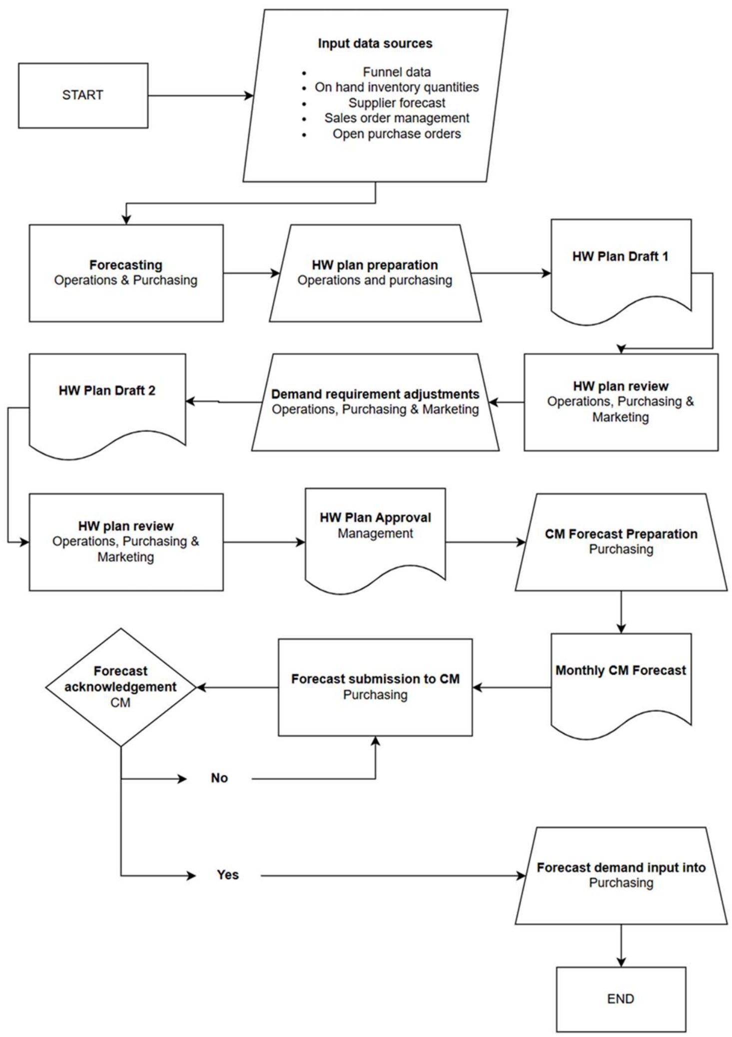

Figure 3. As-is forecasting process pre MRP deployment for Product Line A (adapted from company internal document, 24.5.2023 [restricted availability]).

Product line B utilized already Demantra and reporting tools in some extend in the forecasting process (see Figure 4, p. 43) before MRP deployment, due to cooperation with the mass production site in another geographical region. Forecasting began with creating rolling 18-month demand plan in addition to separate NPI demand plan. Demand plans were gathered by the assigned global demand planner. These were reviewed with the product management. Order backlog was also simultaneously manually checked. Demand plans were sent to contract manufacturer which uploaded the demand into system and gave a commitment. If contract manufacturer committed to the forecast, purchasing process was initiated, production scheduling and manufacturing was performed, and items were delivered to the inventory.

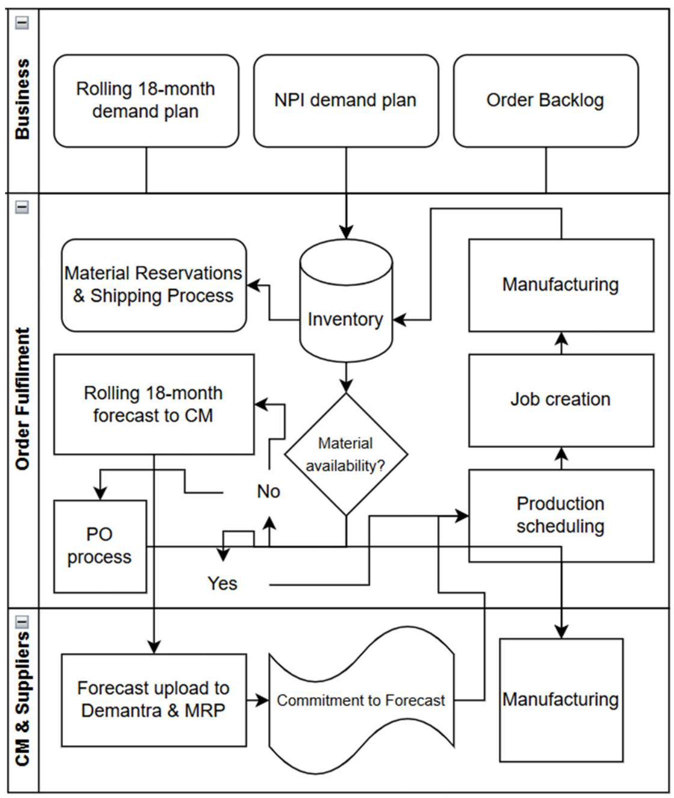

Figure 4. As-is forecasting process pre MRP deployment for Product Line B (adapted from company internal document, 24.5.2023 [restricted availability]).

As-is and to-be analysis was performed in August 2023 (see Table 4, p. 45) including presenting the identified gaps and proposing the next steps. Current state in end user forecasting was manual where a lot of spreadsheets were used. Forecast accuracy was only tracked with contract manufacturer, otherwise there were no knowledge of accuracy.

There was no advanced knowledge of any big deals that were coming in. Primary recommendation from the project team was to deploy Demantra demand management tool into use and secondary recommendation was to use manual forecast set for the Product Line A. Decision was needed if Product line A wanted to take Demantra into use. If Demantra would be used, it would require also taking Oracle Advanced Supply Chain Planning module (ASCP) into use. Demantra works only with Oracle ASCP. Even though Product Line B already utilized Demantra, ASCP was not used in both product lines. Demantra and ASCP would require some training for end users. Demand planner needed to be also identified for Product Line A (Company internal document, 7.8.2023 [restricted availability]).

New Product Introduction (NPI) forecast was sent to CM monthly via email. There were weekly meetings to review any material requirements. Build plans were adjusted for production orders. The team reviewed inventory, open orders, opportunities, and negotiations via Excel. Recommendation from the project team was to implement Demantra and Instrument Outsourced Demand Management (IODM) tool into use and training was offered for the tools. As a gap, there was a decision needed from case company site if Demantra, IODM and Oracle ASCP would be deployed for CM forecasting (Company internal document, 7.8.2023 [restricted availability]).

There was no separate forecasting in place for repair parts. Repair part needs were managed through holding inventory to support those requirements. Non-standard jobs were used to drive any additional materials for repair parts forecasting. Recommendation from project team was to either create Oracle non-standard jobs to drive demand for repair material if not used already or enter a separate forecast. No gaps were identified for repair material (Company internal document, 7.8.2023 [restricted availability]).

Table 4. As-Is and To-Be Analysis of Forecasting and Planning Processes (adapted from company internal document, 7.8.2023 [restricted availability]).

Process	Current State (As-Is)	Future State (To-Be)	Current State (As-Is) Identified Gaps	Proposed next steps
End Product Forecasting	Manual forecasting using spreadsheets based on: • Sales data • Product roadmap / NPI requirements • Planner experience and judgment • Product MRP buyoff	Product forecasts to be developed using either: • Oracle Demantra, or • A structured manual forecast set	• Demantra doesn't work without ASCP • User training required • Demand Planner role not yet clearly defined	• Define Demand Planner • Training plan and execution
CM Forecasting	Completely manual process: • NPI forecasts sent to CM • Weekly BOM and component reviews with CM; build plans adjusted accordingly • Inventory, open orders, opportunities, and negotiations reviewed to compile production forecasts	Implement Oracle-based planning tools: • Oracle Demantra • Inventory Optimization (IODM) • Reporting tool	• Demantra doesn't work without ASCP • User training required • Standard forecasting workbooks do not fully meet external (CM) requirements	• Finalize tool selection • Develop CM-specific reporting workbooks • Define forecasting responsibility and governance
Repair Parts Forecasting	• No formal forecasting process • Inventory is held reactively to support repair requirements	Two approaches: • Develop Oracle non-standard jobs to generate demand for Repair to Forecast (RTF) materials • Maintain a separate repair forecast outside standard MRP	• No standardized forecasting logic for repair materials • No tool decision for managing repair demand	• Evaluate feasibility of Oracle-based RTF demand modeling • Decide on repair forecasting ownership and method
NPI Forecasting	• Entirely manual NPI forecasting process	Create Oracle non-standard jobs to generate demand for prototype and pilot build. Once products move to production phase, NPI forecasting is migrated to Demantra.	• No formal transition model from NPI to production planning	• Define NPI-to-production handover process • Decide on Demantra usage scope

Following the analysis of forecasting and planning processes, similar as-is and to-be analysis was performed for supply chain planning processes (see Table 5, p. 47). Supplier Response Time (SRT) and Available to Promise (ATP) attributes had to be setup in Oracle for all the applicable products. Values for both attributes were already setup in Oracle so no changes needed unless any concerns would have arisen concerning current SRT values or the way sales orders were scheduling at the time. No gaps were identified (Company internal document, 7.8.2023 [restricted availability]).

Supply Chain Planning process was similar to demand planning, meaning that process has been manual. Jira Kanban boards were used to track purchase requisitions (PR) and purchase orders (PO) which had good overall visibility. Low value purchase parts were planned via min-max planning in the reporting tool. Recommendation from project team was to use Oracle ASCP for supply chain planning, current reporting tool for customer PO visibility, and IODM for CM supply chain. Another considerable option was to keep current process with manual spreadsheets, Jira Kanban and min-max, or to use combination of current and new tools. Final decision was needed from case company site if Oracle ASCP would be taken into use which require training for end users (Company internal documentation, 7.8.2023 [restricted availability]).

Revenue and Shipment Planning was also a manual process including checking inventory levels, deliveries from CM, and reviewing Jira and sales order database. These determined order scheduling and planning. Recommendation was to begin using Oracle ASCP and use current reporting tool for material availability, shortages and reporting. Jira Kanban board was not necessarily needed. Another option was to keep the current processes. As a gap, decision was needed if Oracle ASCP would be taken into use (Company internal document, 7.8.2023 [restricted availability]).

There was several reporting tools used for different purposes but there was no full list yet available of what reports were currently used. Recommendation was to use same reporting tool as primary reporting tool what the case company site had already used so far. There were few other useful tools also recommended. Project team scheduled a separate demonstration session for the new features in the current reporting tool. No gaps were identified regarding reporting tools (Company internal document, 7.8.2023 [restricted availability]).

Table 5. As-Is and To-Be Analysis of Supply Chain Planning Processes (adapted from company internal document, 7.8.2023 [restricted availability]).

Process	Current State (As-Is)	Future State (To-Be)	Gaps
SRT for Quoting	SRT values maintained in Oracle	No change planned to the current SRT setup	None identified
ATP – Sales Order Scheduling	ATP rules defined within product structure	No change planned to ATP rules or logic	None identified
Supply Chain Planning	Manual and decentralized process: • Jira Kanban used to track supplier and customer purchase orders • Production plan created based on sales forecast data • Manual Excel-based forecasts sent to CM • CMs responsible for committing dates and material availability • Low value purchased parts planned via min–max	Multiple future-state alternatives: • Implement Oracle ASCP: – Develop product forecast and load into ASCP – Sales orders auto-scheduled and loaded into ASCP – Calendar integration (holidays/workdays) – Planned forecast and sales order consumption, demand/supply netting – Planners release orders to manufacturing and CM – Use ASCP and/or reporting tool to track purchase requisitions – Use reporting tool for customer PO visibility – Use IODM for CM supply chain planning and commitments • Alternatively: – Keep current manual tools (spreadsheets, Jira, min–max) – Hybrid model combining current tools with reporting workbooks	• Training required
Revenue / Shipment Planning	Manual assessment based on: • Inventory levels • CM delivery commitments • Planner experience and judgment • Jira Kanban review	Two alternatives: • Use ASCP supported by monthly/quarterly review reports to maximize revenue • Increase visibility using backlog and updated reports • Apply Oracle sales order reservations to inventory and jobs or keep existing manual approach	Decision pending on use of ASCP for revenue and shipment planning
Reporting	Current reporting approach undefined	Use enterprise reporting tools	Lack of standardized reporting framework

4.1.3 Benefits, challenges, and recommendations

In October 2023, the local project team in Finland consisting of order fulfilment employees and managers from both product lines A and B had a meeting concerning first thoughts about the upcoming deployment project and seen benefits and challenges that

MRP implementation would bring to help with final decision-making if the site would proceed with the deployment and taking needed applications and tools into use.

Both product lines raised several positive things that were seen in MRP deployment (see Table 6, p. 49). Processes could be tailored based on company site's needs and focus. By taking MRP into use, there would be fewer human errors with more automated and streamlined processes within production planning, purchasing, order management, and supply chain planning. Factory Order Management (FOM) plan for purchased parts would be automatically released based on MRP. MRP would automatically calculate proposals from system for release to purchasing and production work-in-progress (WIP), and process discrete jobs automatically (Company internal document, 10.10.2023 [restricted availability]).

MRP would bring better accuracy with on hand balances against the demand and better visibility to seeing CM stock on hand. Contract manufacturer would be able to see the demand online through supplier portal. Option to simulate customer orders and material shortages for big deals was also seen beneficial. Using different systems with multiple integrations would increase automation and decrease manual work (Company internal document, 10.10.2023 [restricted availability]).

MRP was also seen as more time-efficient, and forecasting would be statistically more aligned and visible. Commodity managers would be able to see the actual demand in a component level. Monthly error analysis will show where the company site has been off and how off for future adjustments. Also, an option to use separate forecasting lines for NPIs and big deals, and demand visibility for demos was seen as a positive enhancement. Reporting tools would be more advanced and automated which require fewer manual spreadsheets. Warehouse management would be more accurate which give better inventory turnaround. There would be no more out of stock situations (Company internal document, 10.10.2023 [restricted availability]).

Table 6. Identified Benefits of Automated MRP Deployment by Product Line.

Product Line A – Benefits	Product Line B – Benefits
Reduced risk of human errors due to increased system automation	Reduced reliance on Excel spreadsheets for forecasting
Higher level of automation and streamlined planning processes	Ability to operate manually when required, while remaining aligned with MRP logic
Enhanced system integration across multiple planning and execution platforms	Improved reliability of on-hand inventory data
Improved forecasting efficiency, with statistically aligned and clearly visible demand signals	Automatic generation of purchase requisitions directly from the system
Availability of advanced, automated reporting and analytics tools	Seamless transformation of customer forecasts into system-generated demand
Significantly reduced dependency on manual spreadsheets	Automated forecast transmission to stakeholders (e.g. contract manufacturers)
Improved warehouse and inventory management accuracy	Increased visibility of on-hand inventory for contract manufacturers
Reduced likelihood of stock-out situations	Capability to maintain manual forecasting if exceptional situations require it

Local project team listed as challenges (see Table 7, p. 50) that data needs to be reliable and accurate which would require more system maintenance regarding the bill of materials, lead times (SRT and ATP), supplier lists, and routings. Current data was not up to date in some areas so it could cause errors at the beginning of the MRP deployment. If there would be a new revision implemented for certain product or changes in NPI, forecasting and purchasing was seen as a question mark. Since the product structures are customized and complicated, more specific setups would be required. All reports and CM forecasting can't be fully automated. Daily tasks and resources need to be reorganized, and special concerns were mentioned for possible increases in workload and changes in job roles (Company internal document, 10.10.2023 [restricted availability]).

Table 7. Identified Challenges and Considerations by Product Line.

Product Line A – Challenges	Product Line B – Challenges
Ensuring data reliability and accuracy, requiring increased system maintenance and data governance	Defining forecasting and purchasing practices for new product revisions
Full automation of reporting and contract manufacturer (CM) forecasting processes requires stable and high-quality master data	Adapting existing working methods to support revised product versions
Customized and complex product structures require dedicated system configurations and setup	Managing workload and process split between manufacturing sites in Finland and other geological region
Reorganization of daily planning tasks and resource allocation needed to support automated processes	Managing MRP behavior to support agile ways of working, particularly during period-end activities
—	Ensuring item setups and lead times are accurate and continuously maintained for both production and purchased components
—	Addressing increased workload, role changes, and resource requirements resulting from new planning processes

In addition to opinions from local project team, project team in the other geographical region gathered benefits and challenges about the key process decision areas. If Demantra would be taken into use, it would be integrated to Oracle E-Business Suite ERP system (Order Management and ASCP). Demantra would collect sales history automatically from Oracle, and provide multiple forecasts, accuracy metrics, and reports. NPI forecasting would be managed from Demantra, forecasts could be simulated, and Statistical Forecast or Override could be used. Demantra would be scalable as the business grows (Company internal document, 7.8.2023 [restricted availability]).

If Oracle ASCP would be taken into use, it would also be integrated to Oracle E-Business Suite ERP system (Order Management, WIP, PO, Inventory, etc.). Forecast and sales order consumption, and demand and supply netting could be automated. Suggested orders could be generated for planners to review and possible releases to be done directly from the plan to WIP and purchasing. There is an option to create forecast for CM's. For procurement, there would be less manual buy item requisition creation since releasing purchase requisitions would happen from ASCP Workbench and requisitions are automatically approved without needing approval from managers. Forecasting would be also possible for non-CM suppliers if needed (Company internal document, 7.8.2023 [restricted availability]).

If the primary reporting tool would be continued to be used, it is integrated into Oracle ERP. There is a capability for planning simulations and creating own scenarios. Reporting includes sales order backlog and many other planning reports and analytics. Email notifications and alerts could be automated (Company internal document, 7.8.2023 [restricted availability]).

In addition to benefits, project team in the other geographical region gathered few challenges (see Table 8, p. 52) that need to be taken into consideration in the deployment phase. Setting up and testing of Demantra tool and Oracle ASCP would be required, and those would be new tools to learn and train for employees. Regarding forecasting, case company site must follow the certain timelines for publishing the forecast in Demantra. CM forecasting would probably still require manual tasks, and approximately over 50 % of the current tasks would be able to be automated. Additionally, taking Oracle ASCP means that the plan runs twice per week and might be needed to be customized for the case company site’s specific needs (Company internal document, 7.8.2023 [restricted availability]).

Table 8. Evaluation of Key Planning System Decisions (adapted from company internal document, 7.8.2023 [restricted availability]).

Decision area	Advantages	Limitations	Recommendation
Adoption of Oracle Demantra	• Integrated with Oracle ERP • Automated historical sales data collection from Oracle • Support for multiple forecast types • Built-in forecast accuracy measurement and reporting • NPI forecasting capability • Forecast simulation functionality • Supports statistical forecasting with manual override options • Scalable as business volume increases	• System setup and validation required • End-user training required • Increased process discipline due to standardized forecast reporting structure • Requirement to comply with defined forecast publication timelines	**Proceed with Demantra implementation**
Use of Oracle ASCP – Planning	• Integrated with Oracle • Automated consumption of forecasts and sales orders • Automated netting of demand and supply • System-generated planned orders for planner review and release • Forecast distribution to contract manufacturers (CMs) • Supports global planning visibility • Scalable planning capability as the organization grows	• Initial setup and testing effort required • Training required for planners • Current planning cycles are limited (e.g. plan runs twice per week)	**Adopt ASCP** Start with a phased deployment (e.g. single organization or product line)
Use of Oracle ASCP – Procurement Planning	• Reduced manual creation of buy requisitions and inventory replenishment orders • Automated approval workflows for purchase requisitions • Improved forecasting for non-CM suppliers • Supports blanket purchase agreements (BPA) for stable-priced materials	• CM forecasting still expected to require some manual adjustment; estimated automation level approximately 50%	**Utilize ASCP for procurement**, assuming master data (BOMs, routings) is accurate and maintained

4.1.4 Application and tools

Based on the meetings held with the project team, there were no new or customized Oracle Planning solutions required for the deployment. Company site was deploying only standard Oracle functionalities and solutions. Demantra and Oracle Advanced Supply Chain Plan (ASCP) tools were to be deployed in the company site. Planning and procurement teams would utilize ASCP for plan releases. Reporting and product lifecycle management tools were used before MRP deployment and continue to be used to support planning processes (Company internal document, 5.12.2023 [restricted availability]).

Demantra Forecast Set Flowchart was developed and sign-off was received from business teams to proceed with the deployment (Company internal document, 18.12.2023 [restricted availability]). There was a decision needed on how to generate forecast for the contract manufacturer (CM). As mentioned earlier in the benchmarking study (see pp. 36–37), there is a possibility for CM to see the demand online through supplier portal – Instrument Outsourced Demand Management tool (IODM) – which is integrated to Oracle and is fully automated solution. IODM tool was considered for deployment at a future date and would require new setups for both CM and company site (Company internal document, 5.12.2023 [restricted availability]).

4.1.5 Project scheduling

As seen in the below Figure 5 (p. 53), actual MRP deployment project started in October 2023 with gap wrap-up, part list finalization, design, and testing data setups, and continued until January 2024. In January 2024, test cycle and possible updates were scheduled to be performed. In January 2024 and February 2024, data setups were scheduled to be moved from test instance to production instance, and reports were further developed. End user training was planned to be executed and needed responsibility roles to be assigned in the system in mid-March 2024 (Company internal document, 28.9.2023 [restricted availability]).

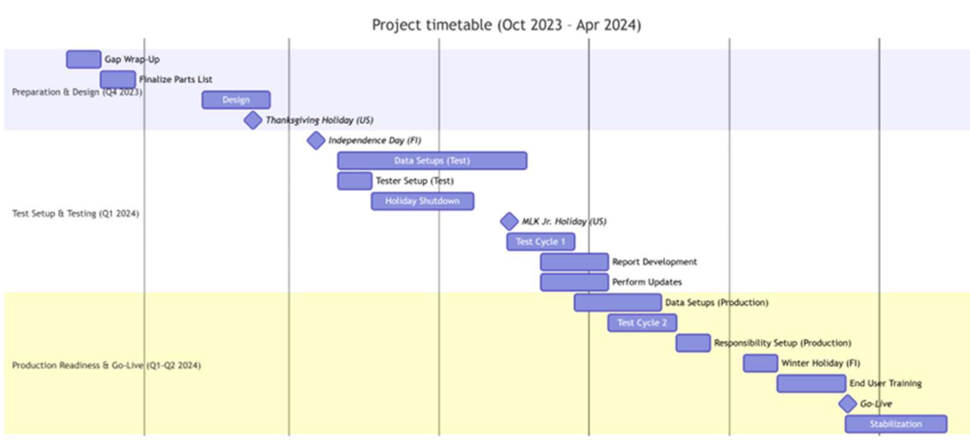

Figure 5. Project Timetable for the MRP Deployment.

Go-live for the MRP tool was planned for the end of March 2024. Stabilization phase was scheduled from end of March – end of April 2024. Thanksgiving Holiday in November, and holiday shutdown in December had a slight effect on the project scheduling, but overall, not caused any significant delay for the project planning (Company internal document, 28.9.2023 [restricted availability]).

4.1.6 Resource planning

Project organization included three sponsors/stakeholders, overall project lead and 3 experts from other geographical region, local project manager and 15 team members from Finland, IT support, and demand planning manager. Team in Finland was required to be involved in identifying and finalizing the gaps, identifying parts list for implementation, participating in the design phase, test cycles, and end user training, and developing reporting tools. Local project team was expected to be responsive, provide requested information in a timely manner, and be open to learning something new. Time allocation for the project was maximum of 3 hours per week for the team in Finland (Company internal document, 23.10.2023 [restricted availability]). Overall, the different project phases were estimated to require working hours as presented in Table 9 (p. 54).

Table 9. Project Tasks and Responsibilities (adapted from company internal document, 10.10.2023 [restricted availability]).

Task	Estimated Effort (Hours)	Related Milestone
Identify new gaps and finalize existing gaps	32	Identify any new gaps / finalize gaps
Identify parts list for implementation	24	Identify parts list for implementation
Design	32	Design
Set up planner codes and add planner names	1	Data setups (Production)
Check ATP lead times and SRTs	16	Not applicable
Extract 36-month PTO model-level order history	32	Data setups (Test & Production)
Define supply and demand planning attributes	32	Data setups (Test & Production)
Set up safety stock (if required)	16	Data setups (Test & Production)
Set up required reports	40	Develop reporting tools and workbooks
Testing	48	Test cycle 1 / Test cycle 2
Training (part planning, procurement planning, reporting)	43	End-user training

4.1.7 Project tasks

Internal Teams group was created for communication and documentation during the project. Group content included meeting presentations, recordings, relevant material, and project task list (Company internal document, 18.12.2023 [restricted availability]). There were several completed tasks internally in the case company site during the project that were based on the resource planning tasks listed in above Table 9 (p. 54). Tasks were divided between project team members, followed up in regular meetings, and all the tasks were completed by the given deadline.

4.2 Testing

Test cycle in the Oracle PPRD environment was conducted in January 2024. Test cycle required involvement from the team in Finland approximately ½-1 hour per tester during 3 working days. For the testing, the team had to decide few superusers and testers for the make part planning testing. Superusers and testers needed to have a lead role going forward with hands-on experience, and who could share the knowledge with other team members once moving on with the deployment. Procurement team in the other geographical region covered the testing for the procurement activities. Developing reporting tools and workbooks was scheduled to late January 2024 which also required some involvement from the team in Finland (company internal document, 18.12.2023 [restricted availability]).

4.2.1 Data setups

Before MRP system testing was conducted in the case company, needed responsibilities for MRP end users had to be setup and current source data setups had to be checked if any updates or additions were needed. In Oracle Planning instance (PPRD), planners needed Local Supply Chain Analyst role that is used for Planner Workbench. In Oracle Source Instance (OPRD), end users needed Demand Planner Source role to enter and review forecast, Planning Superuser role to view or update item attributes, supplier response times (SRT), and planner codes or names, Production Scheduler role to view Bills of Material, make reservations, and open or close discrete jobs, and APS Release role to be able to release planned orders (Company internal document, 15.6.2016 [restricted availability]).

There were data cleanups needed first to be performed, especially regarding the buy items. Product line A had few min-max items that required to be setup into inventory planning and planning time fence, demand time fences, and missing ATP rules to be updated for some of the items. There were also plenty of buy items in the system with incorrect item statuses. Product line B had also few min-max items where attributes and demand time fence had to be updated, and missing ATP rules had to be added. Product line A had slightly over 50 % and product line B approximately 78 % of total number of buy items that required further validation before proceeding with the deployment (Company internal document, 23.2.2024 [restricted availability]).

For the source data setups, the following steps had to be checked and performed in system if not yet completed:

- Items, item attributes, and BOMs are entered
- Routings are loaded for make parts for generating the lead times
- Item lead times are loaded for buy parts in Approved Supplier List (ASL)
- Item lead times are rolled up for make parts
- Sourcing rules and sourcing assignment sets are setup
- Planning percentages are added to BOMs at Option Class and Option Level
- On hand inventory is accurate in nettable sub-inventories
- Forecast sets are loaded
- Forecast data is loaded at PTO Model Level in weekly buckets
- Sales orders are entered and scheduled using Available To Promise rule (ATP)
- ATP rules are entered into Oracle for the ATP Lead-Time Items
- Supplier Response Time (SRT) is entered in Item Attributes for PTO Model items

- Other BOM attributes entered, such as Forecast Control, Planning Time Fence (PTF), and Demand Time Fence (DTF)
- Planner codes are entered for selecting and sorting data (Company internal document, 15.6.2016 [restricted availability]).

Key item attributes are maintained in Oracle Item Organization & Approved Supplier List (ASL) functions that significantly influence planning flow. Buyer name, minimum order quantity (MOQ), fixed lot multiplier (FLM), lead time, safety stock, and min-max quantity are some of the fundamental planning aspects that can be updated. Incorrect data will lead to inaccurate plan suggestion, or the item is not captured in Advanced Supply Chain Planning (ASCP) instance at all. Thus, it is important to maintain correct attributes in the system and make changes to the values whenever necessary (Company internal document, 28.6.2016 [restricted availability]).

4.2.2 Test Cycle

To be able to perform the testing in Oracle test environment, there was a requirement to setup few PTO level items into the test environment system. Testing team in Finland consisted of 7 end users, including 5 end users from factory order management (FOM)/logistics team and 2 end users from procurement team. Four end users from both teams were named as superusers to gain additional superuser access rights in system (Company internal document, 16.1.2024 [restricted availability]).

Testing was conducted in January 2024 via Teams call together with the project team in another geographical region. Testing was split into two sessions; first Oracle ASCP and OPRD environment were tested, and later testing included the usage of new reporting tools. Exit criteria for the test cycle was to test and troubleshoot all test scenarios, test IT updates and finalize plan for production deployment, identify and resolve any gaps or issues, and document for future resolution (Company internal document, 13.2.2024 [restricted availability]).

4.2.2.1 Oracle ASCP (Advanced Supply Chain Planning) and OPRD (Planning)

First testing session regarding Oracle ASCP focused on validating Bill of Material and demand Explosion to check the components and quantities, validating item attributes, performing functional testing, and lastly validate ATP testing. End users had to first check that data settings were setup correctly in the reporting tool to view certain reports. Test links for Oracle and reporting tool were provided to make sure that the access for the test environments was seamless for everyone (Company internal document, 24.1.2024 [restricted availability]).

There were several test scenarios that end users had to go through to complete the testing in Oracle ASCP. First scenario was to login to Oracle Planning instance successfully to ensure that end users can login without issues. As a result, there were issues identified with missing responsibilities. Then, end users added background settings to be able to review planned orders in ASCP plan. Once the settings were correct, testers went to the ASCP workbench to review the planned orders to ensure that planned orders were found in the workbench. Fourth scenario included exporting planned order data from Oracle to Excel successfully. Fifth and sixth scenarios included finding a correct make item from the list of planned orders and releasing it from the workbench successfully (Company internal document, 24.1.2024 & 13.2.2024 [restricted availability]).

Once Oracle ASCP testing was completed successfully, testers went to Oracle OPRD source instance to ensure that all can login Oracle OPRD without issues. Once login was performed successfully, testers used Production Scheduler role to validate and create work order under Discrete Jobs functionality (Company internal document, 24.1.2024 [restricted availability]).

4.2.2.2 Procurement

Testing for procurement activities was separately performed by the project team in another geographical region. For buy items, current workbooks in the reporting tool were reviewed. Exploded demand was seen as accurate. However, it was noted that planning percentages were not correct to utilize forecasting tools for contract manufacturing. Further exploration and implementation of planning percentages had to be occurred to have proficient procurement forecasting especially for contract manufacturer (Company internal document, 13.2.2024 [restricted availability]).

Buy item attributes were already loaded prior to test cycle. Fixed Days Supply (FDS) and Planning Time Fence (PTF) needed to be set as agreed in Oracle OPRD. Supply chain setups were reviewed via reporting tool to validate that setups are done correctly. Regression testing was performed for procurement and no issues were noted. In conclusion, no issues were identified in buy item procurement and planning and for the plan that was utilized (Company internal document, 13.2.2024 [restricted availability]).

As next steps, after the team has determined and loaded the needed planning percentages into system, procurement validation was required. Adding planning percentages would add the most value to the project implementation for buy item forecasting (Company internal document, 13.2.2024 [restricted availability]).

4.2.2.3 Reporting tools

There were few new workbooks created into currently used reporting tool e.g. regarding the simulations for big deal opportunities and common material shortage analysis for sales order requirements. The accessibility and usability were tested before deployment, and no issues were raised other than training for the end users of the new tools was required.

4.2.2.4 Summary

As a conclusion, overall plan releases and testing went well. There were no issues with the functionality. Test scenarios for planned releases were passed. Demand was validated, and planning percentages were overviewed and solidified results were seen at purchased part level. Further clarification was provided regarding forecasting and planning percentages to the Demand Planning team. Demand Planning testing highlighted few issues which were resolved quickly. There were some data issues identified which required further cleanup and setups before deployment to production. ATP testing went well and some calendar updates were needed in the background settings. IT testing went also successful, gaps were identified and solutioned, and deployment plan was finalized (Company internal document, 13.2.2024 [restricted availability]).

4.3 Training

Project included several training sessions between March and April 2024. Training sessions were organized by the project lead and procurement lead in another geographical region. All the training sessions were related to new tools that were taken into use regarding MRP and forecasting.

Training sessions began in March 2024 with introducing the new planning process. There were few sessions arranged for the make and buy part planning. Half of the sessions included the whole project team, and other half only the planners and local project lead. In April 2024, there were additional sessions arranged regarding the weekly routines. Those sessions included planners, project lead, and managers (Company internal material, 2.5.2024 [restricted availability]).

Demand planners from the global team arranged few online meetings on how to use Excel spreadsheets for demand planning and forecasting and determining planning percentages. Participants included demand planners, operations managers, procurement, and local planners. Walk-thru of the newly created workbooks in the reporting tool was held in May 2024 via Teams meeting. Participants were from FOM team, procurement team, production planning, and operations management (Company internal email communication, 27.4.2026 [restricted availability]).

4.4 Deployment and stabilization

Before deployment, some activities had to be still performed in the company site that were identified after the testing. Data cleanups were needed for buy items, such as adding few missing attributes, sourcing rules, and costs. Planner and buyer details needed to be also updated for some of the items. Planner codes were determined, divided to make and buy parts, and related items were assigned to planners. Buy items were also assigned to dedicated buyer. Planning attributes were reviewed and some of the attributes were updated to be in alignment (Company internal document, 2.5.2024 [restricted availability]).

Min-max items were also reviewed to ensure that both min and max levels were set, release time fence (RTF) was set to certain parameter, and simultaneous MRP planning was turned off for min-max items. Additionally, planning percentage updates were done for option products, and identified outdated planner codes, planner and buyer names, incorrect item types, statuses, and MRP attributes were corrected. There was also identified some mismatch with product categorization for demand planning, and issues in forecast validation where quantities were not showing correctly. These were fixed immediately after identification (Company internal document, 2.5.2024 [restricted availability]).

Stabilization phase included internal check-in meetings in April and May 2024 with the planners, project lead, and managers. Stabilization exit date was at the beginning of May 2024. Local managers arranged a meeting regarding the new roles within the order fulfilment team. There needed to be decided backups for forecasting during the holiday periods and sick leaves, who is going through the updates for planning percentages and making needed changes in Oracle ERP, who executes the weekly plan releases in Oracle ASCP and discrete jobs in Oracle OPRD, and what reports will be used in the future (Company internal document, 2.5.2024 [restricted availability]).

5 Results

In this chapter, results from the case study concerning post MRP deployment process mapping, KPI analysis, and end user feedback are introduced. First, the post MRP deployment processes regarding demand planning, forecasting, and purchasing were analysed in March-April 2026 against the as-is processes that were mapped in year 2023. Secondly, KPI analysis was simultaneously performed to further analyse the impact what automated MRP tools have brought on operational efficiency in case company site's order fulfilment.

Selected KPIs to be measured were cycle time, data accuracy, automation, and inventory turnaround. Lastly, end user feedback was collected from the employees in the case company site in February 2025 and March-April 2026, including operations managers, and members of the factory order management (FOM) and procurement teams to get an insight how end users find the changes in planning processes, and how those have affected to their daily work tasks.

5.1 Post MRP deployment process mapping

Post deployment MRP and forecasting processes were mapped in November 2024 and April 2026. In the following sections, current processes will be introduced and analysed comparing to the as-is process mapping that was completed during Autumn 2023.

5.1.1 Demand Planning and Forecasting

As of writing this thesis, current demand planning process for Product Line A is customized for case company site's specific needs and still partially differs from the organization's global process. Own observations were completed based on monthly internal email communication between different parties during timeline 2023-2026 (restricted availability) regarding forecasting process. When comparing the pre- and post-deployment process flows for Product Line A (see Figure 3, p. 42 & Figure 6, p. 65), those show that current process includes some new sub-steps compared to the previous as-is process. New process includes forecast file review cycle which is a recurring monthly process documented via email. Review is initiated by the demand planner, and reviewed by local planner, and operations manager. Files contain previous month actuals and up-coming month forecast. Typical review actions include removal of non-forecasted items, and discontinued products. Deadlines and official publishing dates are clearly stated each month. Forecasts are updated into the planning system after review confirmation. The process demonstrates manual review effort layered on top of system-generated forecasts.

Another new monthly review process is regarding planning percentage updates. Purpose is to review and adjust BOM-level planning percentages in Oracle ERP and ensure accurate material explosion and procurement activities. Excel files contain current planning percent, and calculated planning percent based on 6-month history. Review includes removal of non-forecasted items. Adjustments are based on historical demand and parent-child BOM relationships. Approved changes are uploaded for mass update.

In current process, automated reports (Supplier Forecast, Sales Order Management) are exported from reporting tool into Excel format, which serve as a baseline for preparing the actual forecast Excel spreadsheet for further discussions with product management. In previous as-is process pre MRP deployment included several other uploaded supporting reports.

After the monthly higher-level forecast has been finalized, separate CM forecast will be created via Excel for communicating the demand for contract manufacturer. Forecast is still sent manually to contract manufacturer via email for confirmation. Currently, contract manufacturer doesn’t have any other visibility to case company site’s numbers. If, and when the CM supplier portal will be opened in reporting tool, there is no need for manual sending of forecasts via email any longer (internal email communication, 17.4.2026 & 20.4.2026 [restricted availability]).

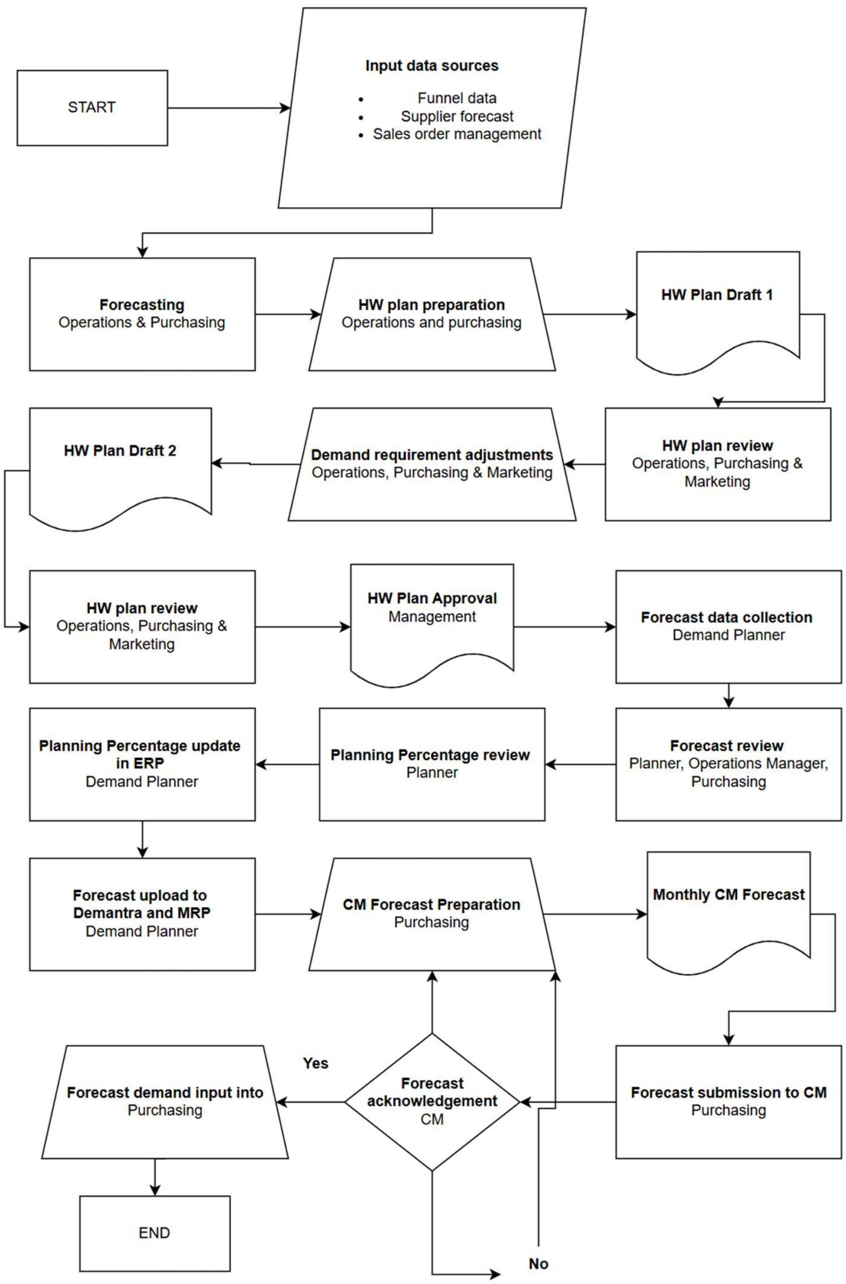

Figure 6. Post MRP Deployment Monthly Demand Planning and Forecasting Process in Product Line A (adapted from company internal document, 17.4.2026 [restricted availability]).

Demand planning and forecasting process for Product Line B stayed almost the same as it already was described in Figure 4 (see p. 43), which means no new process mapping was required. As mentioned in the introduction section, mass production was transferred from Finland to another geographical region for most Product Line B products during MRP deployment, so therefore forecast reviews are currently done in close cooperation with the other factory.

To give an overview to the global MRP Forecast Explosion process that both product lines now utilize in the current process, forecast for the PTO Model come from Demantra or it is manually entered in the source forecast sets. Forecast is then derived for each model component whose Forecast Control is set to Consume and Derive. Forecast explosion stops at the first standard BOM. Forecast quantity for the component or child is calculated with formula: Parent's Forecast x Qty Per x Planning %. The processing lead time of the parent is used to offset the child's forecast, and the forecast date will always use the first workday of the week. Because Phantom BOM's have standard BOM type, no forecast is derived for the components structured under the Phantom BOM. These components will receive dependent demands in the ASCP planning process (Company internal document, 7.6.2016 [restricted availability]).

Forecast is exploded in the Oracle source instance OPRD. The data collection process collects the exploded forecasts from OPRD into PPRD along with other demands, supplies, items, BOM, WIP, and other critical information. Advanced Supply Chain Planning (ASCP) uses all the collected data to generate a supply chain plan for all planned items. The exploded forecasts are brought in as independent demands. This is the highest level of demand as seen in the pegging form (Company internal document, 7.6.2016 [restricted availability]).

Forecast is consumed by sales orders in ASCP. Sales order is exploded in similar process as forecast explosion, and the forecast for every model component whose forecast control is set to Consume and Derive, will be consumed within the Forecast Consumption window as defined in the Forecast Set. The result of the forecast consumption process would be net forecast and sales order demand (Company internal document, 7.6.2016 [restricted availability]).

5.1.2 Make and Buy Planning

Processes for make and buy part planning have changed drastically from the pre-deployment process (see Figure 2, p. 41). Current make part planning includes new sub-steps within the process (see Figure 7, p. 67). New workbooks are utilized in the reporting tool, such as Job Release Tool to see the jobs that are clear to build or still have material shortage. Both product lines now have the same production planning tools to utilize than the benchmarking sites introduced in Chapter 4.1.1.1 (pp. 35–37). If job is clear to build, Factory Order Management / logistics team will open Oracle PPRD instance, and release related planned order from weekly make part plan. Once planned order is released, system automatically creates a work order number that will be added into a separate downloaded Excel spreadsheet containing the suggested planned orders by the system. Then, FOM / logistics team will open Discrete Jobs function in Oracle OPRD instance and validate details in the work order before updating the job status and making material reservations for the job.

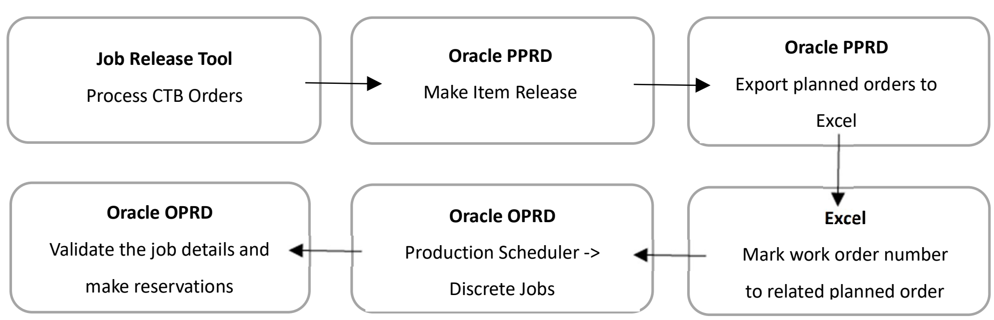

Figure 7. Post MRP Deployment Make Part Planning Process.

Buy part planning includes also new sub-steps within the process (see Figure 8, p. 69). In Product Line A, FOM team checks the material shortage for booked sales orders via Shortage Analysis workbook in the reporting tool, that indicates the requirements per sales order or per component. System automatically calculates the material shortages based on on-hand inventory balances, 6-month demand, and open sales orders. There is also currently an option to do shortage simulation in reporting tool for big sales opportunities, that are not yet booked in system to check the current on-hand balances and shortages. Based on the material simulation, possible pre-purchases can be done well in advance for critical components that might have a longer delivery lead-time. These new workbooks are not in active use in Product Line B, and the team follows the same as-is process sub-steps that was assessed in Figure 2 (p. 41).

With the help of the Shortage Analysis report, FOM team places purchase requests for the shortage material into Jira Kanban board for purchasing team to process further. Additionally, FOM team opens Oracle PPRD instance, and release the related planned orders for the purchased items with needed quantities. System generates automatically a purchase requisition in Oracle OPRD and no approval from manager(s) is required. Buyer auto-creates a purchase order based on the automatically generated purchase requisition and sends it further to the supplier via email. In case the sales order is recently booked, and the shortage is not yet showing in the ASCP plan, then purchasing team will continue to create purchase requisition manually in Oracle OPRD for manager's approval. Once approved, PO will be generated.

Purchasing process for the forecasted items is also mostly automated, since system creates planned orders based on the uploaded forecast. If buyer finds the suggested planned order from the weekly plan for the component related to actual forecast demand, then planned order will be released from Oracle ASCP Workbench into purchase requisition, which can be processed into purchase order automatically without manager's approval as in normal purchase process described above. Planning for min-max items is also automated. When the requirements go below the set minimum level, system creates purchase requisitions automatically to replenish the stock to maximum level.

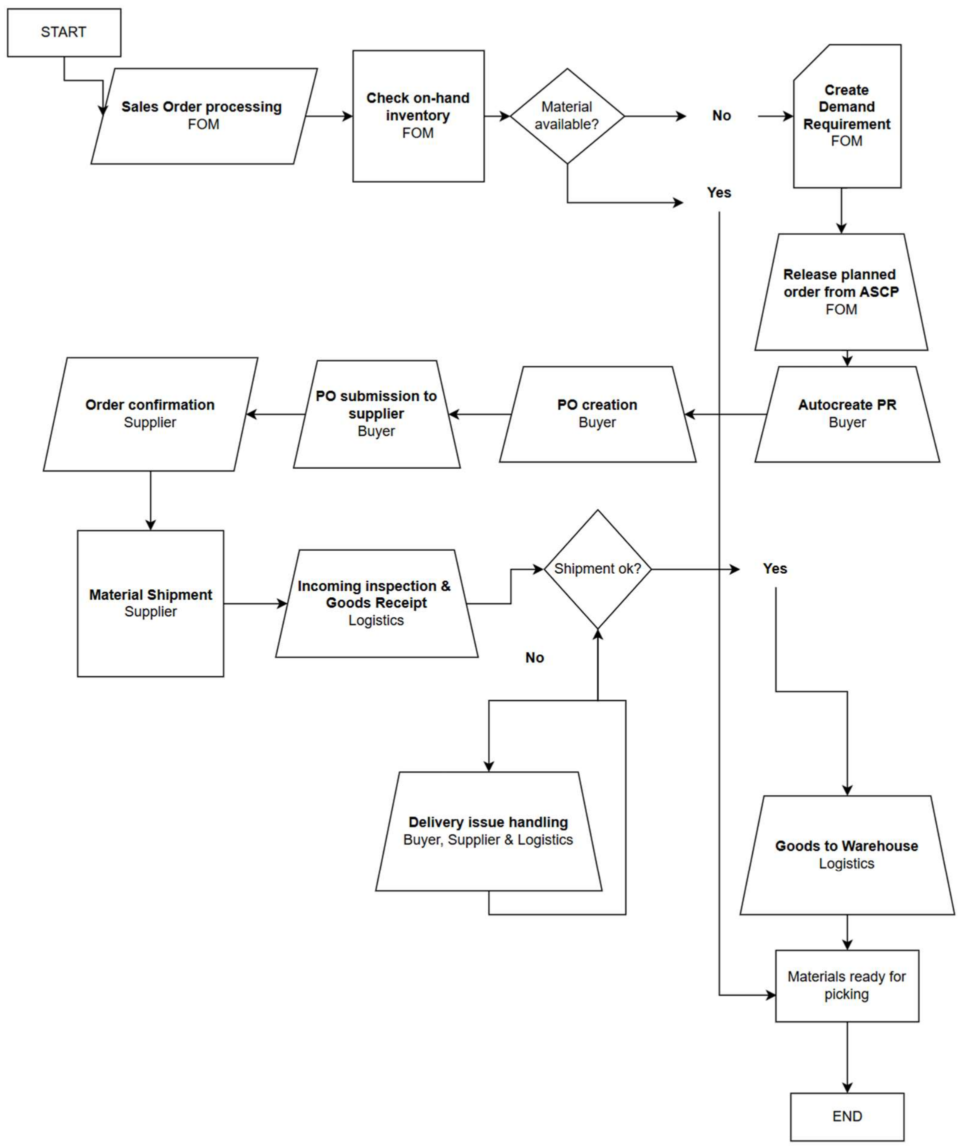

Figure 8. Post MRP Deployment Buy Part Planning Process.

5.2 KPI analysis

In this study research, selected KPIs were analysed based on the case company site's specific interest. KPI analysis was more focused on Product Line A, but some areas included also analysis for Product Line B. Selected KPIs included cycle time, data accuracy, automation, and inventory turnaround. Each KPI analysis is introduced in the following sections.

5.2.1 Cycle Time

Cycle time was analysed in March 2026 by collecting feedback from end users regarding their daily planning activities. Presented questions can be seen in Appendix B (p. 94). Based on the Table 10 (p. 72), total cycle time before MRP deployment for the material management process in Product Line A from analysing the shortages and creating purchase request tickets into Jira Kanban board has taken approximately 20-40 minutes per day. Factory Order Management team evaluated that MRP practices that are currently in use are approximately 50 % faster than with the previous manual process, taking currently time approximately 10-20 minutes per day (Company internal email communication, 23.3.2026 [restricted availability]).

The used time depends on the size of the customer order. Going through the items in bigger orders were seen as challenging in the previous manual process. Previously, material management process required only to check the material shortage status manually from reporting tool and open the purchase request ticket in Jira Kanban board. Current MRP process includes additional releasing of purchasable items from Oracle ASCP via weekly plans (Company internal email communication, 23.3.2026 [restricted availability]). In Product Line B, releases for purchased items are performed by the buyer, and not the logistics team, so the agreed process owners for ASCP plan releases differ between the product lines.

For the actual purchasing process, there is no longer manager's approval needed for purchases released from Oracle ASCP. This has shortened approval process cycle time by maximum of 1 working day for both product lines. There is also no longer need to create purchase requisitions manually in Oracle OPRD instance for the components that are found and released from weekly planned orders, which has decreased the buyer's processing time by maximum of 30 minutes per each requisition, depending on the number of items in the requisition.

When evaluating the current process of creating discrete jobs in Oracle OPRD to previous process, FOM team estimated the current process to be faster by 20 %. There is no huge change to previous process. After the job is automatically opened, job status is updated and reservation is done in Oracle OPRD. In previous process, these were completed at the same time when job has been opened (Company internal email communication, 23.3.2026 [restricted availability]).

Process regarding forecasting in Product Line A is currently seen a bit faster than in pre-deployment process. Before MRP was deployed, the cycle time for preparing the forecast has taken approximately 1 hour. Post deployment, the cycle time is currently around 30-40 minutes. Preparing the forecast is seen as more efficient, when exporting several Excel spreadsheets from another reporting tool is no longer required (Company internal email communication, 20.4.2026 [restricted availability]). On the other hand, current forecasting process includes few additional monthly reviews, that were not included in the process earlier, which has increased workload a bit for planners, operations manager, and purchasing. Total estimated increase in these new review processes is 1-2 hours per month.

Table 10. Summary of Cycle Time Improvements Post MRP Deployment.

Process	Pre-MRP Cycle time	Post-MRP Cycle Time	Improvement	Outcome
Material shortage analysis & purchase request creation	~20–40 min/day	~10–20 min/day	~50% reduction	MRP replaced manual shortage analysis and ticket creation with automated planning support, reducing manual effort especially for large customer orders
Approval process for purchasing	Up to 1 working day	0 days	Up to 1 day reduced	Manager approval is no longer required for purchases released from Oracle ASCP, eliminating an approval step from the process
Purchase requisition creation in Oracle OPRD	Up to 30 min per requisition	0 min	Up to 30 min per requisition saved	Requisitions no longer need to be created manually for items released via weekly planned orders
Discrete job creation in Oracle OPRD	Baseline	~20% faster	~20% improvement	Job opening, status update, and reservation are partly automated; however, overall process logic remains similar to the previous approach
Forecast preparation	~60 min/month	~30–40 min/month	~33–50% reduction	Forecasting became more efficient as multiple report exports are no longer required after MRP deployment
Additional forecasting reviews (new activity)	Not applicable	+1–2 hours/month	Workload increase	New monthly review practices were introduced post-deployment, increasing total process workload despite improved efficiency

5.2.2 Data Accuracy

Based on questions presented in Appendix B in April 2026 (p. 94), the feedback from purchasing team was that even though forecasting process was partially automated, and accuracy is constantly improving, human validation was still required. Oracle ASCP has generated planned orders based on forecast explosion from Demantra and min-max planning partially correctly, but there is still some discrepancy regarding the timing when planned orders appear in the ASCP plan compared to the actual need-by dates that are calculated based on the manual Excel forecast. However, forecasted quantities in the ASCP plan seem to be in alignment with the manual forecast (Company internal email communication, 20.4.2026 [restricted availability]).

Unseen surprise demand affects into correctness of the forecast data. Product management should provide more information in the HW plan meeting regarding the demand that are not visible in the funnel yet. When the forecast data comes from product management to order fulfilment unexpectedly without any pre-alert, it usually changes the demand for the short-term period, and affects also to contract manufacturer's own material management, and production planning schedules (Company internal email communication, 20.4.2026 [restricted availability]). More insight to data accuracy can be seen in end user feedback (pp. 78–79).

5.2.3 Automation

Statistics related to MRP usage provide a quantitative dataset for evaluating impact in operational efficiency, and it enables before-and-after comparison of deploying automation. Reported key metrics include MRP usage rate which is based on share of purchase requisitions created to inventory via MRP and min-max automation compared to the manually created purchase requisitions in Oracle OPRD. Current reporting has been done from go-live in April 2024 onwards. Management in Product Line A has set goal targets for MRP usage, 65 % for H1 FY2026 and 72% for H2 FY2026. There are no set targets for Product Line B due to low MRP usage. Presented charts show the monthly and quarterly trend and pre- and post-automation comparison.

Firstly, collected data from Oracle OPRD instance regarding the processing of purchase requisitions was analysed per product line by using the timeline between post implementation in April 2024 until the end of latest business quartal January 2026. Figures 9 (p. 74) and 10 (p. 75) show, that there are some monthly peaks and dips identified in both product lines A and B. Lowest usage has been during early implementation phases in 2024, and significant increase was seen by late 2025.

As seen in the Figure 9 (p. 74), manual purchase requisition creation was at first still mostly used, and MRP usage was lower due to adapting to the new process and adjusting the planning settings based on the hands-on experience during the stabilization phase. Additionally, urgent customer deliveries required creating manual purchase requisitions immediately, since in some cases the shortage was not yet visible in Oracle ASCP weekly plan which affected negatively to the MRP usage. Min-max automation was taken into use in May 2024. Once on-hand inventory level has transferred below the minimum level, system automatically generated few purchase requisitions per each month based on the set minimum and maximum order quantities into Oracle OPRD for each needed component.

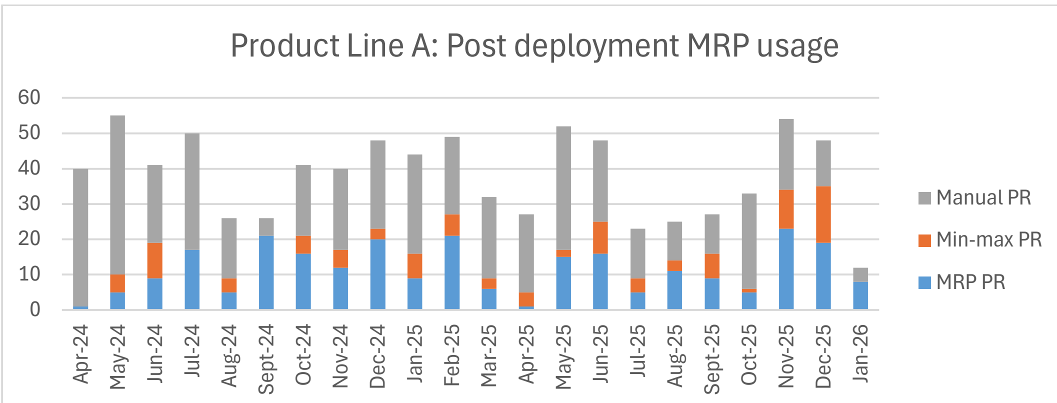

Figure 9. Post deployment MRP usage in Product Line A (Total amount of requisitions per month).

Product Line B does not utilize MRP as much as Product Line A (see Figure 10, p. 75). Amount of purchase requisitions in each month is significantly lower than in Product Line A. This is due to mass production operations for many Product Line B products were transferred from Finland to another geological region, and only few Product Line B products are still manufactured in the case company site. However, min-max automation was also utilized for some components in Product Line B. During the first months after deployment, min-max planning generated multiple purchase requisitions automatically for Product Line B components that were not eventually needed and were then cancelled in system. Min-max settings were seen to be off in system, and therefore adjustments to the minimum and maximum order quantities had to be made for automation to work properly and to avoid unnecessary purchase requisition creation in the future.

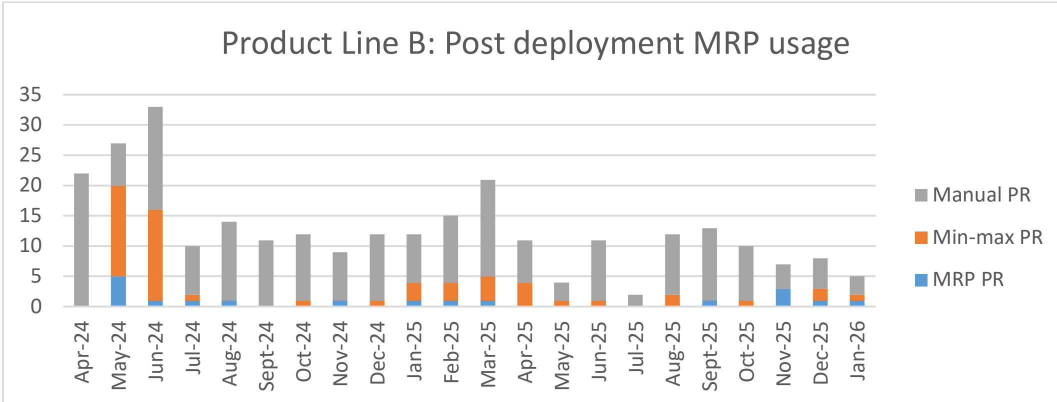

Figure 10. Post deployment MRP usage in Product Line B (Total amount of requisitions per month).

Once the order fulfilment team was more confident and familiar to utilize MRP in weekly plan releases, the amount of MRP planned order releases increased noticeably compared to creating manual purchase requisitions. Also, after setting goal targets for each business quarter for fiscal year 2026 helped in tracking the usage and motivated the team to utilize MRP as much as possible. Earlier, there was no clear set targets for MRP usage.

In below Figures 11 and 12 (p. 76), monthly MRP automation rate is analysed in percentages, which shows the trend how automation has been utilized over time post MRP deployment. Figure 11 for Product Line A (p. 76) shows how the automation rate fluctuates monthly. E.g. in September 2024, there was the highest automation rate of slightly over 80 %. Lowest automation rate was in May 2024, April 2025, and October 2025 with the percentage being around 20. After the management set the usage targets for fiscal year 2026, it increased from November 2025 onwards significantly to 63-73 %.

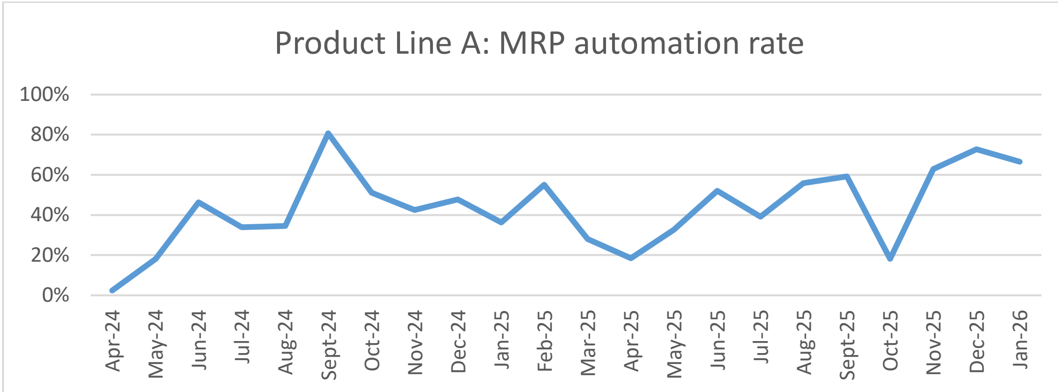

Figure 11. MRP automation rate in Product Line A (total percentage per month).

Below Figure 12 (p. 76) for Product Line B shows how the automation rate was high (74 %) in the early stage of stabilization phase in May 2024, which is caused by the incorrect min-max automation settings and unnecessary purchase requisitions generated by the system. More realistic percentages are seen from June 2024 onwards where the monthly automation rate was between 0-48 %. Product Line B does not have a set automation target percent due to lower MRP usage, but also during fiscal year 2026, the automation rate was increased significantly to 38-43 %.

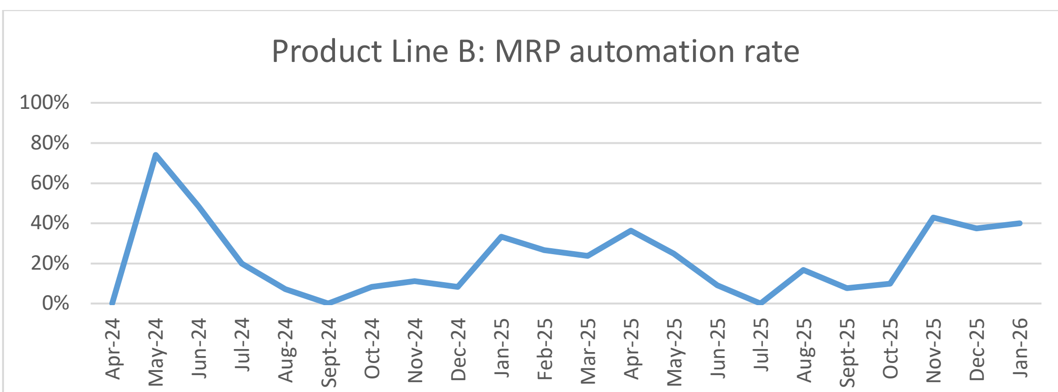

Figure 12. MRP automation rate in Product Line B (total percentage per month).

In addition to monthly reporting, the same percentual automation rates are calculated for each business quarter. Figures 13 and 14 (p. 77) demonstrate the quarterly deviation. Figure 13 concerning Product Line A shows clearly the increase in automation during Q1 and Q2 FY 2026. Set target was 60 % and the target was passed in Q1 FY2026 by 8 %, total being 68 %.

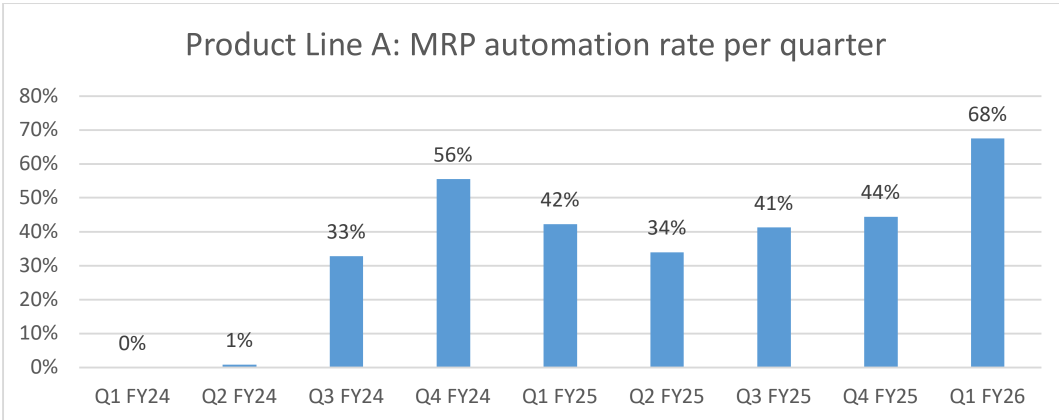

Figure 13. MRP automation rate per quarter for Product Line A (total percentage per business quarter).

Automation rate for Product Line B has fluctuated drastically quarterly. As was seen in the monthly trend chart (see Figure 12, p. 77), quarterly trend shows the same increase in automation during Q1 FY 2026. As there was no set target from management for MRP usage in Product Line B, this report still serves as a guideline to demonstrate the post-deployment usage to management and end users.

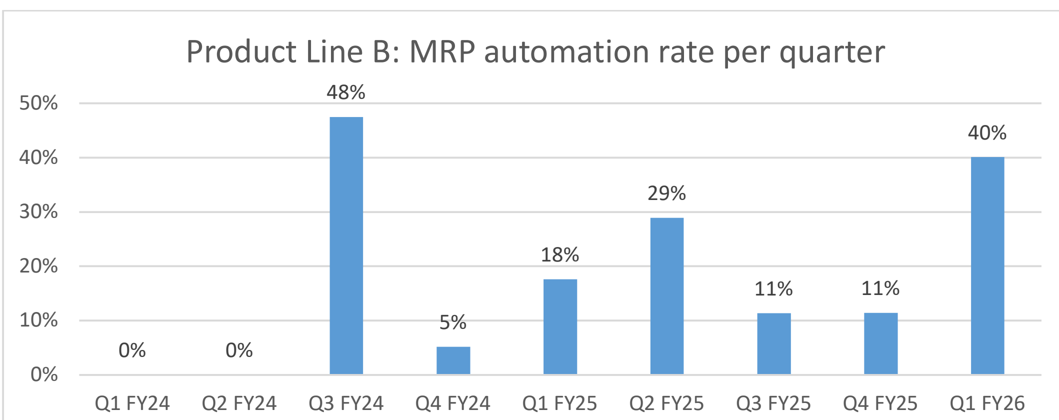

Figure 14. MRP automation rate per quarter for Product Line B (total percentage per business quarter).

5.2.4 Inventory Turnaround

Inventory turnaround for Product Line A was analysed based on the data received from financial department in April 2026. Analysis for inventory turnaround was not performed for Product Line B. Report (Company internal document, 27.4.2026 [restricted availability]) shows the quarterly actuals in dollars with the values of Days of Inventory (DOI). In this thesis, results of the analysis are business confidential so therefore no numerical values are presented.

Jenkins (2022) defines DOI as a metric which shows how many days of sales a business keeps in the inventory. It measures the average turnover of inventory and is valuable when assessed together with other metrics to support business decisions. If the DOI value is high, or getting higher, it indicates that company keeps excess on-hand inventory, or sales orders are dropping. Lower DOI is preferred and it suggests that a company can convert its inventory into sales. However, it cannot be too low to enable order fulfilment. In technology industry, average optimal turnover is between 45-90 days (Allianz Trade, 2026).

Pre- and post-MRP deployment, the average DOI has been in alignment with the industry average turnover in the Product Line A. Post MRP deployment, buffer levels have been further adjusted which shows positively in the lower inventory values and DOI, where in few quarters DOI has been even lower than average.

5.3 End user feedback

End user feedback was gathered during and after the MRP deployment during timeline of years 2025-2026 (see Appendix B, p. 94) from planners, purchasing team, and operations manager in several internal meetings, and email discussions.

End users stated that MRP provides better understanding of current processes and future capabilities, especially compared to earlier manual planning. MRP was described as a useful foundation for decision-making when evaluating whether to move away from non-MRP processes. Manual work reduced through automatized planning. Factory Order (Company internal document, 12.2.2025 [restricted availability]).

Demand and supply alignment was seen as more consistent. Users acknowledged that once planning attributes, routings, and item setup are correct, MRP becomes usable and reliable. MRP was seen to systematically test safety stock, lead times, and forecasting logic. MRP was seen supporting cross-site and global collaboration. Users mentioned that learning from other company sites was helpful, and MRP was seen as a common planning tool to be utilized. MRP deployment project enabled discussion and development across different functions, such as planning, procurement, and manufacturing (Company internal document, 12.2.2025 [restricted availability]).

As a challenge, end users highlighted the high dependency on correct master data. Incorrect routing, lead times, planner codes, or item attributes caused incorrect MRP outputs. Some items were not seen under jobs or were not correctly planned, which lead to inventory not updating the on-hand balances as expected (Company internal document, 12.2.2025 [restricted availability]).

Competing priorities such as daily operational work limited time available for MRP tasks. MRP recommendations in ASCP were questioned to be incorrect. Users questioned large, suggested purchase quantities and asked why MRP proposed them. Users needed to manually verify whether lead times, costs, and forecasts were correctly transferred to purchase orders. Training and guidance were needed, since users highlighted the importance of instructions, process descriptions, and updated guidance to use MRP correctly. MRP usage required shared documentation, and process clarification since all the end-users were unfamiliar with MRP (Company internal document, 12.2.2025 [restricted availability]).

6 Discussion and conclusions

6.1 Discussion on results and findings

As presented in the Introduction chapter (see p. 11), objectives of the study were to analyze how automated MRP tools improved planning processes in the case company site compared to the as-is and to-be pre-study and evaluate the impact on operational efficiency post MRP deployment by measuring relevant KPIs. Literature review supported the practical study analysis, and both complemented each other.

Results from the pre- and post-deployment study show that demand planning processes were customized for case company site's needs. Some new sub-processes were added to the previous forecasting and demand planning process, and new tools were taken into use. Processes for make and buy part planning had also drastically changed from the pre-deployment process with more automated tasks and new routines. Conducted process mappings were processed as guided in the literature regarding business process reengineering (see pp. 15–19).

Based on the literature review (see pp. 12–15), measuring key performance indicators are an essential strategy when evaluating the improvement in operational efficiency. Selected KPIs for this case study were cycle time, automation, inventory turnaround, and data accuracy. When evaluating the improvements in cycle time in the case company site, it was evident to see that both planning and procurement cycle times decreased post MRP deployment, especially in Product Line A (see Table 10, p. 72) due to removal of most manual process steps and increased visibility.

Findings summarize that process cycle times were reduced after MRP deployment, mainly due to the removal of manual planning and purchasing steps, and improved end-to-end visibility. MRP enabled automated generation of purchase requisitions and planned orders, system-driven material proposals instead of manual calculations, and faster response to demand changes via simulations.

Managers approval was not anymore needed for items that were released from Oracle ASCP, and planning processes were shortened with the help of automated shortage reporting tools and job creation which enabled faster response time to customer orders. Cycle time for forecasting was also decreased by utilizing fewer Excel spreadsheets than in the pre MRP process. New monthly review processes were implemented for updating planning percentages and forecasts, but overall, there was not much increase in total workload due to these new processes.

Data accuracy improved notably post-MRP deployment, particularly regarding on-hand inventory balances, demand visibility, and component-level requirements. There is currently better alignment between demand and inventory through system-controlled planning, reduced human error as calculations and netting are performed by the system, and improved visibility for commodity managers at component level to support costing and agreements. Manual steps were reduced in order handling, and how data flows from MRP into execution tools was clarified. Review cycles were standardized, which enabled control during early deployment.

There were challenges seen with data quality through the MRP deployment, manual workload alongside automation, and guidelines to be set what comes to maintaining planning accuracy. The impact what MRP brought to the master data quality has been critical success factor. Data quality was widely improved before go-live and after stabilization. Needed tasks to check the data quality for planning attributes, and BOMs were performed before deployment. Based on the given feedback by the end users, human validation is still required especially in forecasting process, even though the process is partially automated and accuracy is constantly improving.

Automation reduced reliance on manual forecasting and purchasing that were based on multiple Excel spreadsheets and process steps. Most purchase requisitions are processed automatically, min-max requirements are generated automatically, and planned order releases replaced manual work. There was low usage in MRP directly after go-live, then steady growth as processes stabilized and user confidence increased.

Once the order fulfilment team was more confident and familiar to utilize MRP in weekly plan releases, the amount of MRP planned order releases increased noticeably compared to creating manual purchase requisitions. Also, after setting goal targets for each business quarter for fiscal year 2026 helped in tracking the usage and motivated the team to utilize MRP as much as possible. Earlier, there was no clear set targets for MRP usage.

The KPI analysis highlights that to realize the value of MRP, it requires dedicated time and continuous monitoring post deployment. Setting KPIs, such as the MRP usage rate, are critical for progress tracking and process standardization. MRP improved visibility and transparency regarding the whole material management process for both operational teams and management.

Reporting usage of automated MRP tools helped management to get informative insight for decision-making and target setting. The regular sharing of MRP usage statistics, trend charts, and set targets received positive feedback from management. This indicates that visible data reporting helped to see MRP as a strategic tool, not just a system operated in ERP. Reporting is a key factor to secure support from management, and to show the concrete benefits that MRP has brought to planning processes. Monthly and quarterly executed reporting separates clearly the portion of manually created purchased requisitions against the automatically created purchase requisitions via MRP and min-max.

Automation exposed weaknesses in related processes, which enabled broader improvement for end-to-end processes. Even though MRP reduced manual purchasing activities, human judgment was still needed. It was already acknowledged in the beginning of the deployment project, that full automation cannot be deployed immediately. Many routine tasks are currently automated by MRP, and resources can be allocated towards more value-added work.

Inventory turnaround improved through better inventory control and demand planning based on the process outcomes. MRP enabled more reliable on-hand inventory data, reduced excess material ordering caused by manual buffers, and improved visibility to shortages and excess via simulations and planning tools. The study supports the conclusion that inventory is moving faster and is better aligned with actual demand.

According to general end-user feedback, MRP is perceived as valuable for structured planning, automation, and cross-functional alignment, but its effectiveness is highly dependent on master data quality, system setup, and user training. During implementation, users experienced increased workload and occasional frustration due to incorrect recommendations and tool availability issues.

6.2 Managerial recommendations

Continuous management of the correct planning attributes is required for the newly created items. If master data is not maintained properly, more issue handling will arise which will interrupt the normal MRP execution process. It was evident to acknowledge that to maintain seamless automation, it requires continuous finetuning. Recommendation to maintain strong master data is to clearly indicate the owners of the data management: who will update the item attributes, regularly review the quality of the data, and set the minimum requirements (e.g. valid ASL, sourcing rules, lead times, planner codes, MRP and inventory planning setups) in every new item setup before it is added into MRP planning. This will reduce the need for regular cleanups and prevent errors in MRP and min-max planning.

Visibility for contract manufacturer has not yet improved by using the CM supplier portal so that could be something for management to take into consideration if it could improve future forecasting actions and cooperation with the CM. Product Line B could take MRP into more active use where possible in the future to align with the same processes that Product Line A currently successfully uses.

6.3 Theoretical contribution

As mentioned in the Research methodology chapter (p. 31), there was a gap identified for a case study that links as-is and to-be process changes with real operational KPI outcomes. Prior literature focused primarily on introducing basic MRP logic, supply chain planning processes and systems, and the evolution of automation and digitalization. The results of this study fill the missing gap by providing new insight on understanding causal relationships in what happens in real organization settings when automated MRP tools are deployed, how planning processes and efficiency change in a single site's daily operations, and what measurable outcomes are achieved using key performance indicators.

6.4 Limitations and future research recommendations

This thesis was subject to several limitations. Study focused on a single case company site, which limited the generalizability of the results. The analysis relied heavily on internal operational data, which may include inconsistencies, or incomplete historical records. Observation period following the deployment of the automated MRP tools was limited, and long-term efficiency effects couldn't be fully assessed.

When considering the possible future research, there is one interesting topic to study further. Case organization is proceeding globally to deploy new Oracle Supply Chain Planning Cloud ERP environment. The global need for the transformation becomes from current planning systems causing delays and inefficiencies, slow decision cycles for demand propagation and big deal simulations, systems are seen as inflexible for the business growth, current on-premise applications have stopped developing new features, and legacy platforms are seen outdated (Company internal document, 25.8.2025 [restricted availability]).

Oracle Supply Chain Cloud is an AI-driven platform that drives operational efficiency. Vision is to standardize and simplify planning across the organization, integrate execution and simulation into single, cloud-based platform, use artificial intelligence and machine learning in forecasting and prescriptive insights, create rapid simulations, reduce turnaround times, and increase visibility across the case organization and contract manufacturers (Company internal document, 25.8.2025 [restricted availability]).

Project is estimated to last 2 years (Company internal document, 25.8.2025 [restricted availability]). Currently as of writing this thesis study, the project is still in design phase, and some pre work requirements have been requested from each site. This project will bring new functionalities across the whole supply chain planning. Since MRP has just recently been deployed into use in the case company site well behind the other company sites, there will again be another large transformation project ahead in a short time frame which requires significant new input from the case company site. Possible future studies could be related to this new ERP Supply Chain Cloud system transformation by conducting research on how current processes have further improved based on the same or additional KPIs after the latest transformation project.

6.5 Conclusions

MRP deployment in the case company site was conducted due to previous material management processes for not being efficient and scalable. Project planning for deployment began in early 2023, and MRP finetuning continues after 2 years from the system go-live in March 2024. Results of the deployed project showed that automated planning processes significantly improve operational efficiency over time. However, it is crucial to acknowledge that the system deployment alone does not guarantee success. Effectiveness of automated MRP tools depends on accurate master data and its management, strictly followed guidelines and routines, tracking of continuous improvement parameters, and regular measurement of key performance indicators. Automated MRP tools were deployed progressively into the existing material management processes, and human judgment is currently still maintained to support automated functions.

When analysing the achieved benefits post MRP deployment (see Table 11, p. 87), the most increase was seen in automated planning and purchasing activities that were processed via MRP and min-max planning. The findings indicate that operational efficiency has progressed based on the increased automation/usage rates, improved visibility and transparency, reduced manual execution of several routine process steps, and standardized processes. Success of the MRP deployment was largely based on good coordination and communication within the organization.

Table 11. Summary of the Benefits of MRP Post Deployment.

Benefit	Evidence
Higher automation rate	Increased MRP usage metrics
Transparency	Regular MRP usage reporting
Reduced routine work	Shift to exception-based reviews
Process standardization	Monthly structured review cycles
Better planning quality	Continuous planning-% refinement
Issue visibility	Recurrent data quality corrections
Broader improvements	Reporting tool and process enhancements

There were several challenges faced during the MRP deployment (see Table 12, p. 88). The most improvement was needed in data quality, since it was seen to have weaknesses, especially for buy items. Data cleanup was required to enable accurate and reliable planning. Planning parameters had to be corrected and streamlined for both product lines. Accuracy of the parameters was evident to enable automated forecasting and procurement processes.

In early stage of the MRP deployment, manual processes remained significant. MRP deployment progressively reduced manual routine work, but increased workload due to different corrective actions for faced exceptions. Ownership of the roles was seen unclear during implementation and stabilization phases, which were afterwards clarified for the end users. Based on the results regarding MRP usage rates in the case company site, level of automation can be continued to be maintained and even increased to meet and pass the set goal targets. MRP usage can be enhanced also for Product Line B by finetuning the current planning processes to align with the processes what Product Line A currently successfully follows.

MRP deployment required training for end users even after the go live date. Users were especially unfamiliar with the new Oracle ASCP instance which required several hands-on sessions. Training involved make and buy part planning, demand planning, and reporting. Hands-on user experiences in the stabilization phase brought valuable feedback for finetuning and streamlining MRP processes.

Gaps were identified regarding integrations and visibility. There were e.g. data mismatches between systems, forecasts were not uploaded into Oracle ASCP as accurately as expected, and there were some reporting inconsistencies seen across platforms. This required manual execution which limited smooth automation.

Forecasting and demand planning had also challenges regarding continued manual efforts in creating forecasts, and difficulty forecasting option-heavy and NPI products. Even though manual spreadsheets were still used in forecasting, the number of needed reports decreased which speeded up the current end-to-end process. New shortage simulation tool in reporting instance helped with getting visibility into big deals, so material requirements and shortage could be checked before the actual customer sales order was received. This enabled planning the purchases for the lower-level components if immediate procurement actions were required due to e.g. long lead times and low on-hand inventory.

Table 12. Summary of the Challenges in MRP Post Deployment.

Challenge Area	Evidence
Master data quality	Test cycles, stabilization updates
Planning parameter accuracy	Test cycle procurement & planning reviews
Manual workload	Forecast & status updates
Role clarity	Stabilization phase meetings
Training needs	March–April 2024 sessions
Tool integration gaps	Process mapping & tool reviews
Forecast uncertainty	MRP study & forecasting decks

MRP deployment is seen successful from both operational and deployment perspective. MRP has been taken into use in daily planning and purchasing activities, it has reduced manual process steps and streamlined default planning processes to be in alignment with rest of the global organization. End users were eager to take MRP into use and find time to finetune MRP alongside with other daily activities whenever there were issues found during the new process. Successful MRP deployment was not immediate and was hugely dependent on the level of master data quality, training, and active post-deployment improvement.

End users within planning, purchasing, and factory order management teams used MRP for weekly demand and supply reviews, purchase requisition and purchase order creation, safety stock, min-max and lead-time settings, and monthly planning cycle reviews. Planning behaviour changed drastically which demonstrates the success of MRP deployment. Corrective actions were immediately performed once issues were identified during and after the deployment. End users are progressively trusting MRP as a great planning tool and are confident to utilize it without being hesitant to contribute to the new processes.

References

Adesola, S. & Baines, T. (2005). Developing and evaluating a methodology for business process improvement. *Business Process Management Journal*, *11*(1), 37–46. https://doi-org.proxy.uwasa.fi/10.1108/14637150510578719

Al-Ababneh, H., Alrhaimi, S., Siam, I., Alsalim, F., & Khader, J. (2025). Digital transformation of supply chain management: Trends and prospects. *Acta logistica, 12*(4), 769–780. https://doi.org/10.22306/al.v12i4.713

Allianz Trade. (2026). Allianz Trade US. Insights. Days Inventory Outstanding (DIO): Definition, Formula, Strategies. https://www.allianz-trade.com/en_US/insights/days-inventory-outstanding.html

Bozarth, C. C., & Handfield, R. B. (2013). *Introduction to Operations and Supply chain management* (3rd ed.). Pearson.

Dey, P. K. (2001). Re-engineering materials management. *Business Process Management Journal*, *7*(5), 394–408. https://doi.org/10.1108/eum0000000006002

Gray, D. E. (2014). *Doing Research in the Real World*. SAGE Publications.

Jenkins, A. (2022). Days in Inventory (DII) Defined: How to Calculate. Oracle.com. https://www.netsuite.com/portal/resource/articles/inventory-management/days-in-inventory.shtml

JuzSolutions. (2026). 11 Key Metrics to Measure Operational Efficiency. https://www.juzsolutions.com/measure-operational-efficiency/

Kohli, A., & Malik, O. P. (2025). Digital transformation in SMEs: A literature review on optimizing supply chain management. *Journal of data, information and management (Online), 7*(3), 245–264. https://doi.org/10.1007/s42488-025-00151-6

Kumar, S., & Harms, R. (2004). Improving business processes for increased operational efficiency: A case study. *Journal of manufacturing technology management, 15*(7), 662–674. https://doi.org/10.1108/17410380410555907

Lansdowne, J. (2010). *Oracle Demantra Demand Management User Guide*. Oracle.com. https://docs.oracle.com/cd/E18727_01/doc.121/e05179/T493571T503146.htm

Mabert, V. A. (2007). The early road to material requirements planning. *Journal of operations management, 25*(2), 346–356. https://doi.org/10.1016/j.jom.2006.04.002

Malsam, W. (2022, August 31). *Operational Efficiency: A Quick Guide.* ProjectManager. https://www.projectmanager.com/blog/operational-efficiency

Mashaba, V. S., & Emwanu, B. (2026). Optimizing integrated supply planning in logistics: Bridging gaps for enhanced operational efficiency and strategic decision-making. *EPJ Web of conferences, 347*, 1–11. https://doi.org/10.1051/epjconf/202634703001

Matonya, M. M., & Budai, I. (2025). Cloud-Based Data-Driven Framework for Optimizing Operational Efficiency and Sustainability in Tube Manufacturing. *Applied system innovation, 8*(4), 1–25. https://doi.org/10.3390/asi8040100

Mills, A.J., Durepos, G., & Wiebe, E. (2010). *Encyclopedia of case study research*. Vol. 0, 371. SAGE Publications, Inc. https://doi.org/10.4135/9781412957397.n138

Milne, R. J., Wang, C., Yen, C. A., & Fordyce, K. (2012). Optimized material requirements planning for semiconductor manufacturing. *The Journal of the Operational Research Society, 63*(11), 1566–1577. https://doi.org/10.1057/jors.2012.1

Murray & Myers. (2016). *Oracle MRP User's Guide*. Oracle.com. https://docs.oracle.com/cd/E18727_01/doc.121/e15188/T478564T479164.htm

Myers, MacLean & Westgate. (2011). *Oracle Advanced Supply Chain Planning Implementation and User's Guide*. Oracle.com. https://docs.oracle.com/cd/E18727_01/doc.121/e13358/toc.htm

Oakland, J. S., Oakland, R. J., & Turner, M. A. (2020). *Total Quality Management and Operational Excellence*. Routledge. https://doi.org/10.4324/9781315561974

Plenert, G. (1999). Focusing material requirements planning (MRP) towards performance. *European journal of operational research, 119*(1), 91–99. https://doi.org/10.1016/S0377-2217(98)00339-7

Samaranayake, P. (2009). Business process integration, automation, and optimization in ERP. *Business process management journal, 15*(4), 504–526. https://doi.org/10.1108/14637150910975516

Shamsuzzoha, A., & Jaakkola, T. (2024). The scope of demand-driven material requirements planning in operative purchasing of a multi-national company: A case study. *International journal of engineering business management, 16*, 1–21. https://doi.org/10.1177/18479790241293890

Shaik, T. (2023, June 6). *Operational Efficiency: What Works and What Doesn't Work*. Time Champ - Time and Productivity Tracker; Time Champ. https://www.timechamp.io/blogs/operational-efficiency-what-works-and-what-doesnt/

Trebilcock, B. (2009). Supply chain software basics. *Modern materials handling, 64*(4), 26.

Tripathi S. & Gupta M. (2021). A framework for procurement process re-engineering in Industry 4.0. *Business Process Management Journal*, *27*(2), 439–458. https://doi.org/10.1108/BPMJ-07-2020-0321

Yin, R. K. (2018). *Case Study Research and Applications: Design and Methods* (6th ed.). SAGE Publications.

Appendices

Appendix A. Question set for benchmarking interviews

28.3.2023 (Local project lead, managers, planners)

1. How long have you been using MRP/ASCP module in Oracle?

2. Have you participated in MRP implementation projects earlier?

3. Brief introduction of the module
    a. What functions are provided?
    b. What functions are used?
    c. How are forecasts and orders showing in MRP?
        i. Offer -> Order -> Purchasing -> Production -> Supply Chain
        ii. Is there still some manual work needed or is everything in the process automated?

4. In what roles and tasks are employees using the module? Who were involved in the implementation process? Did certain people have certain tasks before and during the implementation?

5. What steps did the pre-implementation process require and how were those steps executed (what tools/methods used)?
    a. Current process analysis
    b. Testing the module environment
    c. Integrations between systems
    d. Data collection
    e. Data input to Oracle
    f. Training the employees

6. How long did the implementation process last? What was the timeline?

7. Were there any obstacles / challenges that you faced during the implementation process what need to be considered?

8. What kind of operational benefits have you discovered while using the MRP/ASCP?

9. Is there still something that could be improved / done differently?

Appendix B. Question sets for collecting end-user feedback

12.2.2025 (FOM team, purchasing team, NPI team, and operations manager)

1. What are the benefits seen post MRP deployment?
2. What are the challenges seen post MRP deployment?

23.3.2026 (FOM team)

1. How much time it has taken to handle material requirements planning process steps comparing the pre- and post-deployment processes?
2. Is generating discrete jobs currently any faster compared to pre-deployment process?

17.4.2026 (Operations manager and purchasing team)

1. How have forecasting and demand planning processes improved comparing post-deployment process against pre-deployment process?
2. Was there any training sessions arranged during deployment project regarding the new forecasting and demand planning tools that were taken into use?