# Prescriptive Data Analytics in Digital Supply Chain Management

## SAP Optimizer Feasibility Study

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**Abstract**

In recent years, supply chains have been increasingly disrupted by a variety of factors, including global pandemics, political conflicts, and even regional challenges like labor strikes. These disruptions have had a significant impact on pricing, product availability, and lead times. Given this ever-changing landscape, organizational resilience is becoming increasingly important for maintaining a competitive edge. In response to these challenges, this research investigates the potential of prescriptive data analytics to improve decision-making capabilities within a supply chain context.

This study examines the impact of digitalization, knowledge management, and data analytics on supply chain performance. It investigates the factors driving digital transformation in supply chains, the potential of knowledge management to enhance organizational effectiveness, and the opportunities and challenges presented by data analytics for supply chain organizations. Specifically, the research aims to understand the benefits of advanced data analytics such as prescriptive analytics for modern supply chains, assess the current level of data analytics adoption within the target organization, and evaluate the organization's readiness to implement more sophisticated prescriptive analytics tools.

A case study approach was employed to gain a deeper understanding of how a specific organization utilizes data analytics in its supply chain planning. Semi-structured interviews were conducted with members of the organization's supply chain planning team and a partner from an SAP consultant firm. The interview format allowed for flexibility and exploration of the research questions, while a predetermined thematic framework ensured data collection remained focused. The framework addressed current data analytics use, challenges and opportunities, and the organization's future vision.

The findings indicated that prescriptive data analytics has the potential to significantly enhance supply chain optimization. However, the current utilization of data analytics within the target organization is limited, primarily employed for broader tactical planning horizons. The identified challenges include the perception of limited added value for operational tasks, data quality issues, and the user-friendliness of the existing data analytics system. These findings suggest that the successful implementation of prescriptive data analytics necessitates addressing the current limitations.

**Keywords/tags (subjects)**

Digitalization, Digital, Supply Chain Management, Supply Chain Performance, Data Analytics, Data, SAP IBP

**Miscellaneous (Confidential information)**

No

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# 1 Introduction

The global supply chain landscape is a complex network of interconnected processes, from raw materials to finished goods delivered to customers. Optimizing this network for efficiency, agility, and profitability has always been a key challenge for companies. But in today's dynamic marketplace, traditional methods are reaching their limits, and the global supply chain management landscape is undergoing dramatic change. Driven by advances in digital technologies, organizations are increasingly embracing digitalization to optimize their operations, gain a competitive edge, and become more resilient in the face of disruption. At the heart of this transformation is data analytics, the science of extracting meaningful insights from vast amounts of data to enable better decision-making.

Traditionally, supply chains have relied on manual processes, siloed data, and reactive decision-making. This often results in limited visibility, inefficient planning, higher costs, and comparatively poor customer satisfaction. These challenges manifest themselves in the difficulty of tracking the supply chain network, the inability to forecast demand and respond to disruptions, and the inability to meet evolving customer demands. Data analytics provides a solution to these challenges. By analyzing massive amounts of data, companies can gain a deeper understanding of their supply chain and make data-driven decisions that are more informed, proactive, accurate, and efficient.

Digitalization and data analytics are fundamentally changing the way companies manage the flow of goods, from raw materials to finished products delivered to customers. At the heart of this digitization is the promise of increased efficiency, agility, and resilience in the face of ever-changing market demands.

This study looks at digitalization, knowledge management, and data analytics in the context of supply chain management. It examines the key drivers of digitalization in supply chains, how knowledge management can improve organizational performance, and the challenges and opportunities that data analytics presents to supply chain organizations.

## 1.1 Business Context

The case company, UPM-Kymmene Oyj, is a global forest industry company with its origins in the forest industry dating back to the 1870s. It is a multinational company with more than 15,000 employees worldwide and annual sales of over 10 billion euros. The company provides renewable solutions for various end uses, including packaging, construction, energy, and transportation.

This thesis examines data analytics and the application of SAP Integrated Business Planning within the supply chain planning organization in the UPM Fibres business. UPM Fibres, a leading global producer of pulp and paper products, serves as a relevant case study for this research. Their extensive product portfolio and geographically dispersed operations exemplify the complexities managed by many supply chain organizations. By examining how the target supply chain organization utilizes SAP IBP for data analytics, this thesis aims to uncover valuable insights applicable to similar organizations.

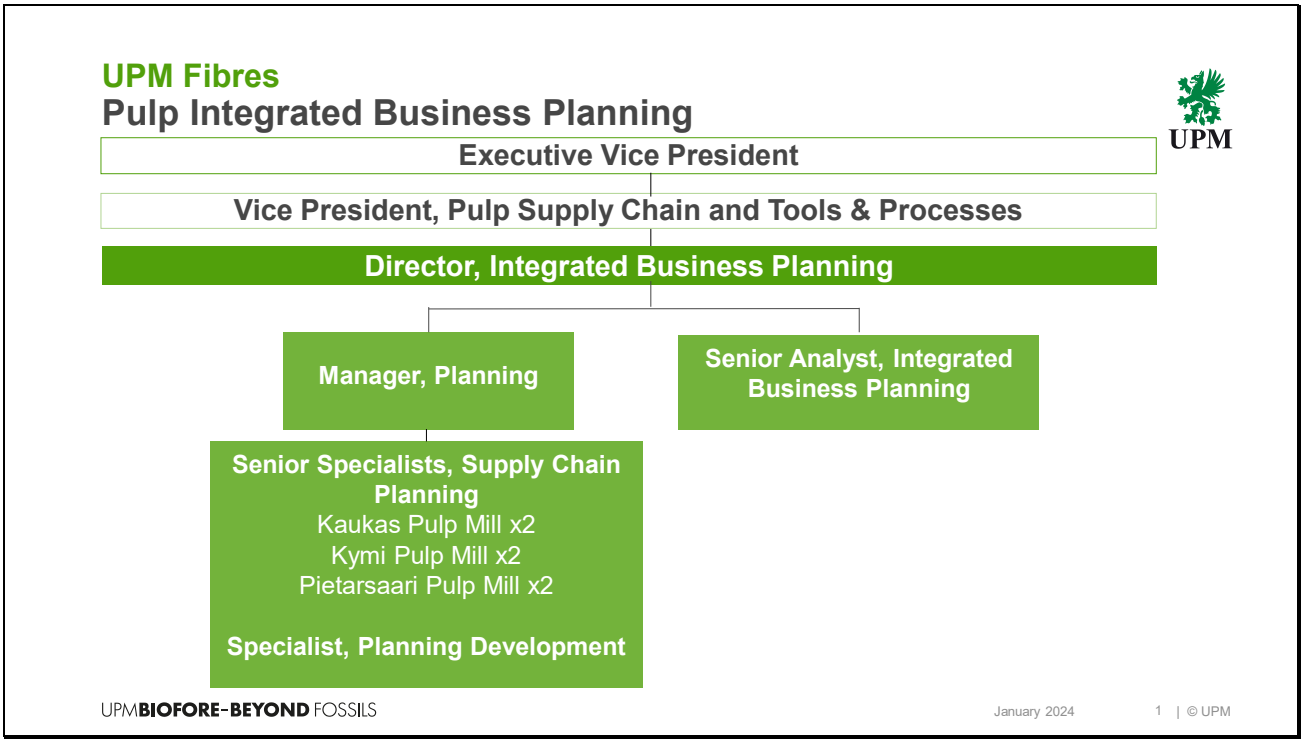


**Figure 1.** *UPM Fibres Pulp Supply Chain Organization Structure*

## 1.2 Delimitations

This chapter serves to define the boundaries of this thesis, particularly emphasizing the scope of the research in relation to the Supply Chain Planning Organization and its use of SAP Integrated Business Planning (IBP). This thesis focuses primarily on the comprehension of data analytics, with a particular focus on how the supply chain planning organization employs SAP IBP for the purpose of its core planning activities.

This thesis examines the role and activities of the supply chain planning organization within the company. While other departments may interact with the planning process or utilize SAP IBP data, the primary focus is on how the supply chain planning team leverages the system for its core functions. These include activities such as demand planning and forecasting, inventory management, and production planning. The thesis does not delve into the specific operations of other departments or how they might utilize SAP IBP data for their own purposes.

Additionally, this thesis specifically examines the use of SAP Integrated Business Planning within the supply chain planning organization. While the organization may use other planning tools or systems, the primary focus will be on how SAP IBP is used for various planning activities, as well as whether or not the implementation of SAP IBP Optimizer would be beneficial at this point. The thesis will not explore alternative planning systems or delve into the technical details of SAP IBP beyond its functionality relevant to supply chain planning.

# 2 Research Methodology

According to Ojasalo et al. (2015) the approach for the research should be determined by reflecting on the research objective. The research approach is not a method, but rather a means to achieve the objective that has been set for the research. It is important to select the appropriate approach for the research before selecting the methods that will be used to conduct the research. There are multiple different research approaches, which do overlap and mix with each other, sharing some of the research methods. The main approaches include, but are not limited to, case studies, action research, constructivist research, service design, and innovation exploration and generation among others.

A case study approach is well suited for research when the purpose of the research is to produce development proposals for the research objective. A case study is an excellent approach to research when a deeper understanding of the case under research or development is desired. They provide us with information on current scenarios and often answer the questions of how and why, and typically, research targets can be refined as the research progresses. Case studies can also focus on more than one case, as long as the cases are understood as a whole. The subject of the research can be a company or a specific part of it, a product, a service, or a process. (Ojasalo et al. 2015.)

The purpose of this study is to gain a deeper understanding of how data and analytics can benefit modern supply chain organizations to succeed, gain an understanding of the current level of data analytics usage in supply chain planning organizations, and determine the organization's readiness to implement more advanced prescriptive data analytics. The objective of the research is to be able to offer proposals for what it would take to implement the SAP IBP Optimizer data analytics tool and what the current issues are with data analytics. A case study is the most appropriate approach for this research, given the objective. The case study will examine data analytics in the target organization and try to identify development items in the organization.

This thesis has the following research questions:

1. How can prescriptive data-analytics support decision-making in supply chain organizations?

2. How is data-analytics currently utilized in the organization, and what are the biggest challenges with it?

3. Would implementing SAP IBP Optimizer be beneficial and boost the organization's performance?

Ojasalo et al. (2015) divide research methods into two main categories: quantitative and qualitative methods, but there are also community-based methods available. Typical research methods include surveys, interviews, group interviews, observation, document analysis, benchmarking, collaborative ideation methods, and forecasting methods. The diversity of the methods is essential in

research, as different methods provide different kinds of information and perspectives to support the research. Therefore, different methods complement each other, and usually it is beneficial to use multiple methods simultaneously to gain a good overall view. The methods used should be chosen so that they fit the research purpose. What kind of information and for what purpose dictates which method is best to employ.

Qualitative methods aim to gather a comprehensive understanding of the research subject and to gain a better understanding of phenomena. Interviews are a frequently used data collection method and a typical qualitative research method used in case studies. Interview methods, as shown in Figure 2, can be further categorized into three groups, with the main difference between them being how the interview questions are fixed and structured. In a structured interview, the questions are fixed, as the name suggests. In semi-structured interviews, the interview follows a predetermined format and questions are prepared beforehand, but there is more freedom to ask follow-up questions and to explore the responses further. The direction of the interview can be changed based on the results during the interview. Lastly, an open or unstructured interview is more conversational and employs open-ended questions. (Ojasalo et al., 2015.)

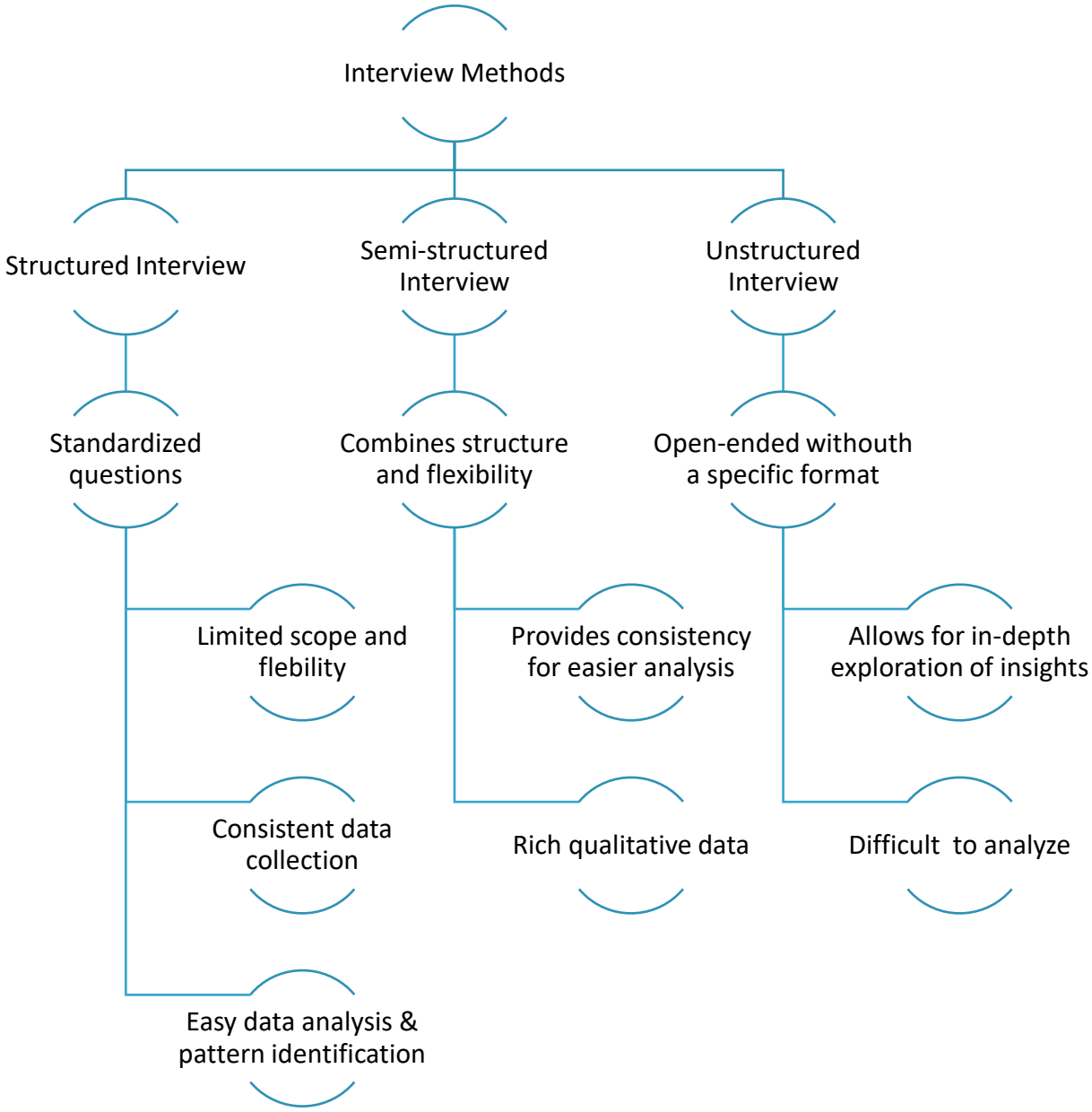


**Figure 2.** *Interview Methods*

The qualitative research method, and more specifically interviews as a data collection method, can be seen as well suited to the purpose of this study, as it allows for the gathering of in-depth information by understanding people's beliefs and experiences. This directly supports the goal of gaining a deeper understanding of the current level of data analytics usage in the supply chain planning organization and the organization’s readiness to implement more advanced prescriptive data analytics.

This research will employ a semi-structured interview format to collect data within and outside the organization. The semi-structured interview format supports this research particularly well, as it allows for more flexibility during the interviews and hopefully also helps with respondent comfort by employing a more open, two-way open dialogue compared to structured interviews. This hopefully leads to rich data from the interviews and allows us to understand how data analytics is seen in the organization currently and what the expectations are going forward. In addition, the semi-structured interview format still provides enough standardization between the interviews, allowing for meaningful conclusions to be drawn from the interview data through analysis.

Ojasalo et al. (2015) explain that for the analysis, the interview material is to be transcribed. The transcription's depth is determined by the research goal and scope. A word-for-word transcription is not required if the context and themes of the material are of primary interest. During the analysis, the data is reviewed several times and classified into themes. It is important to note that the quality of the analysis heavily outweighs the quantity. It is also recommended that the analysis is carried out soon after the interviews have concluded.

# 3 Theoretical Background

In this chapter, theoretical knowledge from past research will be reviewed to support the research. The theoretical background of this thesis will be divided into three main themes: digitalization in supply chain management, knowledge management, and data analytics. These themes will hopefully help us gain a more in-depth understanding of how modern-day supply chain organizations are managed and how data analytics can support decision-making in supply chain organizations.

The first theme of digitalization in supply chain management lays the groundwork for the latter two, gives us a glimpse of how the megatrend is shaping organization management, and supports modern solutions like prescriptive data-analytics. The second theme covers knowledge management and tries to offer insight for us to understand how knowledge and data can be used to support decision-making in high-performing organizations. The third team focuses on data-analytics itself, which will hopefully support the research directly and give us answers on how data-analytics and prescriptive data-analytics in specific can help support decision-making in organizations.

The theoretical background employed a keyword search strategy to identify relevant literature for the study. The main keywords used depended on the topic. The keywords used were, for example, “data analytics”, “supply chain management”, “digitalization”, “knowledge management”, “organizational performance”, and “decision-making”. Synonyms like “supply chain planning” and “prescriptive analytics” were also included to capture a wider range of studies. Boolean operators were used to combine these terms. For instance, “data analytics” AND “supply chain management” or “supply chain management” AND “digitalization” was used to find studies that addressed both concepts. Additionally, filters were applied to limit the search to articles published within the last five to ten years and, if possible, to those published in peer-reviewed journals. The search was conducted in relevant databases, which were the JAMK Online library, Google Scholar, and scite.

The literature selected was evaluated on three main criteria: relevance, credibility, and filling a gap. Firstly, the relevance of a chosen paper to the research and topic was evaluated. Papers were chosen on the basis of allowing for a comprehensive understanding of the topic. Secondly, the credibility of the paper was evaluated. This included consideration of whether the article or paper was from a highly regarded source, whether it had been peer reviewed, and whether it had been cited frequently. Thirdly, some of the literature was selected to address gaps in the existing theoretical framework for the study.

## 3.1 Digitalization and Supply Chain Management

Digitalization is a megatrend that has affected all of us by shaping the world around us by, for example, changing how we communicate with each other and how we consume products and services. Therefore, it is also affecting businesses and organizations around the globe. This has influenced companies to transform their organizations, business models, and tools to meet the needs of this rapid change. Digitizing supply chains is one way for organizations to stay in touch with markets and deliver more value to their customers. Also, by embracing digitalization, companies can be better prepared to avoid disruptions, forecast and plan activities, and serve their customers. This chapter explores the key drivers towards digitalization, some key technologies in the digital transformation, how digitalization is impacting supply chain performance, and finally some of the emerging trends and future directions to look out for.

Firms have adopted digitalization to varying degrees, depending on their industry, readiness to adopt new technologies and processes, resources, and business needs. Amazon, a large global corporation, has pioneered effective digital business models such as Amazon Prime, which relies on digitalization to create value for customers and stakeholders. They have, for example, developed predictive shipping models that utilize big data analytics to assess market conditions and determine demand. Other organizations can adopt similar best practices to improve supply chain flexibility, agility, visibility, performance, and resistance (Marmolejo et al., 2020). Nowadays, there are a wide range of practices for organizations to choose from based on their individual business needs, customer expectations and financial capabilities to digitize their tools and processes.

Supply chain management processes may appear to have distinct functions, but the digitalization and optimization of these processes and the value chain are key to achieving high supply chain efficiency. The digitization process involves automating and streamlining tasks, procedures, and methods by integrating digital tools and processes to be part of the organization's operations. Empirical evidence has shown that embracing digitalization in supply chain management can have a major impact on reducing operational costs while also increasing revenue. These findings highlight the value of embracing digitalization to achieve better effectiveness and increase the chances for organizational success (Brun et al., 2019; Ali 2022).

### 3.1.1 Key Drivers Towards Digitalization

Supply chains are inherently complex, long, and global networks of operations, systems, and processes, and as such, they are exposed and vulnerable to change. The digitalization of supply chains is driven by multiple different factors, Figure 3. Brun et al. (2019) note that the development of global economics has a tendency to follow a pattern after major technological innovations, where the new innovations disrupt and transform operations at different levels of organizations. Gupta et al. (2021) state that often larger and more capable companies are forerunners in adopting new business models and innovations that accommodate the use of new technologies. In recent years and decades, also known as the fourth industrial revolution, which is marked by the widespread adoption of digital systems throughout, organizations and companies have increasingly digitized their supply chains to improve operation efficiency and competitiveness.

The impacts of the new digital era and global competition have highlighted the need for companies to integrate effective techniques to improve their internal tools and processes to develop a competitive advantage in the business landscape. This has led to a shift from traditional linear and analog supply chain processes to digital, technology-based, and data-driven processes. According to Villar et al. (2023) companies that are not adapting and making use of the new digital technologies are in a disadvantageous market position and are risking eroding their market share by lacking a competitive edge. On the other hand, innovative companies are proactively integrating new data-driven technologies such as cloud computing and the Internet of Things (IoT) into their supply chain operations. As digital technologies keep advancing, customer expectations will also continue to increase. Therefore, it is highly important for organizations to recognize, adapt, and implement new digital tools as part of their processes.

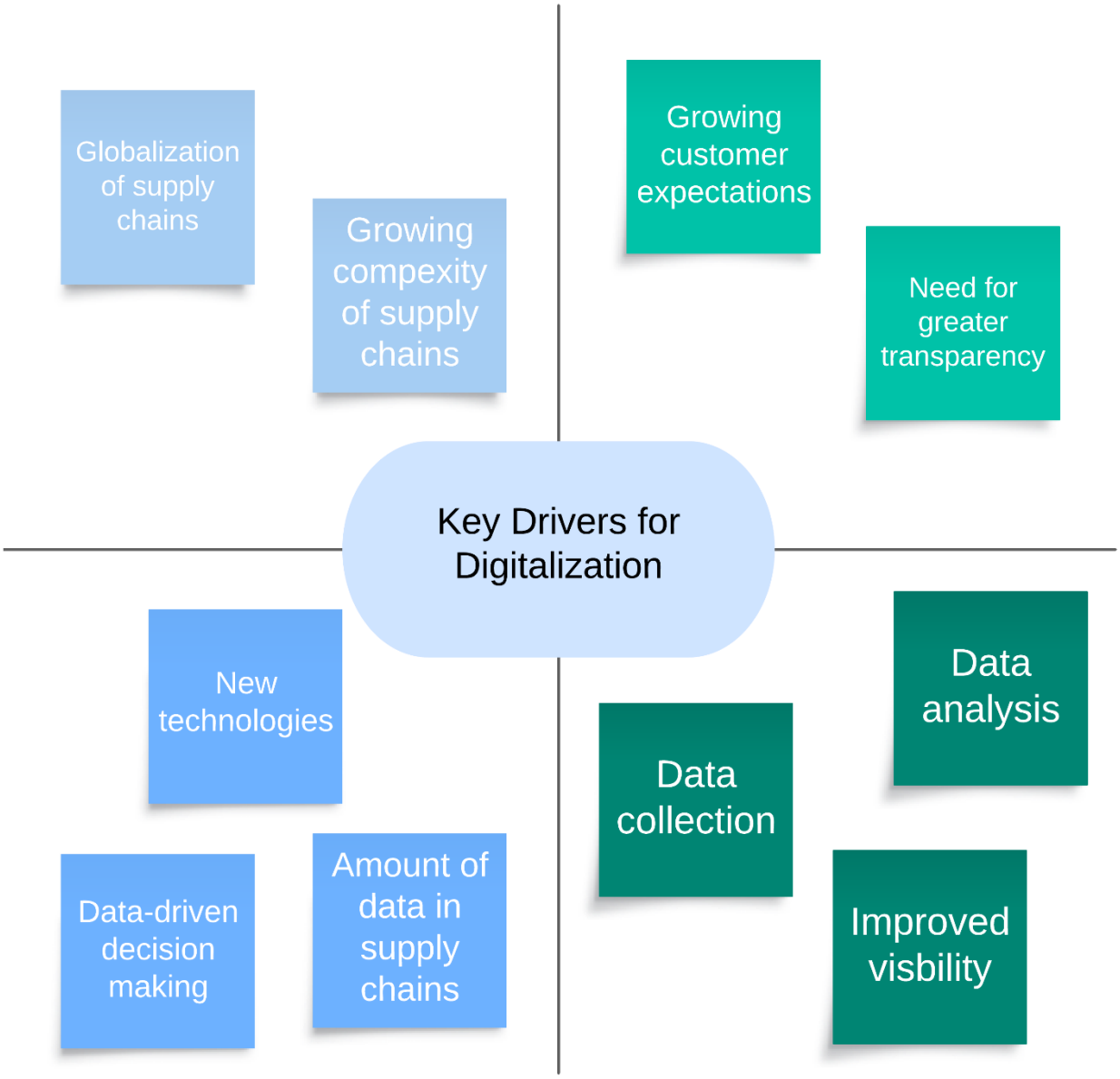


**Figure 3.** *Key drivers for digitalization*

Digitizing helps organizations navigate the modern global economy, where long supply chains and large number of market participants have become the norm. A modern supply chain often involves a wide variety of participants, including suppliers, logistics providers, consultants, government entities, financial institutions, software vendors, and end users. To coordinate and manage these value chains, companies should integrate sophisticated information management as part of the organization's operations (Holmström et al., 2019). The complexity of the value chain shows the importance of digitizing supply chain functions and adopting new technologies such as automation and advanced modern data-analytics. By doing so, organizations can better make sense of all the

data that is being generated throughout the value chain in their daily operations and make sure that a proper flow of information across internal and external stakeholders is achieved (Ali, 2022).

### 3.1.2 Key Technologies in Digital Transformation

Digital transformation, as previously highlighted, has become a highly important part of supply chain management, allowing organizations to integrate data-driven approaches into their processes. In examining the digitization of supply chains, it is essential to consider all of the operations involved, including production, logistics planning and management, forwarding, order management, and other central processes. Technologies, Figure 4, that are enabling this transformation include big data analytics, cloud computing, automation, machine learning, and IoT, among others, which are used to replace legacy infrastructure and labor-heavy processes in traditional supply chain management (Zhou & Wang, 2021). Adopting modern digital tools and processes can help organizations shine a light on the highly complex modern supply chains so they can better leverage data to make optimizations along the supply chain (Ali, 2022).

IoT technology is particularly well-suited for collecting and processing data within supply chains and offers important insight, allowing for better flow optimization. For example, it allows organizations to track their inventories and shipments in real-time and monitor the condition of items. This ensures smoother and safer deliveries, as well as helping to identify and reduce operational bottlenecks that are common in long and complex value chains. Good examples of technologies used are radiofrequency identification (RFID), near-field communication (NFC), global positioning system (GPS), and Bluetooth, to name a few (Taj et al., 2023). These allow for up to the real-time data collection and transfer, which helps to coordinate supply chain activities. New information technologies have also transformed supply chain management by incorporating advanced data-analytics to help with the decision-making process. Modern data-analytics is highly versatile, and it allows management teams to optimize work and item flows in the supply chains.

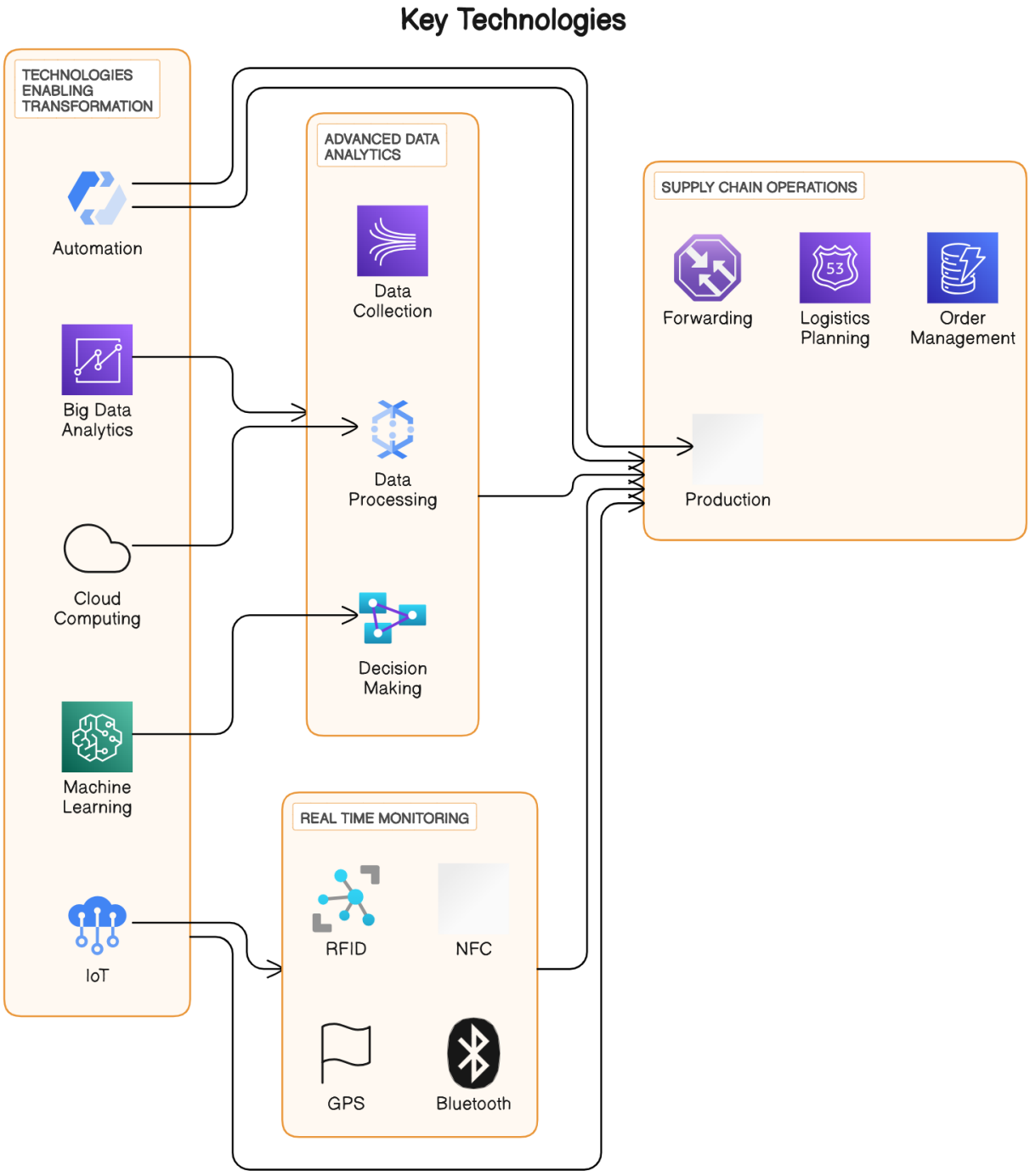


**Figure 4.** *Key Technologies in Supply Chain Digitalization*

### 3.1.3 Impact of Digitalization on Supply Chains and Performance

Effective supply chain management is shown to have a positive impact on the supply chain cost structure and improve its operational performance. These are the main goals for a lot of supply chain organizations, and digitizing and adopting data-driven processes enables the organizations

to strive towards these goals more effectively. The use of digital technologies such as IoT, cloud computing, automation, and big data analytics can provide benefits that improve an organization's strategic position and ability to compete. Adoption of cloud computing, for example, can help small, medium, and large organizations replace older legacy systems with a fairly small barrier to entry without making large capital investments into the development and maintenance of physical legacy systems that are often not able to provide the organization with the flexibility and technology required to stay relevant in today's highly competitive global business world by allowing the organization to optimize its supply chain operations more effectively (Zhou & Wang, 2021).

Organizations are able to reduce costs related to data management by converting system costs and tied capital into smaller operating expenses by adopting cloud-based subscription services that provide the level of performance and capabilities that can be tailored towards the companies' specific needs with greater agility. The rapid evolution of technology can make it expensive for companies to keep up with system upgrades to their digital infrastructure, and for small and medium-sized businesses, it can even become prohibitively expensive, whereas cloud-based solutions typically offer the latest technologies to their subscribers. A cloud-based approach can therefore allow organizations to better handle the demands of modern supply chains, improve their performance, and manage the related costs (Gupta et al., 2019; Taj et al., 2023; Brun et al., 2019).

One of the main challenges that modern supply chains face is visibility within the chain between different stakeholders. Research suggests that a lack of visibility in the supply chain negatively impacts the supply chain's performance by complicating processes, creating blind spots, and adding extra work. Digitization can help organizations improve process and data visibility, solving one major challenge that has a negative impact on supply chain performance. Digital data-analytics can utilize data collected from various points of the supply chain, helping with workflow, data quality and accuracy, and customer satisfaction (Villar et al., 2023). Digital tools and technologies can help to offer real-time visibility, enabling stakeholders in the supply chain to anticipate threats and risks and to be better prepared. Modern data-analytics can also help organizations determine optimal levels for different stages in the supply chain. It is important to find the right balance, as having too much can be as detrimental as having too little.

### 3.1.4 Future Directions and Emerging Trends

Supply chains traditionally have been, and still are to a degree, highly linear, with the processes flowing in a specific, predetermined sequence from start to finish. Along this sequence, various business activities take place as resources are transformed into end products, which are then delivered to customers. Supply chain management has traditionally focused on optimizing the processes and activities that are required to plan, maintain, and execute the product flows. Although many of these practices still exist and are widely used even in modern supply chains, the digital revolution that has been seen in the past few decades has brought significant changes with it to supply chain management and practices (Taj et al., 2023). Digitalization has introduced new layers, Figure 5, into the mix by adding automation, data availability, and enhanced visibility. The significant changes that can be observed in workflows, systems, processes, and interactions within supply chains can be attributed to digitalization across supply chains.

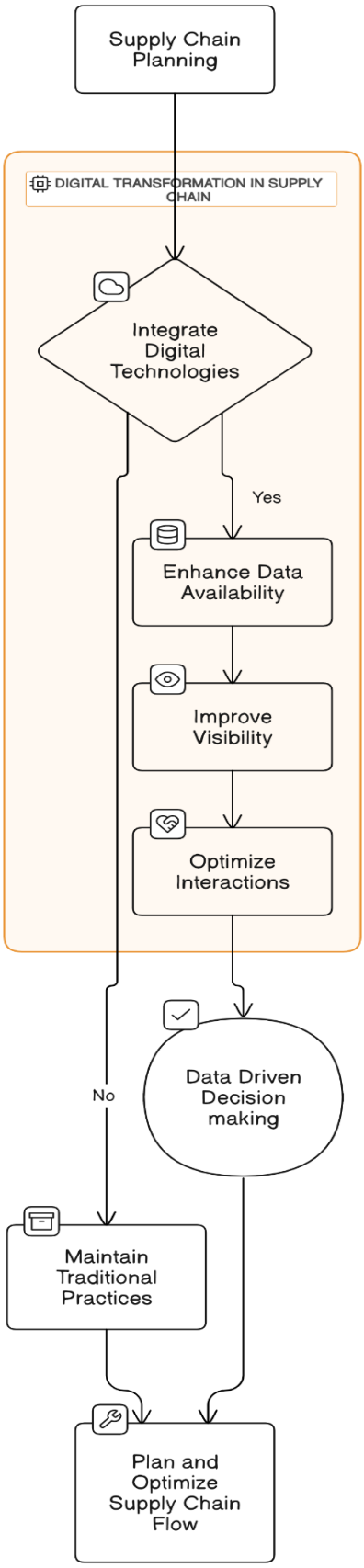


**Figure 5.** *Benefits of Digitalization*

The adoption of new digital technologies can enhance organizational agility. However, the widespread implementation of technologies such as blockchain, AI, machine learning, and new production methods also requires more from organizations. In an environment where new technologies have significantly reduced product life cycles in certain industries, from ideation to production to maturity and decline, organizations must be agile to keep up with the rapidly changing business landscape. Companies operating in industries with shorter product life cycles, such as technology, consumer electronics, and software, must continually adjust their processes and operations to remain competitive. The need for agility and the dynamic nature of modern supply chains have given rise to the concept of Supply Chain as a Service (SCaaS), in which organizations outsource services to external providers. The SCaaS concept enables organizations to focus on their core sectors. While staying up to-date with the latest supply chain trends, Supply Chain as a Service enables organizations to access industry-leading innovations and increase flexibility while reducing operational costs associated with supply chain management. This concept has gained popularity due to major disruptions that supply chain organizations have faced in recent years, such as the COVID-19 pandemic (Villar et al., 2023).

Automation will be one of the leading ways to digitalize supply chains going forward, allowing companies to increase their operational performance while also reducing costs. Research observes that organizations are integrating automation and other new digital technologies to improve flow within supply chains. Research by Brun et al. (2019) suggests that up to 75 percent of companies will use smart robots in their warehouses by 2026. They will either help, replace, or assist humans in simple and technical operations. Other modern technologies are also expected to influence supply chain management in the current decade, such as cloud computing, the IoT, and advanced data-analytics. Intelligent data collections, through RFIDs, for example, are also being researched to help supply chain organizations increase visibility throughout the value chain. Blockchain technology also still shows promise as a new technology moving forward, helping organizations to add an extra layer of value and security to their processes (Brun et al., 2019).

It can be stated that supply chain management has undergone significant transformation and will continue to do so. This is due to major technological breakthroughs that present opportunities for organizations to improve their performance. To remain competitive digitalization can be seen as an essential, even necessary, approach for organizational success. Modern, highly complex global

supply chains will continue to challenge organizations and motivate them to innovate, collaborate, and adopt new technologies going forward in search of competitive advantage.

## 3.2 Knowledge Management

Knowledge and information are vital for any organization that wants to be successful. They are the foundation and core of a knowledge-driven organization. But what exactly are they? It is beyond the scope of this thesis to try and explicitly describe their characteristics and manifestations in detail. Instead, the focus will be to understand aspects of the concepts that are essential for understanding knowledge management and its strategies.

When examining the characteristics of knowledge, some questions naturally arise. Are there different types of knowledge? Is all knowledge equally important? Can knowledge help us understand the past, the present, and the future?

### 3.2.1 Tacit and Explicit Knowledge

As Dalkir (2023) notes, there are two generally accepted and acknowledged categories of knowledge: tacit and explicit knowledge, which can be seen to complement each other. Tacit knowledge can be difficult to express in explicit forms such as books, articles, or other documents and is often referred to as “know-how” or “skill”. Explicit knowledge, on the other hand, is knowledge that has been captured and stored in a tangible form such as text, audio, or images and can be referred to as “declarative knowledge”. It is the easiest type of knowledge to describe, communicate, and understand.

Figure 6 summarizes and highlights some of the key differences between tacit and explicit knowledge:

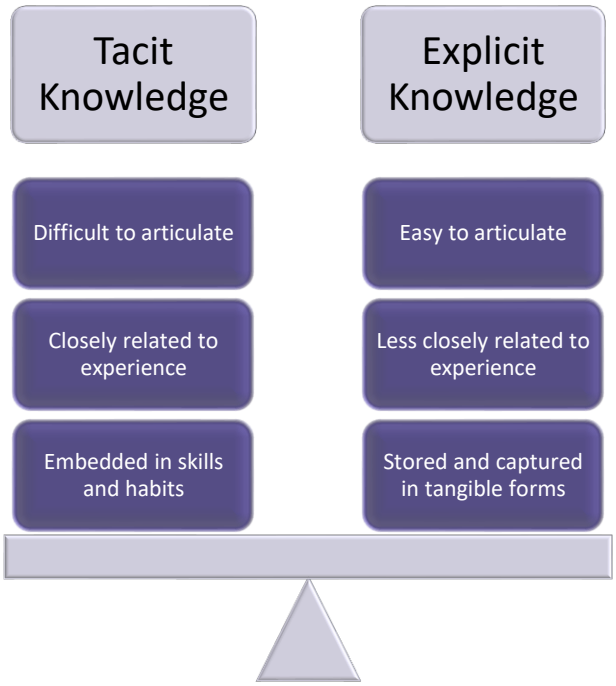


**Figure 6.** *Tacit and explicit knowledge*

Counter-intuitively, the harder the knowledge is to articulate, the more valuable it tends to become for the organization (Dalkir, 2023). Listenmaa (2023) says that this is because tacit knowledge is often embedded in skills and habits within the organization, which helps the individuals adapt and find solutions. Although for any knowledge to be considered valuable, it must serve a purpose.

The distinction between explicit and tacit knowledge from an organizational perspective is made by Millar et al. (2016). In this context, it can be said that explicit knowledge reflects what the organization has learned in the past and has then been transferred into manuals and plans. Tacit knowledge, on the other hand, represents the organization's learning curve. Transferring tacit knowledge into explicit knowledge can be challenging for organizations, but it is essential for them to learn and grow and can also offer competitive advantage and long-term success when done correctly.

### 3.2.2 Importance and Strategies of Knowledge Management

Knowledge management is a tool for trying to help with managing modern-day information-overloaded work environments. The primary function of knowledge management is to help

organizations achieve their targets. According to Listenmaa (2023) these targets can be complex and range anywhere from helping an individual employee develop and succeed to the overall success of the organization. They can also span across all functions and levels of the organization. These different targets and applications might require different approaches to how to apply knowledge management within the organization.

By effectively employing knowledge management, Figure 6, organizations can improve their performance, be more innovative, and serve their customers more effectively. Listenmaa (2023) highlights the importance of noting that knowledge is only valuable if it leads to action. The primary function of knowledge management can be defined as assisting organizations in attaining their objectives, as previously stated. Therefore, knowledge management is not just about making decisions but also about using the knowledge to drive change and innovation in the organization. The steps in the knowledge management process are illustrated in Figure 7.

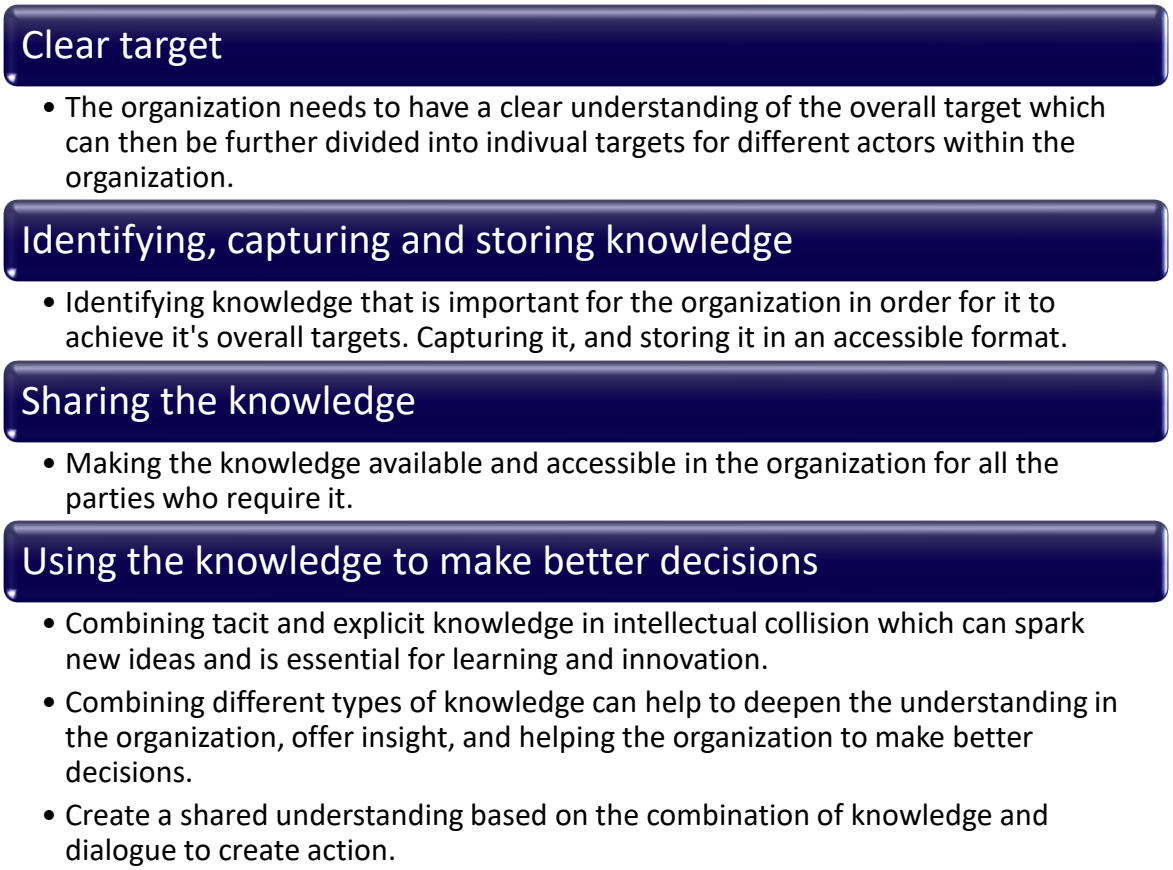


**Figure 7.** *Knowledge management process*

Strategy in the field of knowledge management is defined by Wang et al. (2016) as an overall guideline for managing the process. Knowledge management has a diverse set of strategies for handling the creation, storage, sharing, and use of knowledge within organizations. Successful adoption of an appropriate strategy can be seen as vital for organizational success. A well-chosen and defined strategy creates a foundation for the organization's knowledge resources, understanding, and implementation.

There are a lot of different ways to categorize knowledge management strategies, but one of the most commonly used and accepted classifications divides the strategies into two main categories: codification and personalization. Nguyen et al. (2020) state that this classification reflects the tacit and explicit nature of knowledge itself. Codification places emphasis on storing knowledge, whereas personification emphasizes the sharing of knowledge. The first one can be seen as a system-oriented approach, and the latter as a human-oriented approach.

Choosing the correct knowledge management strategy is crucial for the organization's success and innovation performance. According to research by Nguyen et al. (2020), both strategies, codification and personalization, have been shown to have a positive effect on organizational performance in past studies and have improved radical, process, and product innovation within organizations, but it depends on implementing the correct strategy for the organization. The selection of an appropriate knowledge management strategy, as shown in Figure 8, depends on the specific organization and its targets. When choosing a suitable strategy, the organization should pay attention to the features of the job, organization, and culture.

Organizations can also implement different types of knowledge retention strategies to combat knowledge loss, such as human resources practices, including reward systems. Reward systems like monetary incentives, awards, and peer-to-peer recognition have been shown to play a major role in incentivizing employees to share knowledge and collaborate, which in turn can help to preserve valuable organizational knowledge (Daghfous et al. 2013).

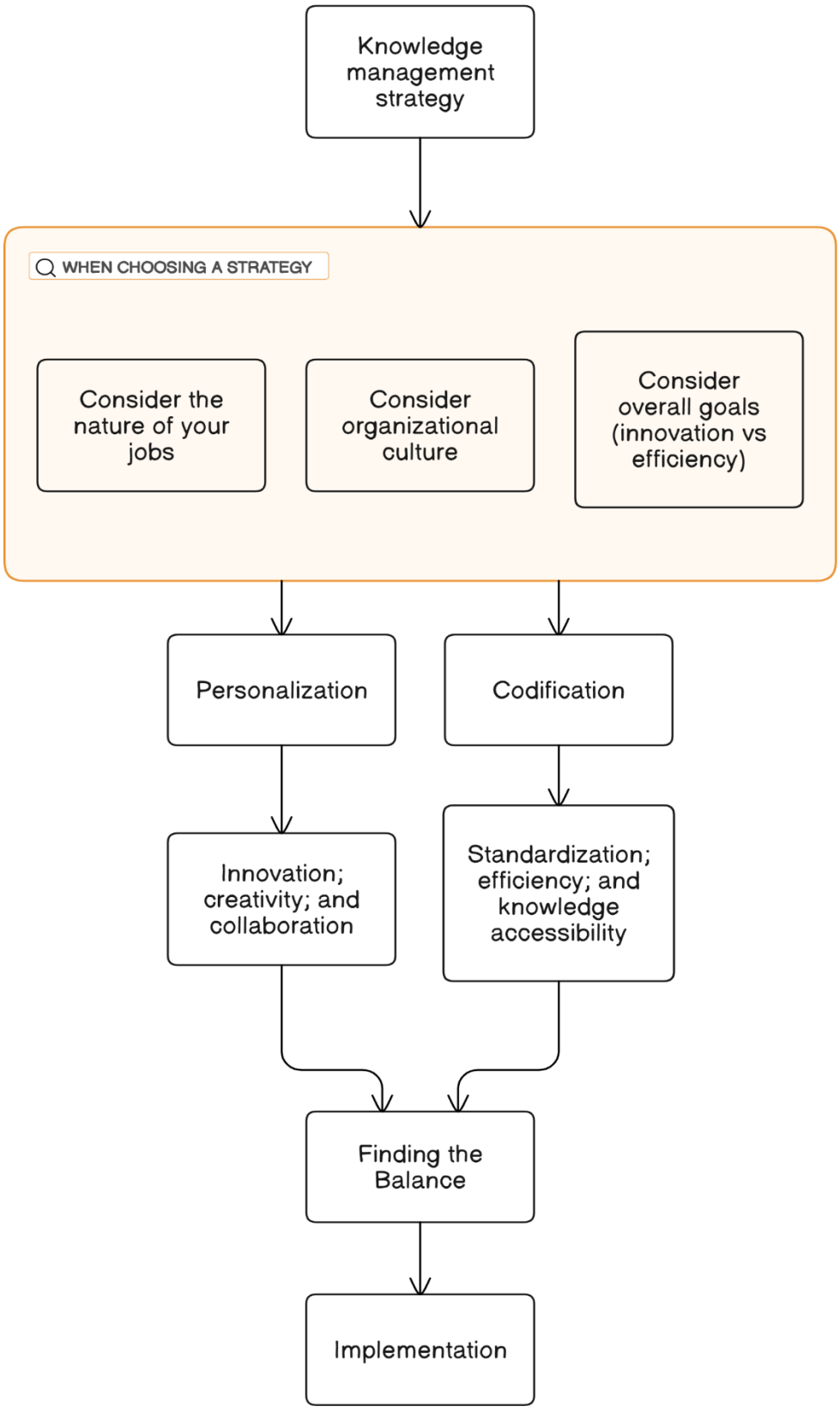


**Figure 8.** *Knowledge management strategy*

**Codification**

Codification strategy focuses on transforming tacit knowledge, which is deeply embedded in experiences and induvial skills, into explicit knowledge that can be communicated and shared amongst individuals. According to Nguyen et al. (2020), this process often leverages technology, systems, and procedures to capture, organize, and store organizational knowledge. The goal of this strategy is to create a database for knowledge, which users can then readily access for resources. Reducing the amount of tacit knowledge in an organization can help the organization share its knowledge easier, and therefore, by managing to transform tacit knowledge into explicit knowledge, organizations can enhance their performance, learning, and innovation. It is worth noting that this has been shown to lead to individuals having less incentive to explore new knowledge.

**Personalization**

Compared to codification, which places emphasis on the transformation of knowledge, the personalization strategy focuses on the direct sharing of knowledge between individuals. Nguyen et al. (2020) differentiate personalization from codification by the forums at which the information is shared. Codification relies on technology to manage knowledge. Personalization relies on informal channels and prioritizes the formation of social networks within the organization. Knowledge sharing is focused on interpersonal interactions, such as discussions and collaborations. Mentoring and apprenticeships can also be seen as a form of personalized knowledge management strategy. An effective personalization strategy can greatly enhance the exchange and recombination of knowledge within an organization.

It is fair to say that neither strategy is better than the other because they’re best suited for different applications. Organizations that value standardization and efficiency are good candidates for a codification strategy. On the other hand, organizations that place an emphasis on innovation and creativity may find more value in personalization, as it tends to encourage the exchange of knowledge and collaboration. One of the important factors is finding a good balance between innovation and the creation of knowledge compared to the utilization of knowledge.

### 3.2.3 Knowledge Management and Organizational Performance

Recent literature has identified knowledge management as a key driver of organizational performance. The dynamic nature of 21st-century business realities points to the superiority of effective organizational knowledge management strategies for today's business competency and sustainability. In recent years, scholarly work has focused on managerial knowledge management practices and the expected consequences for performance, highlighting the complex relationship between knowledge management and performance.

Knowledge management's major role in organizational success has already been briefly discussed in a previous paragraph. With digitalization and a rapidly growing knowledge-based economy, knowledge is becoming more important than ever for organizations on their path to success. Li et al. (2020) also provide a mediated model that demonstrates how knowledge management practices impact both organizational and entrepreneurial success. The authors emphasize the multifaceted nature of knowledge management and how it can impact various aspects of organizational performance and success. They also emphasize the importance of organizations implementing knowledge management strategies and urge them to manage their knowledge assets to drive performance improvements efficiently.

Shahzad et al. (2020) focus on green innovations in the context of understanding organizations' knowledge management processes to boost organizational performance. Their study demonstrates that knowledge management is designed to improve business performance while also improving sustainability. Knowledge management can be a significant factor in determining if organizations can achieve their economic and environmental goals simultaneously. They also mention that senior management support is critical to the success of knowledge management implementations in organizations. In their article, Singh et al. (2021) focused on the link between top management core values, sharing, open innovation, and organizational success. The article suggests that an information-sharing culture can be fostered within an organization with the support of top management, ultimately benefiting the organization's performance. It suggests that by parallelly positioning leadership and knowledge management priorities, organizations can help to create a culture for knowledge creation and sharing.

To draft an effective knowledge management strategy, it is essential to understand the factors that influence the relationship between knowledge management practices and organizational efficiency. Li et al. (2020) suggest that contextual factors play a significant role in mediating and moderating this relationship. This study teaches us that effective knowledge management involves analyzing complex interactions and considering both internal and external factors that impact the organization's performance.

According to the literature, knowledge management can offer a competitive advantage for organizations in the current environment of increasing competition. When it is combined with strong support from management, it can drive innovation and create a culture of information sharing, improving the organization's performance. Organizational performance can be enhanced by an understanding of the relationship between knowledge management practices and organizational goals. This understanding enables the utilization of knowledge to achieve strategic goals. Therefore, it is essential that organizations conduct knowledge management to remain competitive and enable growth in a rapidly changing knowledge-based economy.

### 3.2.4 Knowledge Management in Supply Chains

Modern supply chains are marked by their complexity, which comes from the numerous participants in each value chain. Knowledge management can help these highly complex value chains perform and can be seen as one of the key drivers for organizational performance, also in supply chains. Modern-day supply chains are more and more data-driven, with strategies like just-in-time deliveries being widely used. This means that organizations need to have good knowledge management to ensure a smooth flow of goods throughout the supply chain. This involves utilizing internal and external information to support decision-making, collaborate, and drive innovation. Knowledge management can also help supply chains achieve more agility due to efficient information retention, sharing and innovation (Alzoubi et al. 2020).

More and more businesses are integrating modern technology through digitalization as part of their tools and processes. According to Schniederjans et al. (2020), digital supply chain trends include knowledge management as a foundation. Efficiently managing digital databases is crucial for optimal supply chain performance and organizational competitiveness in the new digital era. Supply chain organizations also recognize sustainability as a high priority.

Knowledge management has many benefits for supply chain organizations and can be seen as essential for maximizing efficiency and agility in their operations. However, technical challenges such as data integration, knowledge sharing, and cultural barriers can pose challenges to supply chain organizations. Additionally, inadequate information access and sharing can be a challenge for many organizations. Supply chains that are able to resolve these challenges and employ effective knowledge management can maintain and gain competitiveness in the fast-paced global market.

### 3.2.5 Future Directions for Knowledge Management

New technology, changes in organizational structure, and fluctuations in the business climate are strengthening knowledge management, and the digitalization of knowledge management processes is essential for organizations. Dassen et al. (2023) analyzed the current level of use of digital data in SMEs and explored the future perspectives for the technology. Their study demonstrated that the internet had revolutionized knowledge creation, dissemination, and utilization. Organizations are increasingly utilizing digital knowledge management to store, transfer, and access data more efficiently. The study emphasizes the importance of digital knowledge management factors and forecasts that more knowledge management integration with other related disciplines is likely. As digitalization moves forward, organizations become more interconnected and more complex. Collaborative cross-organizational learning and recent knowledge management literature can help organizations with the ever-increasing complexity of supply chains.

Pellegrini et al. (2020) have taken knowledge management learnings a step further by creating a map of the field. This map tries to strengthen the field in the future by identifying specific leadership attributes that foster interest in knowledge management initiatives. It also highlights the need to deepen our understanding of the effects of leadership behaviors on knowledge management. The study identifies existing resources and highlights areas for expansion, providing a foundation for future research that aims to connect knowledge management with leadership.

New technologies such as artificial intelligence, machine learning and data analytics are likely to affect the knowledge management field. Knowledge management can offer multi-level integration and help with continuous innovations in the rapidly evolving global market.

## 3.3 Data Analytics

In today's data-driven environment, organizations use data analytics to gain insight and make informed decisions. Data analytics is driving progress and creativity across many sectors, and the data analytic methodology can be divided into four main categories: descriptive, diagnostic, predictive, and prescriptive. While descriptive analytics provides an overview of historical data, diagnostic analytics looks at the reasons behind specific results. Predictive analytics can help forecast future trends, and prescriptive analytics can suggest the best course of action to take. These methods, shown in Figure 9, enable organizations to overcome difficulties, streamline processes, and maintain or gain a competitive edge in a rapidly changing global economy.

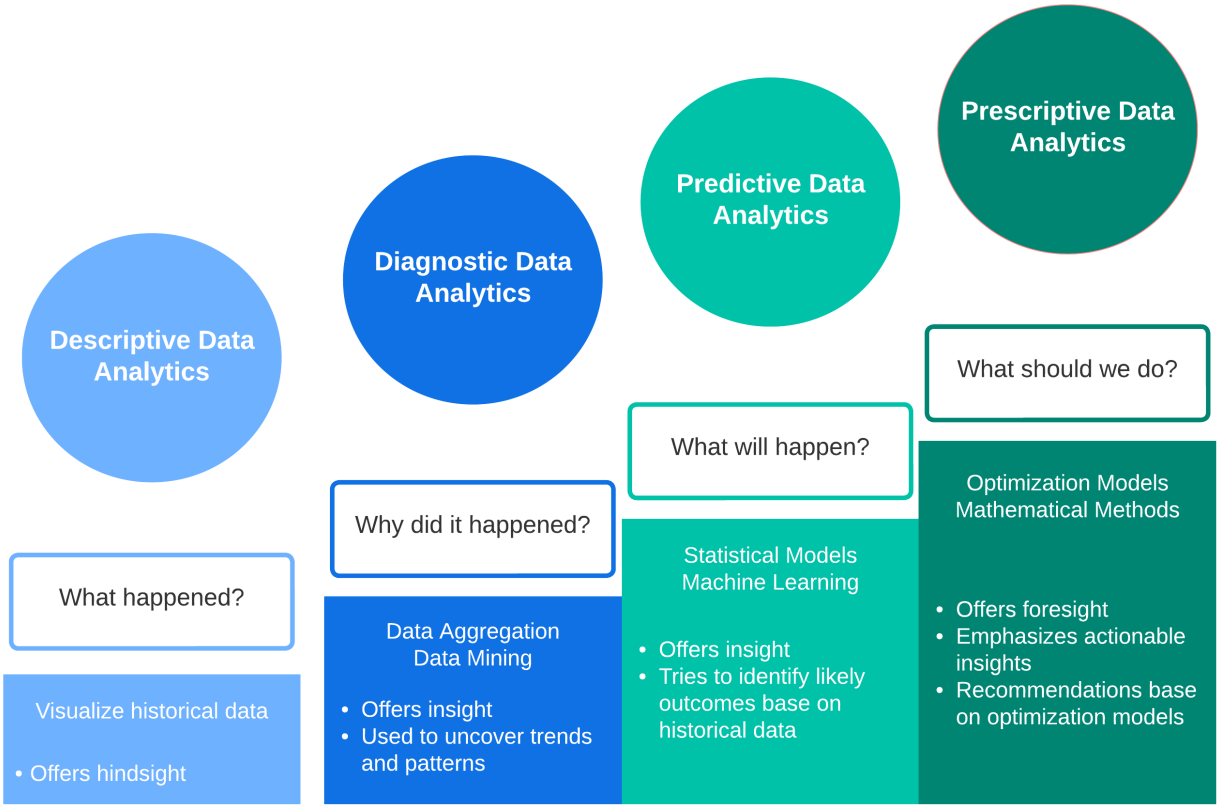


**Figure 9.** *Data Analytics*

Studying descriptive, diagnostic, predictive, and prescriptive data analytics provides an understanding of the evolution and importance of data-driven decision-making in today's context. Descriptive analytics provides a compass for further exploration by providing key insights from historical trends and patterns. By digging deeper and determining the origin of the observable events,

diagnostic analytics enables organizations to conduct root cause analysis and drive continuous improvement. Predictive analytics provides a window into the future and facilitates proactive decision-making. Lastly, prescriptive analytics is a promising tool for strategic direction in complex supply chain networks. It uses machine learning algorithms, simulation approaches, and optimization models to improve data-driven decision-making. Despite obstacles and limitations, technologies like blockchain solutions, digital twins, real-time decision support, and other technological advancements let us believe in a promising future for data analytics. It will be critical for supply chain organizations to embrace data and data driven decision-making if they are to thrive in the future.

### 3.3.1 Descriptive Analytics

At the foundation of the analytics spectrum, descriptive analytics focuses on historical data to reveal patterns and trends from the past. This method of analysis involves researching, creating, and analyzing data to gain a thorough understanding of what has happened within an organization, market, or any particular setting (Atitallah et al., 2020). Descriptive analytics can be seen as a tool that helps organizations find important insights, identify patterns, trends, and correlations, and make informed business decisions based on empirical evidence by looking at historical data.

Descriptive analytics, Figure 10, uses a range of methods and resources to provide valuable data summaries and presentations based on historical data sets. It involves analyzing historical data sets to gain an understanding of the organization's past performance, identify development opportunities, and spot trends that can help guide decision making in the future. Typically, there are three primary stages in analytics. First, the process starts with data collection and preparation, which involves gathering the relevant data from various source locations inside and outside of the organizations. This data can include unstructured information from sources like social media or sensor logs and organized information from sources like databases and spreadsheets. The collected data is then cleaned, transformed, and managed to ensure the validity of the data, preparing the data for further analysis or research (Barua et al., 2021).

Data analysis and exploration follow the data preparation. In this stage, the data that has been produced in the previous stage is subjected to analysis techniques in order to provide insight from the data sets. It is common to use data visualization, exploratory data analysis and summary statistics to identify patterns, trends, and outliers in the data set. As the last stage, the findings from the

descriptive analysis are placed within the framework of the organization's goals and objectives during interpretation and reporting. A clear and understandable presentation of the findings is enabled by visualization through charts, graphs, and dashboards (Frazzetto et al., 2019). These tools are used to communicate the findings within the organization and to stakeholders, allowing them to make data driven decisions based on the data analysis.

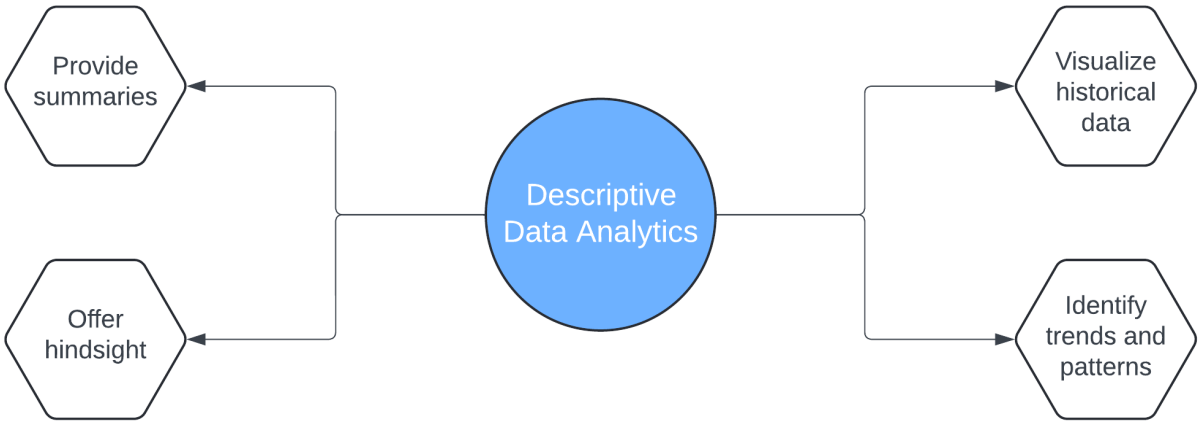


**Figure 10.** *Descriptive Data Analytics*

**Key Methods**

At the base of the data analytical spectrum, descriptive analysis uses various methods to examine historical data in depth. This includes the use of summary statistics like mean, median, mode, standard deviation, and percentile. These statistical indicators are aimed at providing a better understanding of the usual values and variability found in the data sets by summarizing their trends. Organizations can contextualize the data sets by utilizing these methods and identify patterns, trends, and outliers that shape the narrative of the dataset (Ghalehkhondabi et al., 2020). As a result, summary statistics can be seen as a critical component of the descriptive analytical process that enables analysts and organizations to find valuable insights from a wide range of historical data.

Exploratory data analysis (EDA) can be seen as one of the key methods of descriptive data analytics. It is used to analyze data to find patterns, connections, and anomalies in data sets. Using methods like clustering, correlation analysis, and plots, EDA can examine the details of a data set

to reveal the underlying structure. On top of summarizing data sets, EDA can also be used to identify areas that require more in-depth research and help users understand the dynamics of data sets (Koot et al., 2021). Organizations can make confident, well-informed decisions based on the information from EDA. The iterative approach helps to improve the effectiveness of descriptive analytics and can help to establish a basis for more advanced analytics that rely on data-driven plans.

The foundation of descriptive analytics is data visualization, which enables organizations to quickly understand large amounts of data. Data is transformed into easily accessible representations through visual components such as charts, graphs, and dashboards. The visualization of data allows for faster and easier identification of patterns, trends, and correlations from the data set (Hallikas et al., 2021). Visualization of data is a powerful tool that helps organizations gain quicker insights into data and allows more informed decision-making by turning complicated data sets into easy-to-understand formats that are quick and easy to digest. Organizations can therefore add value to their data-driven tasks by utilizing data visualization in order to improve communication, drive collaboration, and enable the organization to make more informed decisions.

**Applications for Descriptive Analytics**

Descriptive analytics is a powerful tool in many different fields and sectors that enables organizations to gain information from their historical data. A well-known application is Business Intelligence (BI), where descriptive analytics is often the foundation of BI systems. These systems provide organizations with a thorough understanding of market trends, consumer behavior, and historical performance and trends (Lee & Mangalaraj, 2022). Descriptive analytics methods enable BI tools to provide organizations with insights into historical data through visualizations like dashboards to support decision-makers.

The foundation of marketing analytics is often descriptive analytics, which gives users important insight into historical data like past campaigns, customer segmentation, buying habits and demographics. By analyzing the past data, organizations can gain valuable insights into the effectiveness of their strategies and help guide future decisions. Organizations can target their marketing campaigns more effectively by identifying trends and patterns in consumer behavior. By doing so, companies can improve consumer engagement through a strengthened strategy and increase the

success of their marketing (Liu et al., 2023). Therefore, descriptive analytics is revealed as an important tool that can be used by organizations to achieve greater marketing success through understanding customer preferences and their segments.

Financial firms use descriptive analytics as a tool for financial analysis. Analysts use historical economic data to identify patterns and anomalies, as well as evaluate risks. Descriptive analytics can support financial planning and investment decisions by monitoring key performance indicators (KPIs) and generating reports based on historical data. Improving the accuracy of financial planning promotes stability and helps organizations gain an advantage (Maheshwari et al., 2021).

Descriptive analytics can also be seen as a useful tool for supply chain management. By understanding and leveraging historical data, organizations can, for example, identify bottlenecks, optimize the flow in the supply chain, and improve operational efficiency. Employing proactive decision-making and ensuring that available resources are used effectively can help supply chains maximize their supply chain performance.

**Challenges and Considerations**

Although descriptive analytics can offer invaluable insight into historical data, there are a number of obstacles, as shown in Figure 11, that organizations should also note and consider. Firstly, data quality dramatically affects reliability of descriptive analytics results. Incomplete, inconsistent, or inaccurate data can affect the reliability and lead to incorrect results. Organizations should therefore value data quality, as missing or inaccurate data can lead to negative results, and data assurance methods should be prioritized. Secondly, data integration can be seen as a significant obstacle when organizations attempt to combine multiple data sources. The process is often difficult and time-consuming, requiring efforts to ensure consistency and compatibility across all the data sets being used (Mukherjee et al., 2022). Seamless data integration and the quality of data can be seen as top priorities for organizations in order to effectively analyze the data and yield results that support the organization in data-driven decision-making.

It is also critical to protect data and ensure the privacy and security of any sensitive information. Data governance and security processes are essential for organizations to prevent security breaches and ensure regulatory compliance. When evaluating the results, it is also important to

make objective judgements based on data analytics and avoid biases or Finally, scalability becomes important as data grows exponentially. Organizations will need to modify analytical practices to effectively manage ever growing data sets in the long term (Punia et al. 2020).


**Figure 11.** *Key Challenges with Descriptive Data Analytics*

### 3.3.2 Diagnostic Analytics

Diagnostic analytics help to create a causal chain that is driven by historical events and trends. Through a detailed examination of historical data, this analytical method searches for patterns, trends, and anomalies to identify the variables that contribute to certain outcomes (Sheng et al., 2021). Retrospective data analysis is the focus of diagnostic analytics, which seeks to identify root causes from data sets and observable events. Compared to descriptive analytics, which simply lists and visualizes historical events, diagnostic analytics looks for the causes of the events. Organizations can find patterns, trends, and causal relationships that reveal the underlying dynamics. The strength of this method is that it provides a deeper understanding of these causal connections than superficial observations (Sodero et al., 2019).

Diagnostic analytics, as shown in Figure 12, is unique in data-driven decision-making because it can simplify complex circumstances through root cause analysis and troubleshooting. By exploring data sets, organizations can gain insightful knowledge that helps them make well-informed decisions and improve their planning by thoroughly understanding past events. This chapter discusses the principles of diagnostic analytics and examines the method's application methodologies and significance.

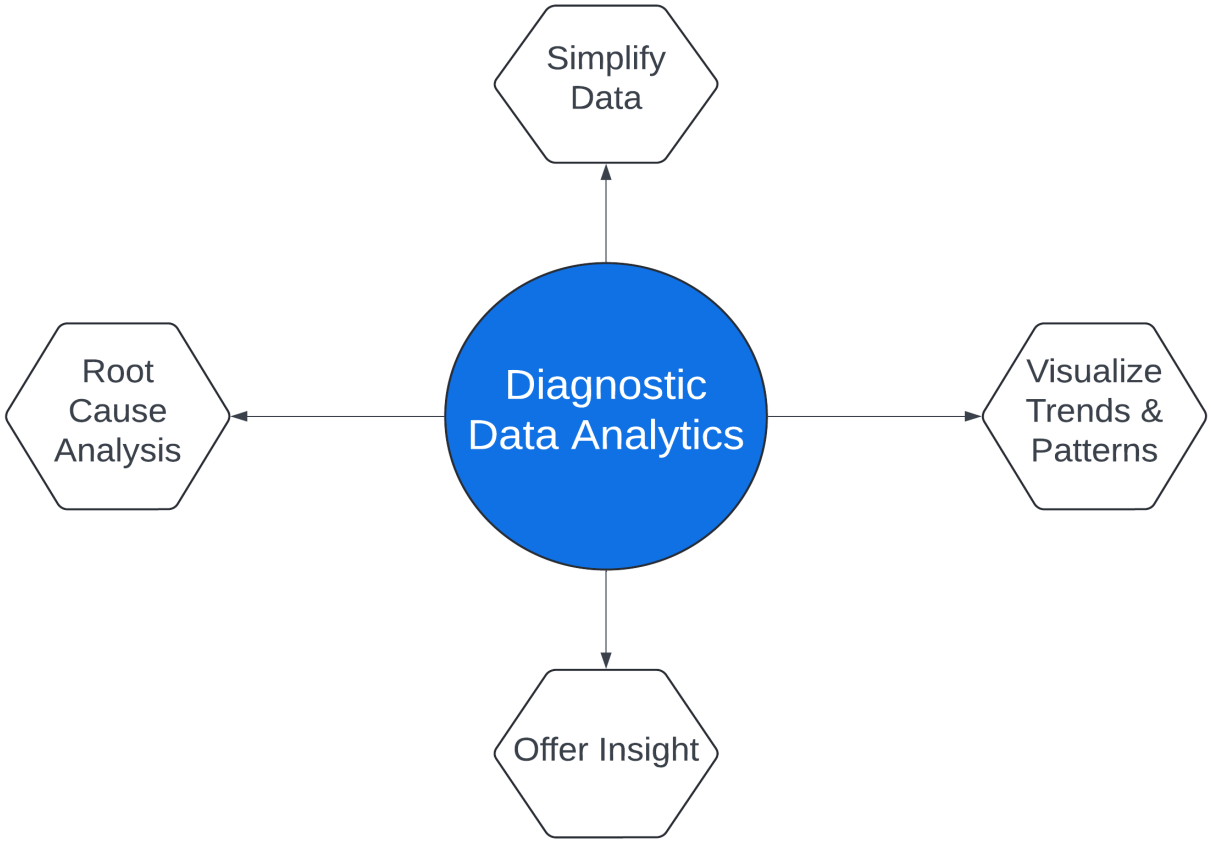


**Figure 12.** *Diagnostic Data Analytics*

**Key Methods**

Diagnostic analytics uses a variety of approaches and methods to identify the underlying causes of previous events and results. The base is statistical analysis, which allows organizations to make connections in the data through regression analysis, hypothesis testing, and correlation detection. For visualization tools, histograms and heat maps are used to help identify patterns and trends by providing a clear understanding of the data structure. Also, analytical methods like predictive modelling and machine learning algorithms can be used to identify strong connections and dependencies that might be missed by more standard statistical methods (Talwar et al., 2021). Multiple diagnostic analytics methods provide organizations with the best opportunity to form a comprehensive understanding of past events, enabling them to make data-driven choices and improve their future decisions based on refined insights from data.

Determining the primary reasons for specific outcomes through root cause analysis is one of the main goals of diagnostic analytics. Organizations can address underlying issues and prevent them

from happening again by implementing targeted solutions to identify the root causes of the problems they're facing. By taking a proactive approach to problem solving, root cause analysis can help organizations address the underlying issues rather than just managing the symptoms arising from them (Barua et al., 2021). Through diagnostic analytics, organizations can identify and target underlying reasons for a problem, like a drop in revenue or an increase in product failure, and implement successful solutions to combat issues.

**Applications for Diagnostic Analytics**

Diagnostic analytics is an adaptable technology that can help organizations extract useful information from already existing data sources, and therefore it has a wide range of applications across multiple sectors. In healthcare, identifying the root causes of medical errors, improving treatment protocols, and improving patient outcomes can be lifesaving. In the financial sector, diagnostic analytics can be used to identify and investigate fraudulent behaviors, which helps banks and other financial institutions mitigate their risks and comply with regulations. Manufacturers can use diagnostic analytics to reduce downtime and identify inefficiencies in their manufacturing processes (Atitallah et al., 2020). Diagnostic analytics is driving organizations towards better effectiveness and can provide them with a competitive edge in their market sector by implementing informed decision-making and continuous improvement in their processes. It can also be seen as highly beneficial for supply chain operations because, when used correctly, it can help supply chain organizations eliminate underlying issues that can, for example, manifest in higher costs, longer lead times, and worse overall efficiency.

**Challenges and Considerations**

Although there are several difficulties and factors to consider, diagnostic analytics has great potential for providing organizations with insightful information. The most important of these factors to consider are data accessibility and quality issues. Inaccurate or insufficient data can lead to false results, highlighting the need for thorough data validation and cleaning processes. Also, the integration and preparation of data for analysis had to be improved due to the many variables in today's data ecosystems, which are characterized by multiple sources and formats of data. Furthermore, domain experience and contextual awareness are requirements to successfully extract relevant insight from the interpretation of analytical data (Frazzetto et al., 2019). By addressing

these factors with strong data frameworks and the development of analytical skills within their teams, organizations can better utilize diagnostic analytics to drive innovation and gain a competitive edge.

The field of diagnostic analytics is expected to undergo a major transition as technologies evolve. Big data and the Internet of Things promise to provide organizations with a wealth of new data for analysis, creating new opportunities to leverage diagnostic analytics in organizations. Also, analytics methods are set to undergo a revolution due to advances in artificial intelligence and machine learning, which will allow diagnostic analytics to have improved capabilities. The advancements in technology will also bring analytics tools and platforms available to a much larger audience. More people will have access to these capabilities which will allow organizations and individuals to use diagnostic analytics more effectively (Ghalehkhondabi et al., 2020). This widespread availability can promote an organizational culture where data driven insights are widely used to support and drive decision-making. The combination of these advances had the potential to deliver new levels of knowledge and optimization across a wide range of sectors.

### 3.3.3 Predictive Analytics

In data-driven decision-making, predictive analytics is a knowledge guide that uses statistical algorithms and machine learning methods to predict future problems by looking at past data trends. Predictive analytics enables organizations to anticipate future events, actions, and outcomes, promoting proactive decision-making by identifying hidden connections and patterns. (Hallikas et al., 2021).

Predictive analytics, as shown in Figure 13, uses statistical methods and advanced machine learning to look into the crystal ball of data. By doing so, unlike descriptive and diagnostic analytics, which only look backwards and interpret past events, predictive analytics is able to anticipate possible future scenarios. It does so by identifying patterns, trends, and correlations within the data set and applying a machine learning element to it. Predictive analytics can be seen as essential for making informed decisions, guiding strategic planning efforts, and ensuring that organizations remain flexible and responsive in the ever-changing global market (Lee & Mangalaraj, 2022). Predictive analytics gives organizations the ability to anticipate and prepare for the future, which might give them more insight. By being proactive, companies can reduce risk, take advantage of new

opportunities, and allocate their resources more effectively. Using predictive analytics as a lens, organizations can face uncertainty with more resilience and confidence.

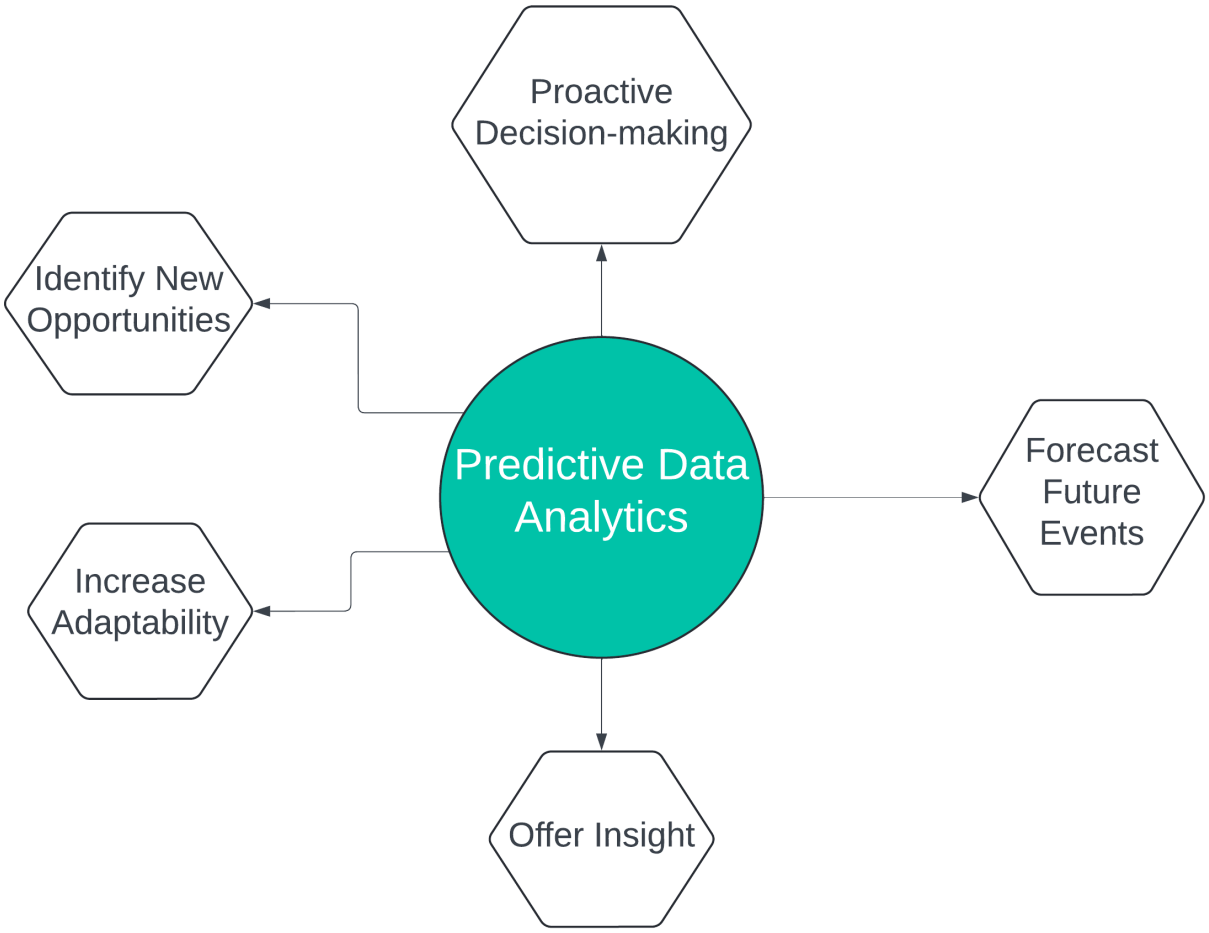


**Figure 13.** *Predictive Data Analytics*

**Key Methods**

Uncovering the secrets hidden in data sets is made possible by the comprehensive combination of approaches and techniques that make up predictive analytics. Regression analysis, decision trees and neural networks are tools that organizations can use to build predictive models that accurately forecast future trends and outcomes. Algorithms for time series analysis, grouping, and classification enhance predictive power by enabling trend forecasting, customer segmentation, and pattern recognition across large data sets. Also, ensemble techniques such as gradient boosting and random forests combine many models to improve prediction accuracy and robustness to complexity (Hallikas et al., 2021). By using a collection of analytical tools and methods organizations

can improve their ability to anticipate opportunities and threats. It also helps organizations allocate resources more optimally and make proactive decisions that can drive success in a dynamic and competitive market. Therefore, predictive analytics is becoming essential for strategic planning and leading organizations to innovation and long-term success.

**Applications for Predictive Analytics**

Predictive analytics is a transformational force that is reshaping decision-making and driving innovation across industries and the global economy. It is transforming retail operations by enabling accurate demand forecasting, streamlining inventory control, coordinating targeted marketing campaigns, and increasing customer satisfaction and profitability. In healthcare, predictive analytics enables early disease detection, classifies patient risk profiles, and optimizes treatment plans. This comes with better patient outcomes and significant cost savings. Also, it supports critical functions in the financial sector, including credit scoring, fraud detection, and investment risk mitigation, giving organizations the insight they need to navigate challenging market environments and protect their assets (Koot et al., 2021).

A key feature of predictive analytics is its ability to support proactive business decisions. By providing insight into the future, organizations can anticipate threats, exploit opportunities, and allocate resources in the most efficient way. For example, an online retailer using predictive analytics can forecast a loss of customers, allowing them to take preventive action and thereby increase the average customer lifetime and value (Lee & Mangalaraj, 2022). Similarly, a supply chain organization can use predictive analytics to forecast demand and optimize production and inventory levels to match the forecast. By embracing predictive analytics, organizations can better manage uncertainty by implementing informed, forward-looking plans and strategies that align resources with expected demand. Predictive analytics can be seen as the foundation for adaptability in diverse sectors, enabling organizations to anticipate new patterns and behaviors, strengthening their leadership in innovation and success in a dynamic global market.

**Challenges and Considerations**

Because of its potential to deliver highly sophisticated insights from data sets, predictive analytics poses significant challenges for organizational data management. The most important part is to

ensure data integrity and quality, as faulty data can make predictive models less reliable and forecast scenarios that are not based on factual data. Also, the complicated framework of predictive algorithms presents difficulties in interpretation, which can bring up moral and legal dilemmas, especially in industries like healthcare and finance. The data validation process must be a continuous process, and observation is required to maintain the relevance and accuracy of the predictive models and scenarios (Punia et al., 2020). For supply chain organizations, it is especially important to address the data validation process due to the ever-changing nature of supply chains. Only with valid data can the predictive analytic models be fully utilized and ensure that their outcomes can effectively guide strategic decisions.

Predictive analytics can offer a lot of opportunities going forward as technology advances. Big Data and the Inter of Things will continue to grow, giving organizations access to more and more data that they can utilize for analytics. This will open new opportunities for predictive modelling and development. Advancements in machine learning and artificial intelligence will pave the way for the creation of more sophisticated predictive models that can identify deeper patterns and connections from the data sets. Predictive analytics tools and platforms will also become more widely available, allowing organizations of all sizes to benefit from predictive insights (Koot et al, 2021).

### 3.3.4 Prescriptive Data Analytics

In supply chain management, prescriptive data analytics offers increased operational effectiveness, reduced costs, and improved customer satisfaction. Organizations can reduce costs, optimize workflows, and provide more personalized services by employing machine learning algorithms, simulation approaches, and optimization models through prescriptive analytics. This next level of data analytics allows companies to even better allocate resources, adapt to changing market conditions, and make informed decisions. All of which promote competitiveness in the market and can help organizations gain an edge over their competitors (Liu et al., 2023.).

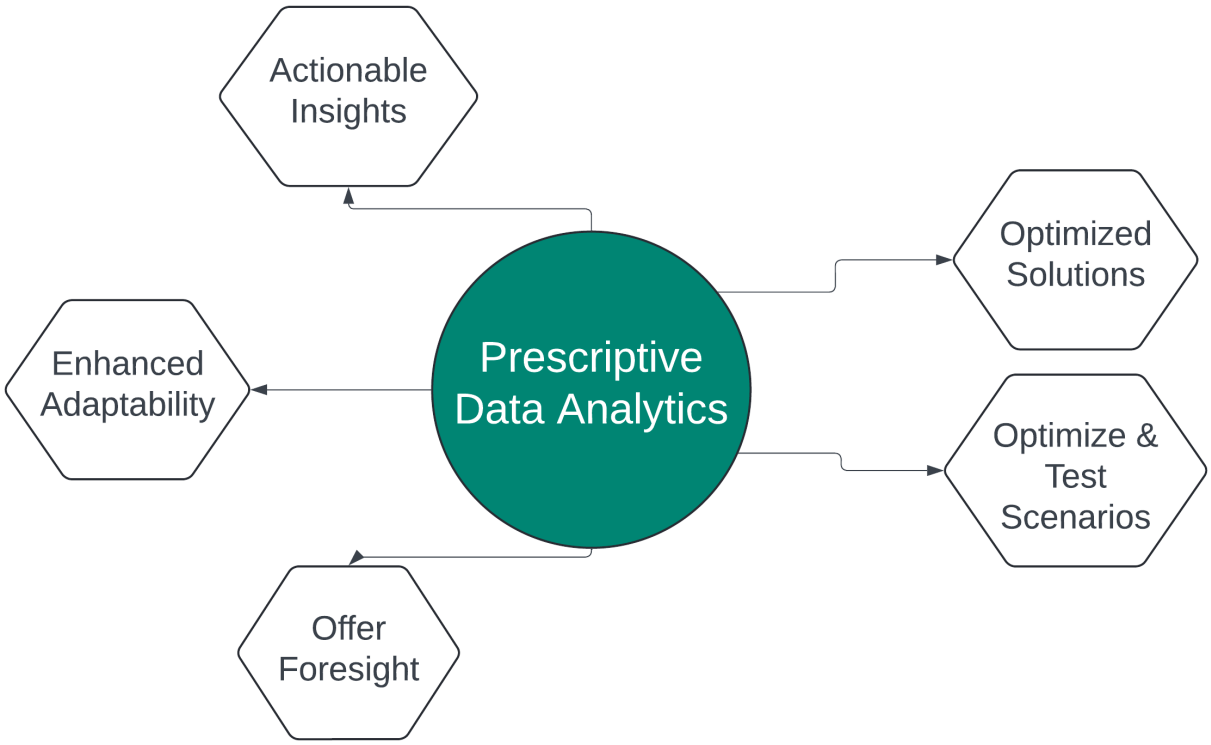


**Figure 14.** *Prescriptive Data Analytics*

Prescriptive data analytics, Figure 14, is a powerful tool for improving supply chain management success and uses various methods to do so. Firstly, there are optimization models, including network optimization, integer programming, and linear programming. These models allow for the optimization of crucial supply chain components such as inventory control, production scheduling, and transportation planning. Organizations are able to promote operational excellence within the supply chain by utilizing advanced models to simplify processes, reduce costs, and optimize the use of resources through the use of optimization approaches. Secondly, simulation approaches make modelling supply chain management processes and evaluating different situations much more accessible. Using optimization simulation, organizations can more easily assess the potential impact of multiple different variables and scenarios on key performance indicators (Maheshwari et al., 2021). This ability can help stakeholders choose the best course of action by modelling different scenarios. Organizations can use the simulations to anticipate problems, adapt faster to changing market conditions, and improve their supply chain resilience.

Organizations can use data to their advantage by incorporating artificial intelligence and machine learning into their supply chain management processes. These modern approaches are able to

analyze large amounts of data to provide organizations with helpful insights based on data sets. The new technologies can enable more proactive decision-making which in turn can improve operational efficiency. Examples of such methods include dynamic demand forecasting and predictive and customized suggestion. In addition, prescriptive data analytics technologies designed to address specific supply chain management issues can offer pinpoint solutions (Mukherjee et al., 2022). The new technologies and platforms enable organizations to make highly informed decisions across the supply chain spectrum by combining and leveraging methods and turning large sets of data into user-friendly interfaces. This can be expected to have a positive impact on the organization's ability to stay agile in an ever-changing global market.

**Challenges and limitations**

Despite the potential benefits, supply chain organizations can also face significant challenges when implementing prescriptive analytics. Firstly, it is crucial to ensure data quality and integration from multiple sources. Accurate and consistent data is essential not only for prescriptive analytics but for all data analytics. Because the supply chain ecosystem includes a large variety of data sources and formats, it can be challenging to obtain good-quality data. Organizations need to really highlight and invest in strong data management techniques and culture to overcome the barrier and ensure data quality so that they can benefit from the results obtained from prescriptive analytics. Secondly, another major barrier can be the computational complexity of optimizing highly complex supply chain networks. Managing large-scale optimization models to support real-time decision making requires sufficient computing power and expertise. Organizations that have limited resources may find it difficult to meet the criteria, which could limit the scalability and effectiveness of the prescriptive analytic results. Addressing these challenges requires significant investments in infrastructure, technology, and skilled labor (Punia et al., 2020).

Organizational resistance and change management can also act as barriers when trying to implement prescriptive data analytics in organizations. Incorporating new technologies and ways of working, e.g., sophisticated analytical techniques through prescriptive data analytics, requires a high level of organizational commitment and support. Resistance to adopting new technologies and the need for increased data literacy within an organization can hinder the implementations effects. In addition, organizational differences can hinder collaboration and information sharing, making it even more difficult to implement prescriptive data analytic initiatives (Sheng et al.,

2021). To ensure that supply chain organizations get the benefits of implementing prescriptive data analytics, they also must implement proactive change management initiatives that address these issues. An organizational culture where collaboration, commitment to data quality, and skilled support can be seen as requirements for a successful implementation of prescriptive data analytics.

**Future directions**

Prescriptive data analytics in supply chain management is expected to have significant growth as technology advances and organizations fully understand the benefits of data-driven decision making. Organizations can quickly adapt to ever-changing market conditions, disruptions, and expectations by leveraging prescriptive data analytic solutions (Sodero et al., 2019). Organizations that embrace advanced levels of data analytics are better equipped to handle the complexity of supply chain networks because of the enhanced agility, which enables them to make data-driven decisions quickly and accurately. The integration of advanced data analytics can completely transform the operational effectiveness and strategic decision-making processes within supply chain management.

The combination of digital twins in supply chains and prescriptive data analytics is an interesting development. Supply chain management is seeing an increase in digital twins, which are electronic replicas of physical assets or processes. Combining this technology with prescriptive data analytics allows companies to create virtual supply chain simulations. The simulations can improve supply chain resilience and efficiency through scenario analysis, risk management, and operative optimization (Schniederjans et al., 2020). Organizations can improve their ability to negotiate difficult situations, identify obstacles, and develop proactive plans by using prescriptive data analytics in the context of digital twins. This can offer smoother operations and flexibility in fast paced global markets. The integration can significantly improve performance and strategic decision-making in supply chain organizations.

The integration of blockchain technologies with Internet of Things solutions offers opportunities for improved supply chain security, traceability, and visibility. Integration of IoT sensors and blockchain technologies allows for prescriptive analytics to provide companies with real-time visibility into supply chain processes (Hallikas et al., 2021). Through data-driven decisions made more

accessible by these technologies, supply chain organizations can proactively address issues such as supply chain disruptions and reliability and improve the network's performance.

# 4 Research

Supply chains have faced many unprecedented disruptions in the last five years, from coronavirus to geopolitical conflicts to inflation and recessionary global market environment, for example. Finland, has on top of these, had its own challenges with labor union strikes affecting supply chains on a national level. These disruptions have impacted pricing, availability, and lead times in supply chains, among other negative effects. When disruptions become seemingly constant, the organization's readiness to face the disruptions can be a significant competitive advantage. This prompted the research to study if prescriptive data analytics could be utilized effectively in the organization to support decision-making in the supply chain. As stated, the objective of this thesis is to study if prescriptive data analytics could be used to support decision-making in the organization. To help us reach this objective, the target was to gain a deeper understanding about how prescriptive data analytics can help modern supply chain organizations succeed, understand the current stage of data analytics in the organization, and make suggestion about whether or not the organization would benefit from implementing prescriptive data analytics as part of its tools and processes in this state.

To conduct the study, a research approach should be chosen that supports the research objective. For this research, the case study was chosen as the approach as it is well suited for research when the purpose is to produce development suggestions and a deeper understanding of the case under study, which supports the research objective of understanding if prescriptive data analytics could be well used to support decision making in this case. Once the objective and approach for the study were established, research questions were formulated to support and guide the research. The research questions can be found below. Based on the research questions and objective, the research method and theoretical background were selected so that they supported the research. For theoretical background, three themes were selected: digitalization in supply chains, knowledge management and data analytics. The first theme covered how digitalization has been changing supply chains and supply chain management. The second theme offered us insight into how knowledge and data can be used to support and drive decision making in organizations. Lastly, the third theme focused on data analytics and how it can enable organizations to succeed.

As mentioned in chapter three, the literature selected for the theoretical background was evaluated for its relevance, credibility, and ability to fill informational gaps. For the research, as mentioned in chapter two, a qualitative method was chosen as it aims to gain a deeper understanding of the research topic, which helps to achieve the research objective.

1. How can prescriptive data-analytics support decision-making in supply chain organizations?

2. How is data-analytics currently utilized in the organization, and what are the biggest challenges with it?

3. Would implementing SAP IBP Optimizer be beneficial and boost the organization's performance?

## 4.1 Semi-structured Interviews

Semi-structured interviews were chosen as the research method for this study. They are a common data collection method in case studies and help us to understand the beliefs and experiences of organizations and individuals, which in turn supports the research objective of this thesis. The semi-structured interview was chosen as the interview format because the participants had prior knowledge of the topic, and it allowed for the participant's responses to guide the flow of the interview. Also, as discussed in chapter two, semi-structured interviews are well suited for case studies as they allow for flexibility and comfort, hopefully leading to rich data but still providing some standardization for analysis.

The semi-structured interviews were carried out as an open dialogue, following a predetermined thematic framework which was based on the research questions, in order to help investigate different sides of the research questions. On top of the thematic framework, some questions were prepared for the interviews beforehand to support and guide the interview, which would help with comparing the responses between participants. The interview framework can be found in Appendix 1. The framework and questions were designed so that the first part focused on current use and perceptions of data analytics, the second on challenges and opportunities in current implementation, and the third on future vision. At the end of each interview every participant was also allowed to have a free speech section on data analytics if they had something that they

wanted to express but that hadn't come up during the interview. The participants were notified about the subject and intention of the interview during the invitations and at the start of the interviews. Figure 15 shows in detail how the interview process was carried out for this study.

The interviews included members from the organization's supply chain planning team and a partner from an SAP consulting firm that had prior knowledge about the company. This selection was hoped to provide a comprehensive understanding of how data analytics is experienced in the organization and how it could be further utilized to support decision-making in the organization.

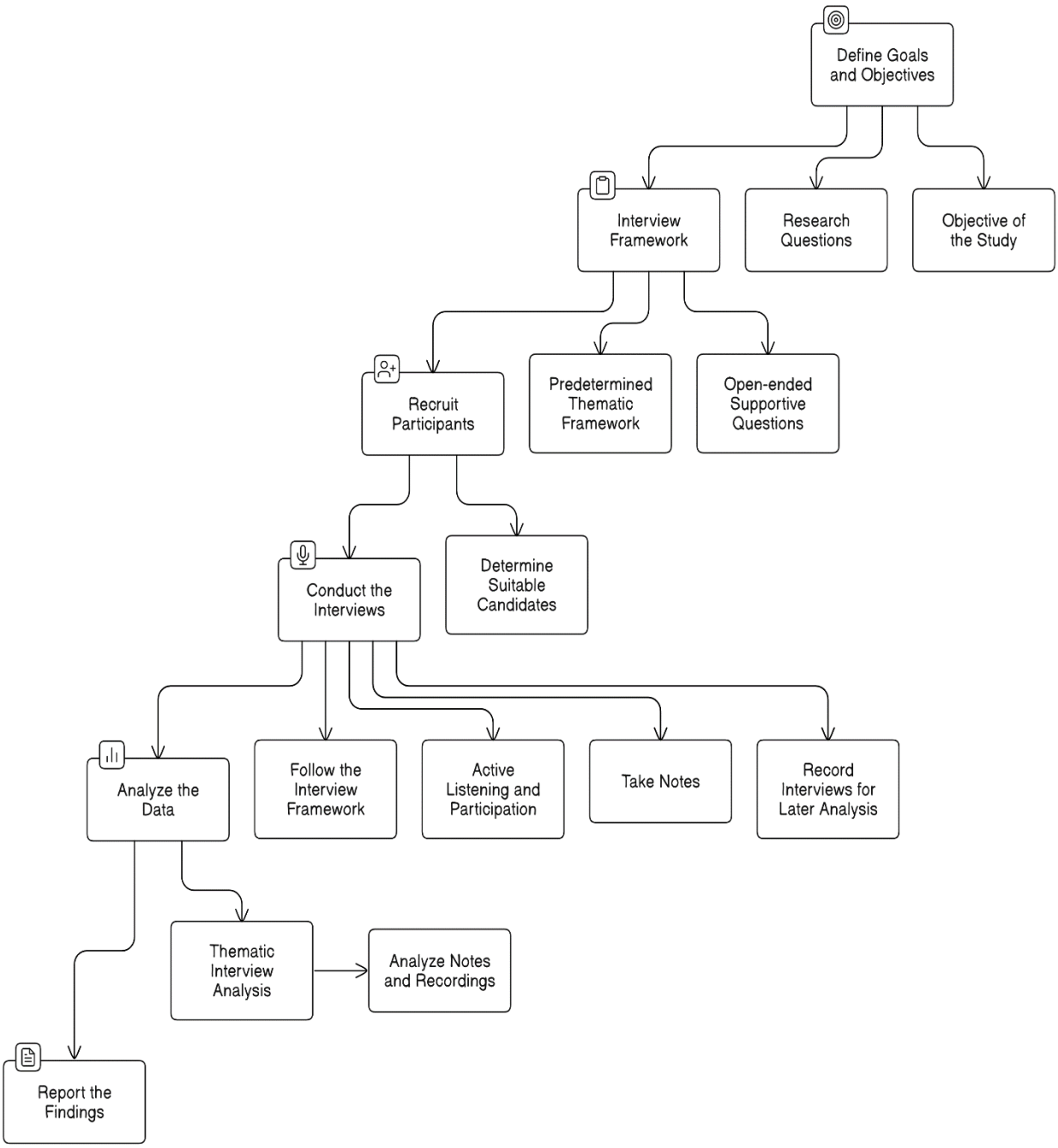


**Figure 15.** *Thesis Interview Process*

**Organization Interviews**

An important part of the research was to try and understand how data analytics is currently being experienced in the organization. The current implementation of data analytics leverages predictive analytics capabilities and is designed for day-to-day use across all locations within the organization. Seven people from the supply chain planning team were interviewed. To gain a full

understanding of how data analytics is currently experienced within the organization, individuals from the supply chain planning team were specifically targeted. A strategic mix of seven participants, Figure 16, were interviewed, including two management-level individuals and five senior professionals. This approach enabled insights to be gained from both a strategic decision-making perspective and the day-to-day implementation of supply chain planning. To ensure representation from different parts of the organization, five senior specialists from different geographical areas were interviewed. This approach broadened the scope of the data and facilitated the acquisition of a more holistic picture of data analytics experiences. The selection process aimed to create a well-rounded group of interviewees that would provide the best overall picture of the current state of data analytics within the organization's supply chain planning function. The interviews were carried out in the organization during March 2024. Most of the interviews were carried out through online meetings, but two were held in person. The average duration of the meetings ended up being 35 minutes, bringing the total to 245 minutes of interview material. All of the interviews were recorded for further analysis, but were handled anonymously and destroyed after the analysis had been concluded.

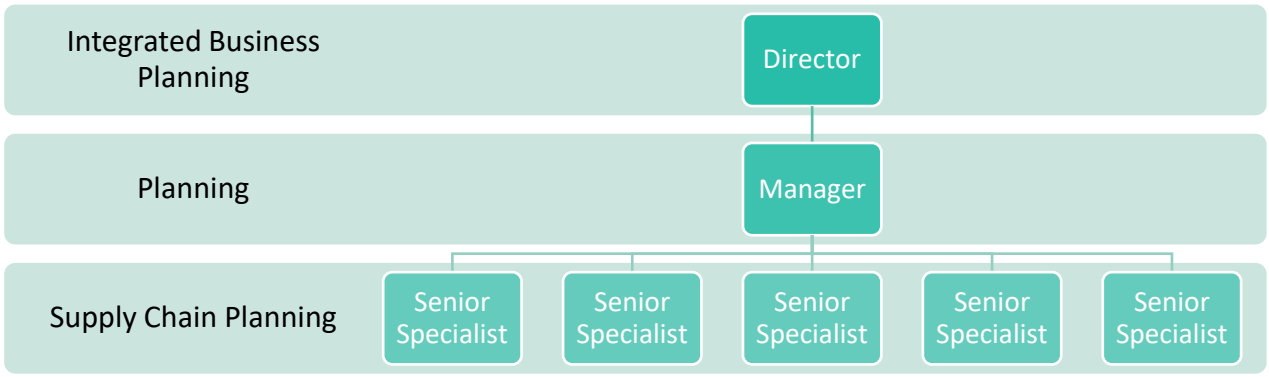


**Figure 16.** *Interview Organization Chart*

**Consultant Interview**

Another important part of the research was to try and gain an understanding of how prescriptive data analytics can support decision-making and boost supply chain performance. To gain focused insight into how prescriptive data analytics could support decision-making and improve supply

chain performance, an SAP consultant with prior knowledge of the organization and its existing analytical tools was selected for an interview. The consultant's expertise in SAP solutions was well aligned with the organization's current data analytics environment, allowing him to provide tailored insights into the potential of prescriptive analytics in this specific context. This interview also followed a semi-structured format but had a different thematic framework and interview questions than the interviews carried out within the organization. The interview framework can be found in Appendix 2. The interview was done in an online meeting and recorded for further analysis, as were the others, after which the recording was destroyed. The time slot booked for the interview was 60 to 90 minutes and it took roughly 60 minutes.

## 4.2 Interview Material Analysis

The interviews were first transcribed using digital tools. After the transcripts had been created, they were checked by listening back to the recordings and correcting any mistakes found in the transcripts. This step also already helped with familiarizing ourselves with the data gathered from the interviews. Notes were also taken during each interview, and these were compared with the corrected transcriptions. Figure 17 shows in detail the transcription workflow.

The transcripts were analyzed using thematic analysis, Figure 18. The first step was to familiarize with the material gathered from the interviews by reading the transcripts, listening to the audio, and going over the notes taken during the interviews. After familiarization, transcriptions were studied to find and collate codes that represent the meanings and patterns seen in the data, and these were then further grouped under themes. For themes, the target was able to find themes that offer insights into the research questions. The themes were then reviewed and revised to see if they had sufficient data to support them.

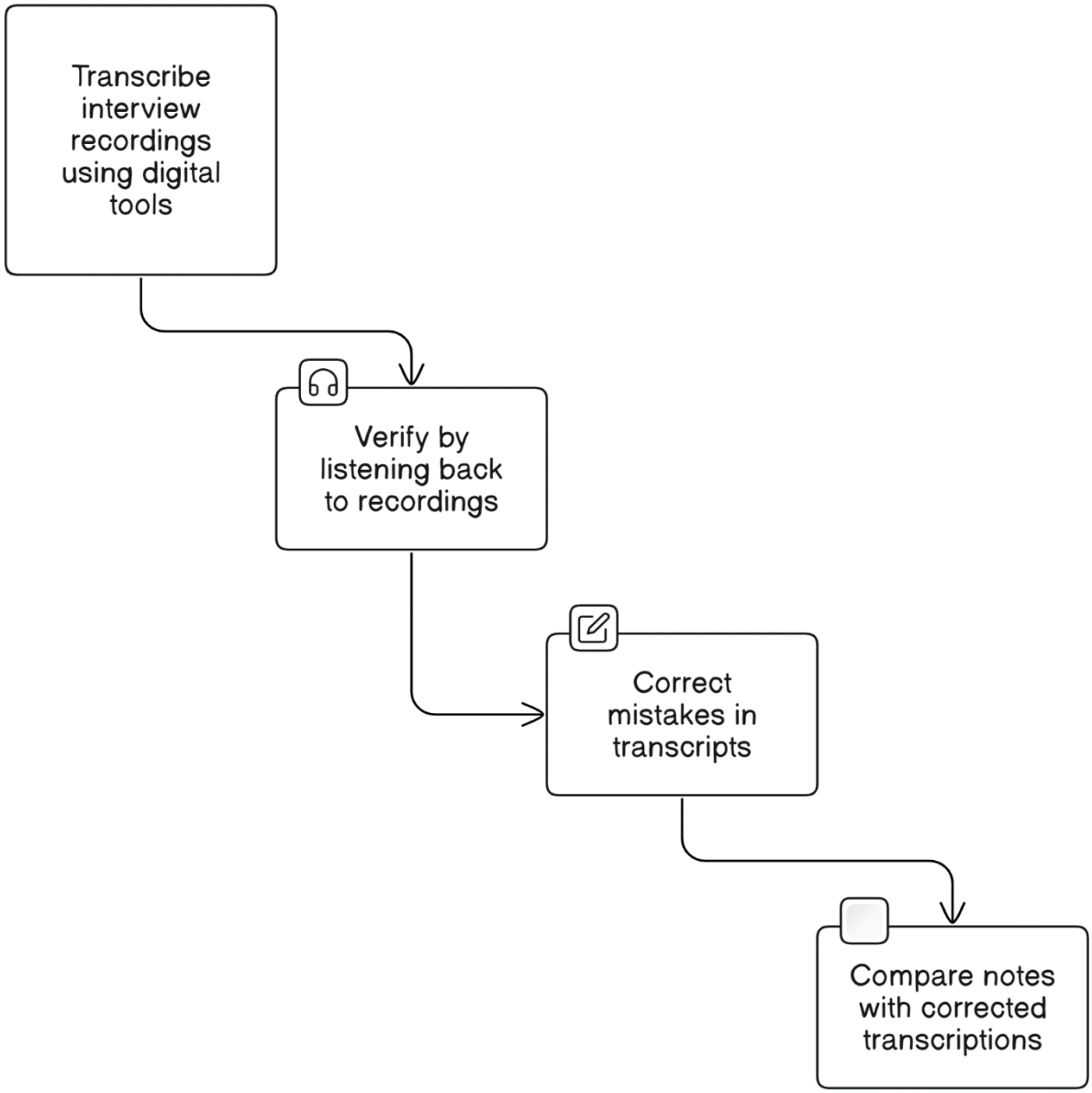


**Figure 17.** *Transcription Process*

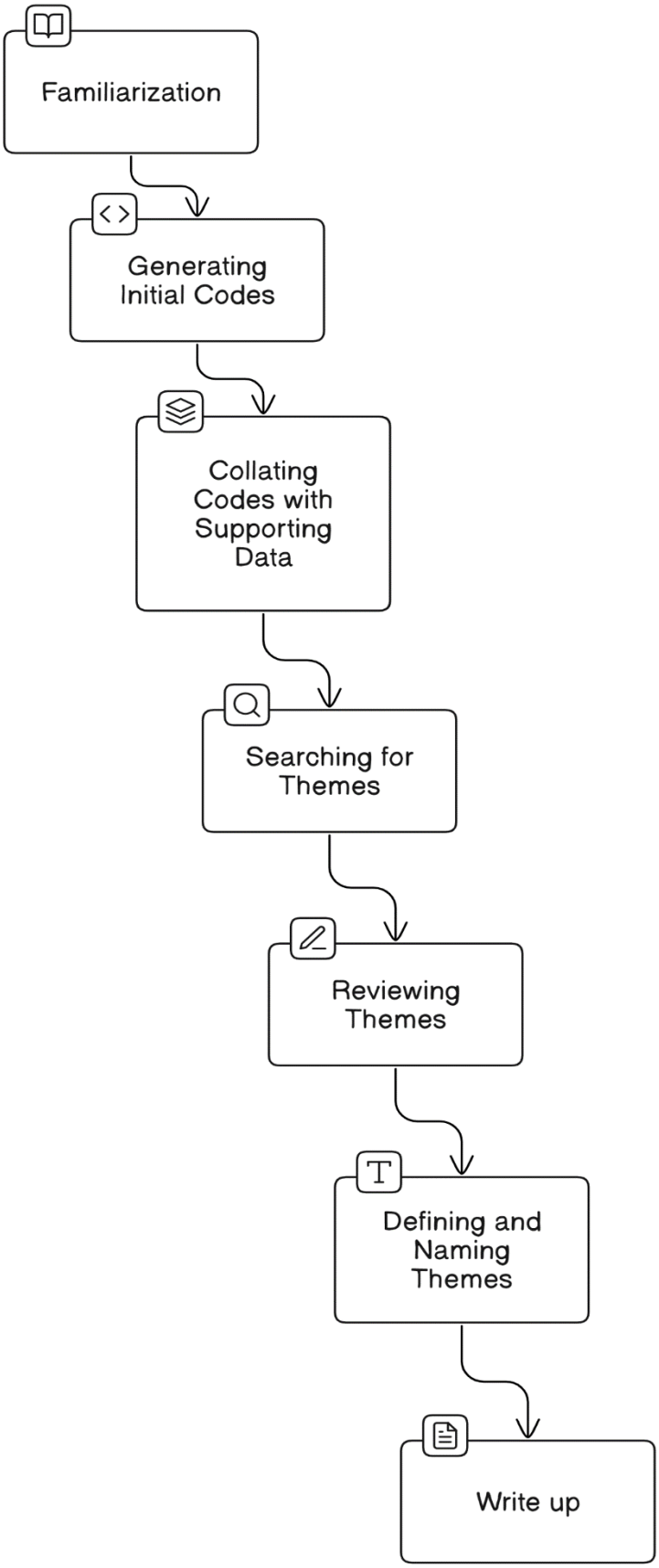


**Figure 18.** *Thematic Analysis from Transcripts*

# 5 Findings

## 5.1 Organization Interviews

In the organizational interview analysis, there was a notable difference in the interview outcomes between the management and senior specialist levels. It could be observed that although the themes for both were common, the interview outcomes varied depending on how the themes were perceived. One of the key differences observed was how the two groups felt the current level of data analytics supported their decision-making which could be from the change in planning horizon going from tactical towards a more operational level. However, three common themes were identified from the interview analysis that supported the research and were supported by the data. The themes were how data analytics supports decision-making, what are the perceived challenges with data analytics, and how people would like the data analytics to evolve, Figure 19.

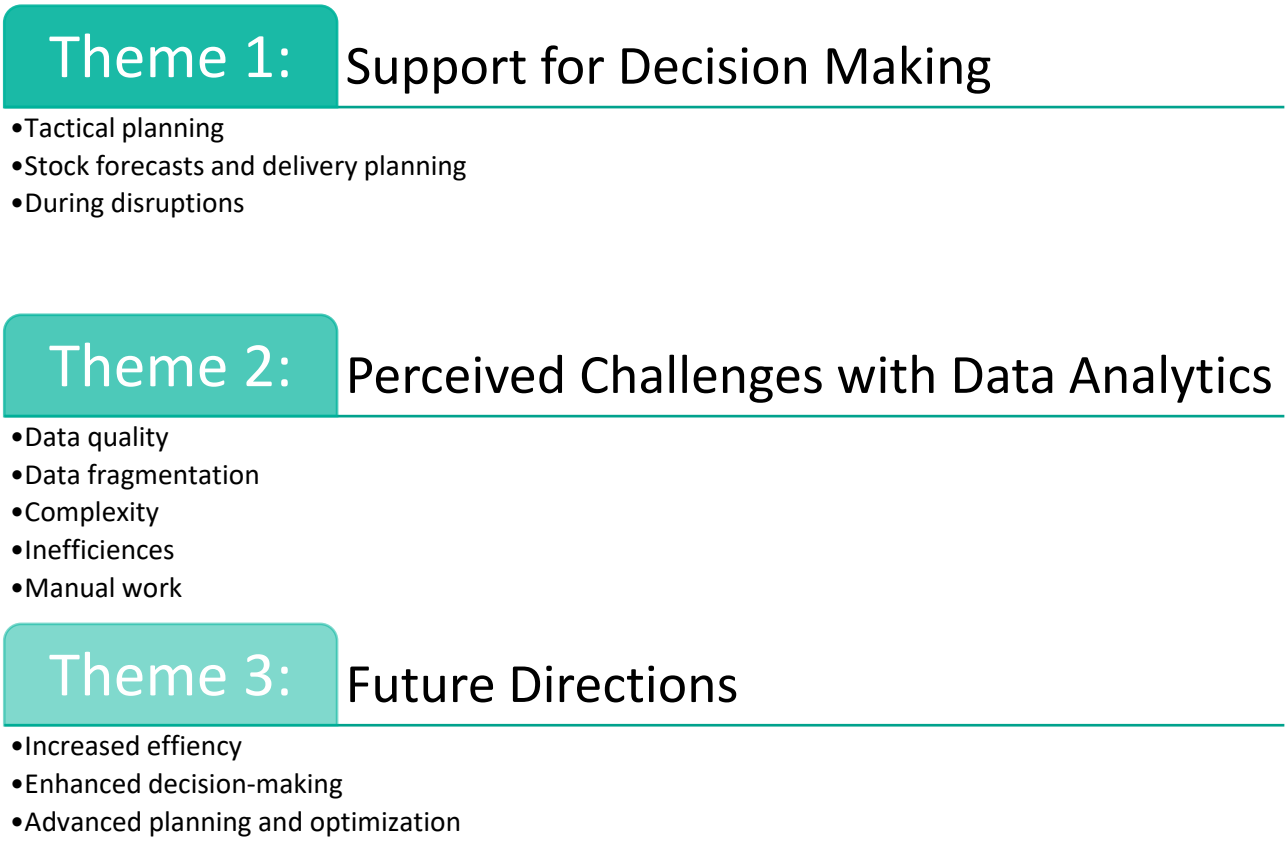


**Figure 19.** *Organization Interview Themes*

**Support for Decision Making**

As mentioned before, there was a noticeable difference between the two groups in how data analytics was perceived to support decision-making in the organization. At the management level, the current predictive data analytics were perceived as an invaluable asset for supply chain planning from multiple perspectives. It supported profitability planning, availability planning, and delivery planning, for example, on that tactical level.

On the other hand, the senior specialists interviewed felt that the current level of predictive data analytics and the implementation model didn't offer them a lot of support for decision-making in their daily tasks. From the interview analysis, it could be seen that there was a consensus that the data analytics supported the supply chain planning process by offering stock level forecasts, which were utilized to plan upcoming deliveries. It is also noteworthy to mention that data analytics were perceived as more useful during disruptions.

*“"I feel that current data analytics provide the most value during disruptions, when it's important to try to get a bigger picture of the entire network."*

*“To be honest, I feel that the support from data analytics for my decision making is limited. It is mostly related to evaluating stock levels in different destinations.”*

**Challenges with Data Analytics**

The interview analysis shows that the challenges perceived with data analytics were much more homogenous. The main challenges associated with the current level of data analytics found in the interview were data quality issues and inefficiencies in the current implementation. In many cases, these two key findings were seen to feed off each other.

Data quality issues could be seen to come from complexity, data fragmentation, data inaccuracies, integration issues, and data cleansing. The analysis revealed that the complexity of the system led to uncertainty among participants regarding the correspondence and meaning of specific numbers within IBP. Another challenge that emerged from the interviews was that because there was little perceived value in decision support from the analytics, people tended to use their own ways of

tracking, forecasting, and planning. This was mainly done using separate Excels. This, in turn, led to the data being fragmented. Most, if not all, of the participants in the interviews mentioned that a challenge with data analytics is data quality. Participants mentioned that there are challenges with incorrect data, missing data, old data that needs to be updated, and even, in some cases, intentionally inaccurate data coming from a siloed organization structure. Lastly, the analysis showed that the people felt fixing incorrect data was a challenge faced by many with the data analytics.

*"I am not always confident that I have a full understanding of the full meaning of a number in IBP."*

*"I use Excels to track inventory and deliveries because I don't feel that the IBP is in support of my decision-making process."*

*"I think there are challenges with the accuracy of the data in IBP. It's not always easy to spot them when you don't have time to use the tool as much as you'd like, and you have to correct everything manually."*

The second key challenge identified in the analysis was inefficiencies in the current system. It came up in the interviews that the system is perceived as time-consuming and has low perceived value among the senior specialists interviewed. Interview analysis showed that many found the current implementation time-consuming and that they did not necessarily have enough time to spare with the system to feel fully confident in getting value out of it. The analysis suggests that the high amount of manual data entry may be a contributing factor. As mentioned earlier, the responses showed that some of the participants found little perceived value to support their decision-making process during supply chain planning. Some of the participants also mentioned that they were not keen to use the system due to lack of time, low perceived value in supporting their work, and the complexity of the system.

*"There's a lot of manual work with updating, but I don't feel like I'm getting much value for it."*

*"I feel discouraged to use the system because I don't have enough time to feel confident with it, and it provides little value in terms of decision making."*

**Future Directions**

The final theme identified through the interview analysis concerns future directions. Examining the key components revealed within the analysis, three main topics emerge: increased efficiency and a focus on data analytics, enhanced decision-making, and advanced planning and optimization.

In the interview, many participants mentioned that they would like to see less manual data entry to free up time for actual data analysis. Many also mentioned that they hoped that other daily tasks would take less time so that they could devote more attention to the data analysis tool.

*"I would like to make more use of the system, but unfortunately I am so busy with other daily tasks that I hardly have any time left for IBP."*

Another topic that had a lot of supporting statements was enhanced decision-making. The analysis shows us that participants were hoping for reliable forecasts based on data analysis that supported their decision-making. The analysis also revealed a desire among participants for the tool's development to move in a direction that provides them with greater value in their planning operations at both the tactical and operational levels. Advanced planning and optimization can also be identified from the interview analysis. The analysis shows that participants would like to see advancements in constraint management, scenario planning, and optimization to offer them better support for decision-making through better analytical models.

## 5.2 Consultant Interview

Analysis of the consultant interview materials revealed two distinct themes, Figure 20, that supported the research and were supported by sufficient data. Firstly, how prescriptive data analytics through Optimizer can benefit the organization. Secondly, what are the challenges when implementing and/or using the Optimizer.

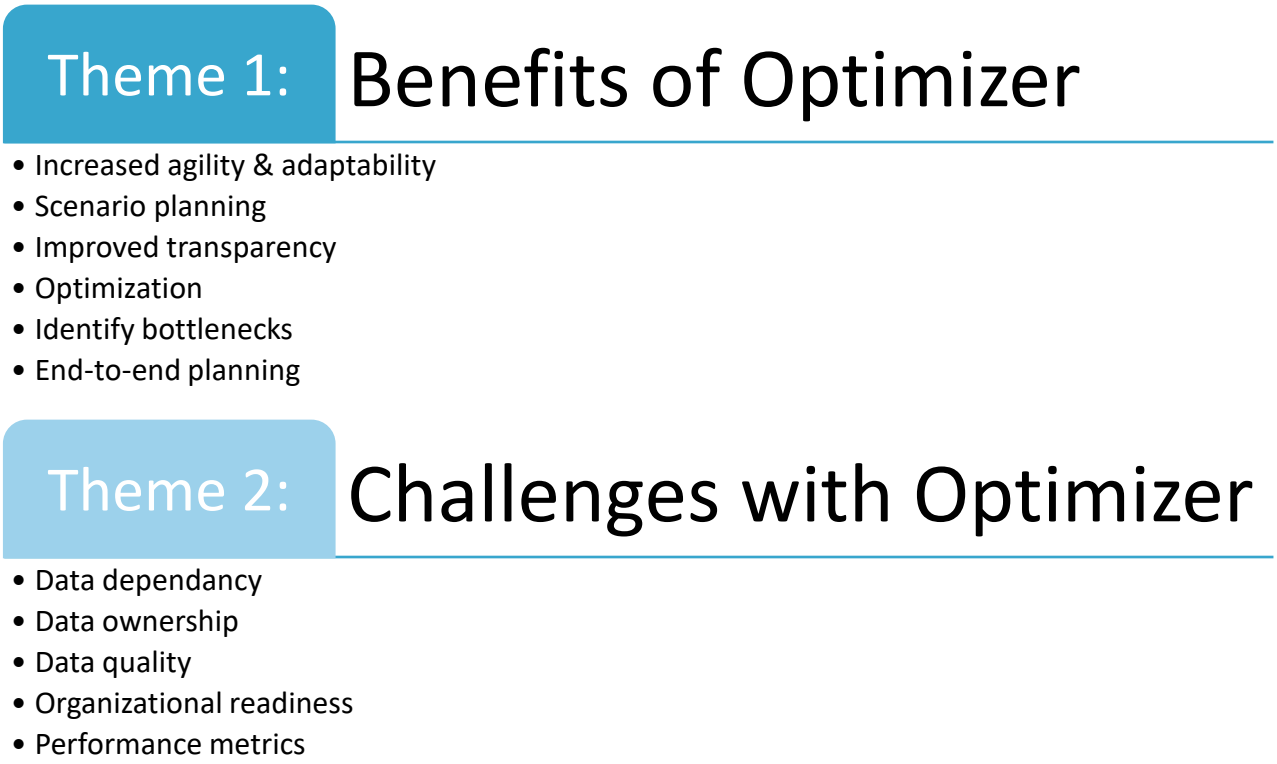


**Figure 20.** *Consultant Interview Themes*

**Benefits of Optimizer**

The main benefits that rose from the interview were that Optimizer can help supply chain organizations to have increased agility and adaptability in planning but also help to identify bottlenecks within the chain, which in turn can help boost the supply chain's performance. The ability to identify these bottlenecks comes from improved transparency in the supply chain.

*"For many companies, the ability to identify a seemingly isolated bottleneck, that can have ripple effects, slowing down the whole production process, is highly impactful. Transparent planning helps identify these issues."*

*"I think a lot of companies, especially after COVID and some of the disruptions that came after that, are now trying to adopt a little bit more of what they call or what we call an end-to-end or value chain focus."*

The increased agility and adaptability in planning comes from Optimizer, which enables organizations to have faster re-planning, scenario planning, and end-to-end planning. Faster re-planning helps organizations quickly react and generate new plans when there are changes in the forecast, demand, or capacity. Scenario planning enables organizations to test and compare multiple different plans against each other to see how the scenarios will affect the supply chain. It can also be used as a strategic tool to try and find optimization between production plants or customer combinations, for example. Improved transparency allows for end-to-end planning where the focus is on optimizing the entire supply chain instead of suboptimizing individual parts of the chain.

**Challenges with Optimizer**

The challenges pinpointed in the interview can be divided into two main groups. Data dependency and organizational flexibility and readiness. It was highlighted in the interview that Optimizer needs a lot of accurate data from the whole supply chain to be able to create end-to-end optimization results. The challenges with data can come from multiple facets as mentioned in the interview. For example, it might be unclear who is responsible for maintaining specific datasets in the organization or whether manual or integrated data should be used and the challenges with each of those.

*“So, it's about identifying the right data and the right constraints that you need for your business scenario.”*

*“So, making sure that the data is correct is critical, and having clear ownership of the data helps with that. If you have something like shared ownership, that could also cause problems.”*

Organizational agility and readiness were also mentioned as important parts of successful Optimizer implementation, which is often a challenge for supply chains. If teams and departments are not willing to truly work together, break down silos, and establish cross-functional collaboration it will lead to suboptimal results. It was also mentioned that organizational rigidity can also challenge parameter setting where it is important to define the rules and priorities, which requires cross-team agreements for optimal results.

*“So, part of it is that the way we measure people, the KPIs, and often the reporting structures are very silo-based, but if you implement an optimizer to help individual silos, then you're just sub-optimizing for that one area.”*

*“You have to have an organizational mindset to get teams to have cross-functional collaboration. So, it is less about the actual system setup and more about the organization setting the parameters to achieve end-to-end optimization.”*

# 6 Conclusions

## 6.1 Prescriptive Data Analytics in Supply Chain Management

One of the research questions was how prescriptive data analytics can support decision-making in supply chain organizations. The theoretical background demonstrates that prescriptive data analytics can support supply chain management in various ways. According to Liu et al. (2023) the advantages of prescriptive data analytics can be divided into five main themes listed below.

- Reduced Costs
- Improved Operational Efficiency
- Enhanced Customer Satisfaction
- Increased Competitiveness
- Improved Supply Chain Resilience

Optimizing workflows, better resource allocation, and optimized processes through technologies like optimization models and simulation allows organizations to minimize waste and streamline their operations more effectively. This can reduce costs significantly. Prescriptive analytics also enables better decision-making through data-driven insights. Machine learning and simulation techniques can predict and address potential issues, optimize production scheduling, and improve inventory management, ultimately enhancing overall operational efficiency in the supply chain. Prescriptive data analytics enables organizations to be more responsive to changing market conditions and customer demands. Dynamic demand forecasting and personalized suggestions enable organizations to anticipate customer needs and personalize services, resulting in increased customer satisfaction.

The advantages of reduced costs, improved operational efficiency, and improved customer satisfaction provide a competitive edge for organizations in the market. This enables the organizations to better adapt to market fluctuations and disruptions and to make informed decisions that strengthen their market position. The advantage also enables proactive decision-making, helping supply chain organizations to be more agile, anticipate and manage potential disruptions, thereby enhancing their overall supply chain resilience.

The theoretical background also offers us insights on why prescriptive data analytics will be important for supply chain organizations going forward. As Sodero et al. (2019) noted, the field of prescriptive data analytics in supply chain management is expected to experience significant growth due to advancements in technology and a deeper understanding of the power of data-driven decision-making by organizations.

The agility it provides in a dynamic market and the enablement of effective data-driven decision-making for ever more complex supply chain networks are reasons why data analytics is expected to play a significant part in supply chain organizations going forward. Prescriptive data analytics enables organizations to quickly adapt to changing market conditions, disruptions, and evolving customer expectations. This agility will be crucial for navigating the complexities of tomorrow's global business landscape. Traditional methods may struggle to keep up with the market's rapid pace, but prescriptive data analytics enables organizations to adjust their supply chain strategies in real-time, empowering them to capitalize on new opportunities and minimize the impact of negative changes and disruptions. Predicting the future is impossible. However, prescriptive analytics can help organizations prepare for it by analyzing vast amounts of data and identifying underlying trends. This enables more proactive planning for various scenarios, providing foresight for smoother adaptation to emerging market conditions and ensuring competitiveness on the market.

Modern supply chains are ever more complex networks with numerous interconnected components. Making informed decisions amid this complexity can be a daunting task. Prescriptive analytics cuts through the noise by providing data-driven insights into every aspect of the supply chain. Organizations adopting advanced data analytics can be expected to gain a significant advantage in managing the complex relationships within their supply chain networks. The use of prescriptive data analytics enables them to make data-driven decisions quickly and accurately, leading to a

complete transformation of operational effectiveness and strategic planning. Traditionally, decision-making in supply chain organizations relies on intuition and experience, which are invaluable but also at times unreliable. Prescriptive analytics can help organizations and individuals back up their experiences with data-driven recommendations. Organizations can optimize inventory levels, resource allocation, and logistics based on real-time data. This leads to more efficient and cost-effective operations.

The interview revealed that prescriptive data analytics can enhance the agility and adaptability of supply chain organizations in planning, as well as identify bottlenecks within the chain, thereby improving its performance. Improved transparency in the supply chain enables the identification of these bottlenecks. Prescriptive data analytics supports faster planning in various scenarios and allows organizations to quickly react to disruptions and changes that affect the supply chain.

The interview results also reveal key requirements for organizations to effectively utilize prescriptive data analytics. Organizational agility and readiness are crucial factors for the successful implementation of prescriptive data analytics, which can often pose a challenge for supply chains.

Supply chain planning can be a very complex and challenging process. However, prescriptive data analytics can help organizations by offering agility and adaptability, which can be invaluable in a global market where disruptions have become the new norm. The reality of supply chains is that disruptions are inevitable. Unexpected changes in forecasts, demand, or capacity can disrupt even the most carefully crafted plan. Prescriptive data analytics addresses this challenge by enabling rapid replanning. The system can quickly analyze new data and generate revised plans, minimizing the time it takes to react and adjust. This allows organizations to maintain a competitive edge by responding swiftly to changing market conditions.

Prescriptive data analytics also goes beyond reactive measures and empowers organizations to be proactive by incorporating scenario planning. This allows organizations to create and test multiple potential plans based on different future possibilities. For example, an organization can model the impact of a sudden increase in demand from a particular region or a temporary shutdown of a production facility. Visualizing these 'what-if' scenarios can help identify potential challenges and opportunities in advance. Scenario planning is also a useful strategic tool for organizations. For

example, testing different combinations of production plants or customer segments can help find the most efficient and profitable configuration for a specific supply chain.

Supply chain planning can often be fragmented, with different departments focusing on their own areas without a clear picture of the bigger picture. Prescriptive data analytics has the ability to improve transparency by providing a holistic view of the entire supply chain. Instead of optimizing individual components, you can focus on optimizing the entire chain as a single, interconnected system. The end-to-end approach of prescriptive data analytics enables the identification of bottlenecks and inefficiencies that may have gone unnoticed in a siloed environment. By streamlining operations across the entire chain, it ensures a smooth and efficient flow of goods and materials.

Effectively implementing prescriptive data analytics enables organizations to achieve a more agile and adaptable supply chain, ultimately leading to increased efficiency, reduced cost, and improved customer satisfaction.

In summary, prescriptive data analytics is revealed to offer supply chain organizations numerous advantages, such as cost reductions achieved through optimized workflows and resource allocation. Furthermore, prescriptive data analytics enables organizations to make data-driven decisions, resulting in smoother operations and improved customer satisfaction through features like dynamic demand forecasting. These combined benefits provide a stronger competitive edge in the global market. Prescriptive analytics can also enhance supply chain resilience by enabling proactive decision-making and scenario planning. This allows organizations to anticipate and effectively manage disruptions. The growth of advanced data analytics can be expected as we look towards the future. Organizations that adopt a data-driven approach and demonstrate readiness to embrace these capabilities are best positioned to reap the significant rewards offered by prescriptive data analytics.

## 6.2 Data Analytics in the Organization

Based on the interviews conducted within the organization, it was found that the current IBP data analytics are utilized to varying degrees. The perceived usefulness of data analytics greatly depends on the scope of the planning, Figure 21. The tool was found to be more effective and was utilized more extensively at the tactical planning level compared to the operational planning level.

At the tactical planning level, the data analytics were found to be useful for decision-making regarding profitability planning, availability planning, and delivery planning. However, at the operational planning level, it was deemed to have limited value for day-to-day decision-making and planning processes. Although the analytics are used for stock level forecasting and deliveries, much of the work is done outside of IBP, mostly in separate Excel spreadsheets. The interviews also revealed that data analytics is perceived to be more useful during disruptions.

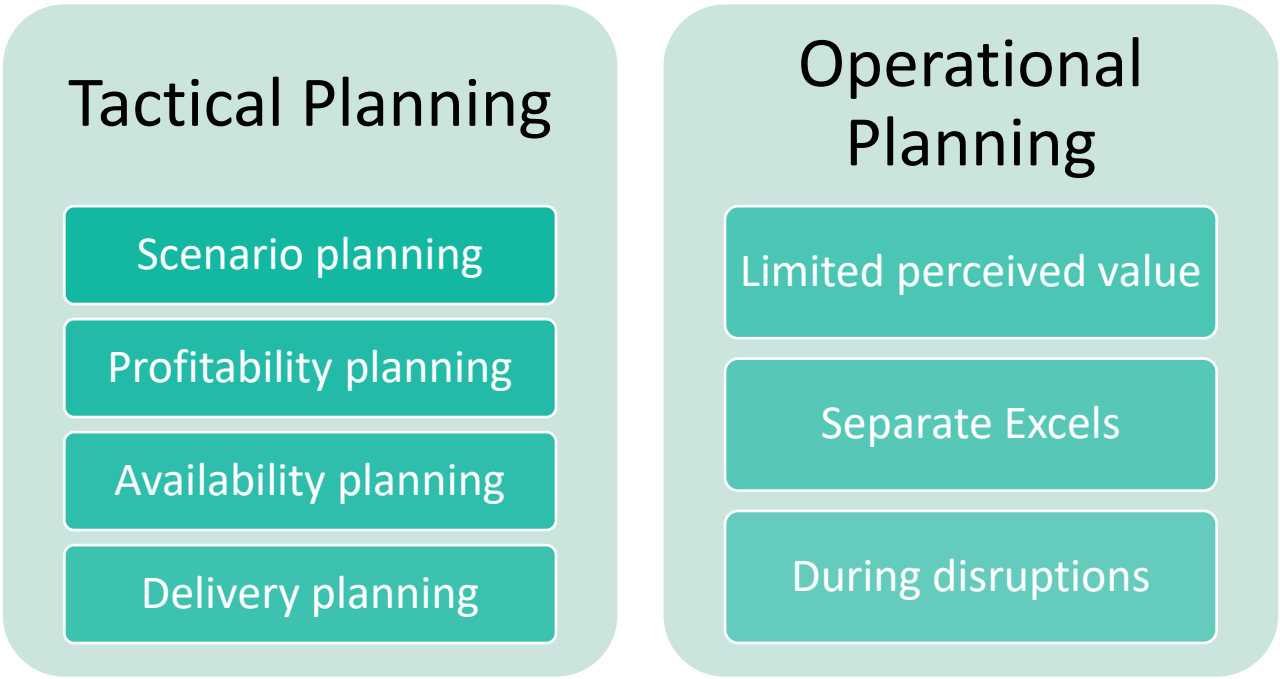


**Figure 21.** *Data Analytics Usage at Different Planning Scopes*

The interviews also gave a lot of feedback about the challenges faced and perceived in the organization with data analytics. Poor data quality, coming from the current implementation's inefficiencies, was a major challenge identified in the interviews. These issues considerably impede the system's effectiveness and often contributed to user frustration. Barriers to effective data analytics utilization in the organization include concerns about data quality, the low perceived value of analytics for day-to-day operations by users, and organizational workload.

One significant challenge in data analytics within the organization is that the analytics tool is not perceived as intuitive to use and is perceived to offer little value to daily planning on top of the already high organizational workload. Consequently, many employees choose to use the tool sparingly, which may explain why it is not considered easy to use. Furthermore, relevant information

for specific tasks is dispersed across multiple sources, making it difficult for casual users to obtain a comprehensive understanding. This lack of clarity can cause confusion, as even members of the organization may be uncertain about the precise meaning of certain numbers within the IBP system.

Another significant concern in the organization is the perceived low value of data analytics for day-to-day decision-making. Team members often feel that the system offers limited support in this area, leading them to create their own methods for tracking, forecasting, and planning. These ”shadow systems” primarily rely on separate Excel spreadsheets. This practice may offer a temporary solution for individual needs, but it ultimately contributes to the fragmentation of data across the organization.

The interviews revealed concerns about the accuracy of the data in the organization. Participants mentioned encountering issues with incorrect data, missing data points, outdated information that needs updating, and in some cases deliberately inaccurate data stemming from a siloed organizational structure. These issues are fixed manually. Such problems discourage users from relying heavily on the IBP system and instead, they use their own methods for tracking, forecasting, and planning.

The interviews provided valuable insights into the current state of the system and the challenges it presents by highlighting specific data quality issues. Addressing these concerns is crucial for improving the user experience and ultimately unlocking the full potential of data analytics within the organization. In summary the use of data analytics across the organization varied based on the planning scope, and the limited perceived value for operational planning and data quality were the main issues faced in the organization. Employees use data analytics tools differently depending on the planning horizon. For broader planning horizons, such as tactical planning, data analytics are considered valuable and are used extensively. However, for day-to-day operational planning tasks, employees found the data analytics system to be less useful. The system is utilized for forecasting stock levels and deliveries. However, it is important to note that much of this work is conducted outside of the main data analytics Integrated Business Planning tool. One obstacle to the effective use of data analytics is the perception that it provides little additional value for daily operations, particularly given the existing workload of employees. Additionally, the data analytics

tool itself is often considered to be not very user-friendly, leading many employees to use it sparingly. This infrequent use may contribute to the perception that the system is difficult to learn. Additionally, relevant information for specific tasks is dispersed across multiple views, which can make it difficult for casual users to obtain a comprehensive understanding. Another concern is the poor quality of the data. This affects the effectiveness of the system and frustrates users. Manual fixes are required to address these issues, which further discourages users from relying on the data analytics system and pushes them towards using their own methods for tracking, forecasting, and planning. Figure 22 highlights the key challenges faced with data analytics currently.

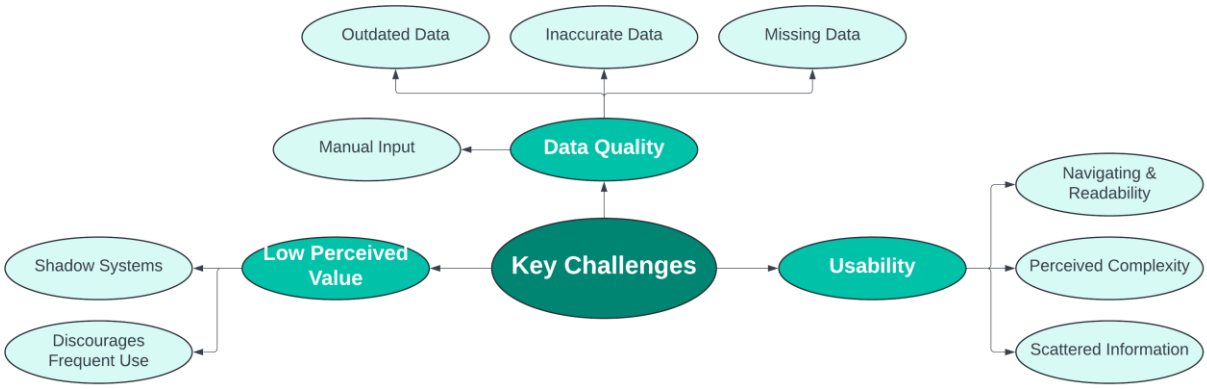


**Figure 22.** *Challenges Perceived with Data Analytics*

## 6.3 SAP Optimizer Implementation Feasibility

Both the theoretical background and the consultant interview demonstrate that prescriptive data analytics can provide supply chain organizations with many advantages. These advantages can help organizations navigate disruptions and make data-driven decisions. Organizations that are ready to adopt a data-driven approach are best positioned to gain a competitive edge in the market. It is easy to recommend that organizations implement prescriptive data analytics as part of their supply chain management. However, successful implementation necessitates careful

consideration, with key requirements for effective implementation being identified in both the literature and interviews.

Punia et al. (2020) note that despite the potential benefits achieved from prescriptive data analytics, supply chain organizations can also face significant challenges in their implementation. They highlight the fact that prescriptive data analytics relies heavily on high quality data. The supply chain ecosystem involves a complex system of data sources with varying formats, making it challenging to ensure consistent and accurate data. Therefore, strong data management practices must be prioritized. Also, an organizational culture that values data quality should be invested in and strived towards. Only by ensuring these can organizations trust the results provided by data analytics and gain advantages from the implementation.

The implementation of new technologies, such as sophisticated analytical techniques through prescriptive analytics, may encounter resistance within organizations. Sheng et al. (2021) note that the successful integration of these tools requires a high level of commitment and support from all levels of the organization. Resistance to change and the need for increased data literacy among employees can impede implementation or limit its effectiveness. Also, siloed departments and a lack of information sharing can further complicate matters. To overcome these obstacles, proactive change management initiatives are essential. Organizations have to foster a culture that prioritizes collaboration, data quality, and skilled support for a successful prescriptive data analytics implementation.

The interview revealed two key challenges associated with a successful Optimizer implementation: data dependency and organizational readiness. These challenges identified in the interview are in an agreement with the literature. It was emphasized that Optimizer heavily relies on accurate and comprehensive data from the entire supply chain to produce reliable results. Additionally, for Optimizer to be truly effective, a high level of collaboration and agility is required across teams and departments in organizations.

When comparing the key requirements for effective prescriptive analytics implementation with the current stage of data analytics in organizations, it is evident that many of them overlap, Figure

23. Therefore, the decision to take next steps towards prescriptive data analytics should focus on first resolving the current challenges perceived with data analytics.

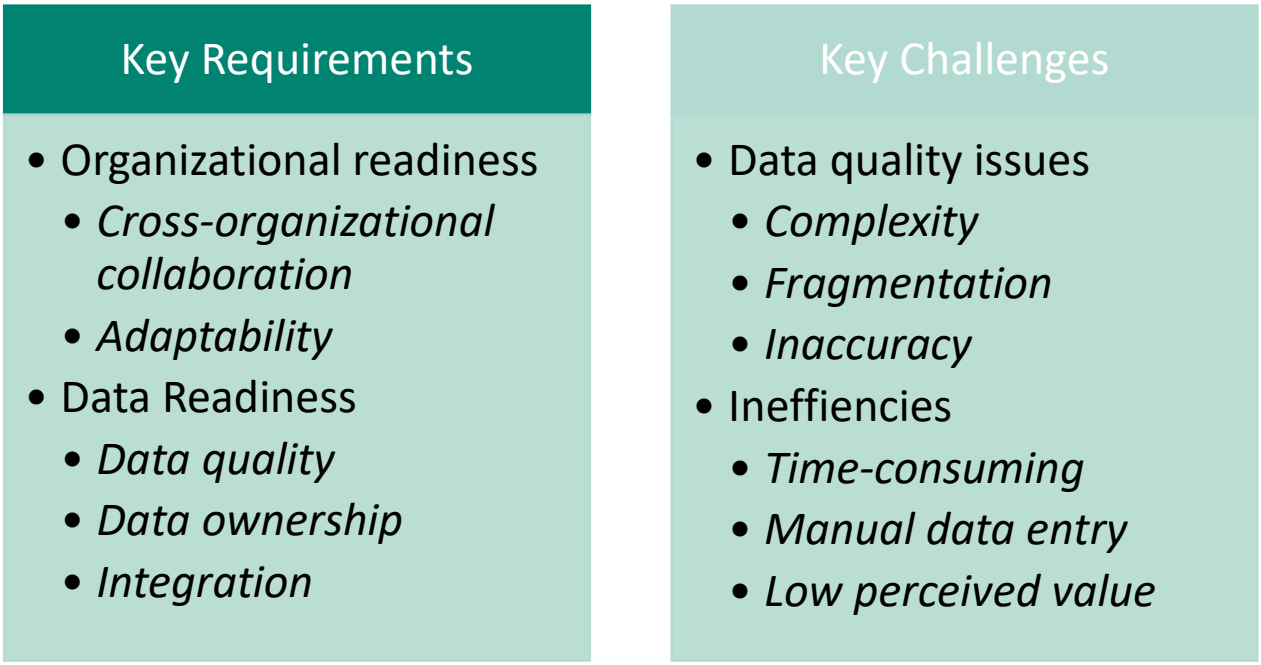


**Figure 23.** *Key Requirements and Key Challenges*

One significant challenge that employees face in the organization regarding data analytics is the workload and the perceived low value for operational planning. These factors have led to fragmented, incorrect, and outdated data. While workarounds may solve short-term issues stemming from these problems, they ultimately create a more significant problem with data management, negatively impacting data quality in the organization. Management should prioritize steps to ensure sufficient resources in the organization to ensure the workload is at a manageable level. Secondly, it would be important to study how data analytics could be better utilized for operational planning, which could help cultivate an organizational culture where data analytics is more widely accepted.

Another significant challenge in the organization related to data analytics is the readiness of the organization to effectively utilize data analytics. To overcome resistance to change, management should ensure that the organization's data literacy is sufficient to enable the effective implementation of prescriptive data analytics. Additionally, to optimize the supply chain network, it is important to avoid focusing solely on one segment, as this may lead to suboptimization. Instead, the

organization should aim to break down silos and establish open cross-functional collaboration throughout the supply chain for the best results.

In summary, it can be stated that successful implementation of prescriptive data analytics requires the organization to first address the current challenges, despite its potential benefits. The organization should prioritize strong data management practices and a culture that values data quality. In order to overcome resistance and foster collaboration across departments, proactive change management is crucial. Addressing existing challenges is the critical first step. This includes tackling employee workload concerns and enhancing the perceived value of data analytics for operational planning. Furthermore, improving data literacy and breaking down departmental silos will be vital for the successful implementation of prescriptive data analytics.

# 7 Discussion

The objective of this thesis was to gain a deeper understanding of how data and analytics can benefit modern supply chain organizations to succeed, to gain an understanding of the current level of data analytics usage in the supply chain planning organization, and to compare what would be the organizations readiness to implement prescriptive data analytics. The aim was to be able to offer a proposal about what it would take to implement the SAP IBP Optimizer data analytics tool and to try and identify what are the current issues faced with data analytics.

The theoretical background for the thesis was structured around three main themes to support the objective and research questions of the study. The themes covered were digitalization in supply chains, knowledge management, and data analytics. This foundation offers a good understanding of how modern supply chains are evolving and utilizing digital tools, such as data analytics. However, the research could have been further supported by a more detailed approach to some of the themes, some of which were covered in a fairly general manner.

The thesis research material is based on thematic interviews that supported the case study. A total of eight interviews were conducted, providing valuable insights into how prescriptive data analytics can support modern supply chain organizations, the challenges faced with it, and how data analytics is used and perceived in the target organization. The data collected from the organizations was sufficient to draw confident conclusions as the interviews reached a saturation point towards

the end of the round. However, gathering additional data from outside the target organization could have provided a basis for comparison and led to further insights.

The research questions for this study were:

1. How can prescriptive data-analytics support decision-making in supply chain organizations?

2. How is data-analytics currently utilized in the organization, and what are the biggest challenges with it?

3. Would implementing SAP IBP Optimizer be beneficial and boost the organization's performance?

This research successfully addressed the initial objectives outlined in the thesis by answering the research questions through a review of recent literature and original research. The study identified key advantages and requirements for data analytics in modern supply chains, as detailed throughout this work. The interviews conducted provided valuable insights specific to the target organization, revealing how data analytics tools are currently used and perceived at different organizational levels. These insights led to the development of proposals aimed at improving both the utilization and perception of data analytics within the organization's supply chain operations. While the theoretical background did not yield groundbreaking revelations, it provided a strong foundation of established research on the potential benefits of prescriptive data analytics for modern supply chains. Additionally, the study successfully identified crucial requirements for achieving effective implementation of data analytics in similar organizational settings.

In response to the first and second research questions, the study demonstrated that prescriptive data analytics can significantly enhance decision-making in supply chains. In summary, the advantages of prescriptive data analytics translate to a stronger competitive edge and increased supply chain resilience, as it enables proactive planning for disruptions. On the other hand, the study demonstrated that data analytics is underutilized for daily tasks in the target organization. The study identified several key reasons for this, including a lack of perceived value, user-friendliness issues, poor data quality, and scattered information. This indicates a necessity for the

implementation of a system with enhanced data management capabilities, offering added value for all planning scopes, in order to fully realize the potential of data analytics for daily operations.

Prescriptive analytics extends beyond the scope of basic data analysis, offering optimized recommendations in addition to insights. This can result in tangible benefits for supply chain organizations in general and the case organization. For instance, the advanced analytics could assist the organization in transitioning away from separate spreadsheets by adding value to operational planning scope, such as vessel planning, with a centralized system that leverages real-time data to suggest the most efficient workflows and resource allocation. This would enable the case organization to take a proactive approach to adjusting inventory levels and production schedules, which ultimately leads to more efficient operations and enhanced customer satisfaction. This would not only reduce costs but also free up employee time previously spent on manual calculations and data manipulation. The implementation of a prescriptive analytics system can also enhance employee adoption by adding value to operational planning scope. By replacing the use of separate Excel files with a unified platform, the organization can ensure consistent data access and analysis across departments. This not only encourages collaboration but also reduces the necessity for individual workarounds, thereby facilitating a more standardized and efficient approach to work. In essence, prescriptive data analytics can enable the case organization to transition from a reactive to a proactive approach to supply chain management. By employing data-driven insights and optimized recommendations, costs can be reduced, operations streamlined, and customer satisfaction enhanced, thereby conferring a significant competitive advantage.

Regarding the third research question, it is evident that the potential benefits of prescriptive data analytics are considerable. However, the study suggests that the organization should address some current challenges before implementing SAP IBP Optimizer. These challenges include data quality management practices, a need for proactive change management to overcome employee resistance and foster collaboration, and the need to improve employee perceptions of the value of data analytics for operational planning. Additionally, improving data literacy among employees and breaking down departmental silos will be vital for successful implementation. By addressing these challenges, the organization can create a more favorable environment for implementing SAP IBP Optimizer and potentially achieve a performance boost.

## 7.1 Reliability and Validity

The research process, methodology, and approach are described in detail in chapters two and four and help in evaluating the reliability and validity of this study. The chosen research methodology was well-suited for this study, and the thematic interview themes directly addressed the research questions of the study. Interviewees were selected for their expertise relevant to the research topic. The semi-structured interviews followed a thematic framework and had supportive interview questions to guide the discussions as necessary. The discussions were open-ended, and the interviewees participated actively.

This study employs a comprehensive and up-to-date set of references, drawing heavily on recent publications to ensure the validity and reliability of the findings. The incorporation of a diverse set of high-quality sources, including the most recent advancements in the field, ensures that the research reflects the current state of knowledge and minimizes the risk of bias from outdated information.

Evaluating the reliability of the study, including its validity and reproducibility of results, requires consideration of several factors. It is important to select interviewees and topics that will provide the most accurate answers to the research questions. Some interviews could have benefited from more information about the subject beforehand. Furthermore, the researcher's own knowledge may have unintentionally influenced the discussions on data analytics at times. However, for the sake of reproducibility, it is likely that the study will yield similar results in the short term within the same organization.

The research was conducted with a commitment to care, honesty, and transparency. All procedures adhered to the reporting guidelines set forth by JAMK. Interviews were anonymized during recording, processing, analysis, and all reporting stages. To ensure complete anonymity, all recordings and notes were destroyed after the research concluded.

## 7.2 Suggestions on Further Research

The thesis combines information from various literature sources about digitalization and its significance in modern supply chain management. It addresses how modern supply chains are evolving

and becoming increasingly reliant on digitalization and information to manage value chains effectively. The research findings are most valuable to the client company, but the advantages, challenges, and requirements for supply chains with advanced data analytics are universal. Further research could benchmark these findings with other supply chain organizations to determine the commonality of data analytics usage and their perceived value in the organizations on different levels and planning scopes. Also, as this study focused on the benefits and feasibility of implementing prescriptive data analytics, further research on how to overcome challenges and requirements would be recommended.

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# Appendices

## Appendix 1. Organization Interview Thematic Framework

**In what situations do you use data analytics currently?**

- Do you feel it supports decision making?
- What are the main benefits you feel you gain from data analytics?
- What are the main challenges you face with data analytics?
- How do you feel about the level of system integration currently?

**How would you like data analytics to support your work in the future?**

- How important do you see it going forward?
- Are there specific areas you'd like data analytics to support decision making?

**Open discussion and wrap-up.**

## Appendix 2. Consultant Interview Thematic Framework

**What are the benefits that you are seeing from Optimizer in organizations?**

- In your perspective, what are the potential benefits of implementing SAP IBP Optimizer for supply chain organizations?
- How do you think SAP IBP Optimizer could help improve our organizations performance?
- Do you believe SAP IBP Optimizer could enhance collaboration across different departments within the supply chain?

**What are the challenges that organizations often face with the implementation?**

- What are usually the biggest concerns regarding the implementation of SAP IBP Optimizer?
- How do you think the current skillset and data literacy within the organization might impact the implementation?
- How important would you say data management practices are for implementing SAP IBP Optimizer?

**Open discussion and wrap-up.**