ASSESSING AND DEVELOPING ANALYTICS CAPABILITIES IN PURCHASING AND SUPPLY MANAGEMENT

A Case Study

Lappeenranta–Lahti University of Technology LUT & University of Twente

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ABSTRACT

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Assessing and developing analytics capabilities in purchasing and supply management

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Significant increase in the available data together with quickly developing technological tools have increased the interest in analytics utilisation in various business functions. Purchasing and supply management (PSM) collects vast amounts of data for example on spending, performance assessment and negotiations that can through analytics be used to improve decision-making. However, transforming the raw data into value and understanding the capabilities required to do so remain as great challenges for practice.

This thesis examines the assessment and development of analytics capabilities in PSM. The study proposes a framework with three interdependent capability areas, namely organisational culture, technologies and data, and talent, on which firms should focus when assessing and developing their PSM analytics capabilities. The framework is based on a single case study that was comprised of a literature review and interviews with PSM managers. The case organisation's PSM analytics capabilities were assessed using the framework. In addition, suggestions for development were derived based on the results.

From the theoretical perspective, the results extend the existing knowledge of PSM analytics capabilities and provide grounds for studying the area in the future. In addition, the study broadens the discussion of the dynamic capabilities view, as it is argued that well-developed PSM analytics capabilities can act as dynamic capabilities and thus provide competitive advantage to organisations. For managers, the study provides benefits by identifying specific PSM analytics capability areas that in turn help firms prioritise their efforts when developing those capabilities.

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Hankintatoimen analytiikkakyvykkyyksien arviointi ja kehittäminen

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Saatavilla olevan datan merkittävä kasvu yhdessä nopeasti kehittyvien teknologioiden kanssa on lisännyt kiinnostusta analytiikan hyödyntämiseen useissa yritystoiminnoissa. Hankintatoimi kerää valtavan määrän dataa esimerkiksi kulutuksesta, suoriutumisen arvioinnista ja neuvotteluista, jota voidaan käyttää analytiikan avulla parantamaan päätöksentekoa. Raa'an datan muuntaminen rahan arvoiseksi tiedoksi sekä siihen tarvittavien kyvykkyyksien ymmärtäminen ovat kuitenkin edelleen haasteita käytännön toiminnassa.

Tämä tutkielma tarkastelee analytiikkakyvykkyyksien arviointia ja kehittämistä hankintatoimessa. Tutkielma ehdottaa viitekehystä, jonka kolmeen toisistaan riippuvaan osa-alueeseen, tarkemmin ottaen yrityskulttuuriin, teknologioihin ja dataan, sekä osaamiseen yritysten tulisi keskittyä arvioidessaan ja kehittäessään hankintatoimen analytiikkakyvykkyyksiään. Viitekehys perustuu yksittäistapaustutkimukseen, joka koostui kirjallisuuskatsauksesta ja haastatteluista hankintatoimen johdon ja esimiesten kanssa. Kohdeyrityksen hankintatoimen analytiikkakyvykkyyksiä arvioitiin viitekehyksen avulla. Lisäksi tulosten perusteella annettiin kehitysehdotuksia.

Teoreettisesta näkökulmasta tulokset laajentavat olemassa olevaa tietoa hankintatoimen analytiikkakyvykkyyksistä ja tarjoavat pohjan aiheen jatkotutkimukselle. Lisäksi tutkimus laajentaa keskustelua dynaamisten kyvykkyyksien teoriasta, sillä hyvin kehittyneiden hankintatoimen analytiikkakyvykkyyksien uskotaan toimivan dynaamisina kyvykkyyksinä, ja siten tarjoavan kilpailuetua yrityksille. Yritysjohdolle tulokset tarjoavat hyötyjä tunnistamalla tiettyjä hankintatoimen analytiikkakyvykkyyksien osa-alueita, jotka puolestaan auttavat yrityksiä priorisoimaan ponnistelujaan näiden kyvykkyyksien kehittämisessä.

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Five years of studies have gone by way faster than I expected. In addition to the hard work, studies at LUT and UT were filled with valuable learning opportunities and unforgettable memories. However, getting through the studies required more than academic support. Therefore, I would like to express my deepest appreciation to my partner who has supported me over the years. Special thanks should also be given to my parents for their unconditional support both emotionally and financially. Finally, I am forever thankful for my group of friends who have provided the greatest peer support throughout our studies at LUT and whom with we have made countless amazing memories. Without you, the many days in the library would probably have been much more productive, but also significantly more boring.

Cheers to the future ahead!

Vantaa 29.5.2023

Noora Höök

LIST OF ABBREVIATIONS

PSM	Purchasing and supply management
SCM	Supply chain management
ERP	Enterprise resource planning
RFID	Radio frequency identification
MRP	Material requirement planning
IT	Information technology

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1 Introduction

This thesis examines the development of analytics capabilities in purchasing and supply management (PSM). Analytics in general refers to the "activities that transform data into action" (Öhman, Arvidsson, Jonsson & Kaipia 2021, 938). Thus, analytics capabilities offer firms the ability to collect and handle vast amounts of available data (Clain, Liberatore & Pollack-Johnson 2016, 27). PSM is a business function responsible for the operative and strategic processes of acquiring materials and services for the organisation (Schiele 2019, 48). Large amounts of data are created for example through spending, performance assessment, and negotiations that can be used to manage risks and monitor performance (Wang, Gunasekaran, Ngai & Papadopoulos 2016, 103). However, transforming raw data into business value and understanding the capabilities required to do so are seen as great challenges for organisations (Arunachalam, Kumar & Kawalek 2018, 416; Ramakrishnan, Kathuria & Khuntia 2020, 56). Investments in analytics technologies alone will not pay off if the capabilities to leverage the technologies are missing.

The recent reports of major consulting firms predict increasing digitalisation and automation in supply chains in the near future and highlight the growing demand for supply chain professionals who have strong digital and analytical skills (KPMG 2021, 7;11; IBM 2023, 8; PwC 2023). This has also been recognised by PSM professionals, who suggest that analytical skills are among the top 10 current and future competencies required in being successful in their job (Bals, Schulze, Kelly & Stek 2019, 6). Big data business analytics refers to the firms' ability to transform data with high volume, velocity, and variety into actionable insights (Wang et al. 2016, 99). When efficiently used, big data analytics can provide a great asset for improving decision-making and is argued to play a key role in supply chain improvement and transformation (Arunachalam et al. 2018, 416). Procurement processes have been suggested to benefit from big data adoption for example through decreased costs and time and increased quality and flexibility (Moretto, Ronchi & Patrucco 2017, 95). In addition, Hallikas, Immonen, and Brax (2021) found that external data analytics capabilities have a positive influence on digital procurement capabilities that further enhance supply chain performance and business performance.

In order to leverage analytics and achieve the benefits, strong data analytics capabilities must be developed (Mikalef, Boura, Lekakos & Krogstie 2019, 271). In supply chain management (SCM) literature, the many benefits of strong analytics capabilities include for example increased supply chain transparency (Zhu, Song, Hazen, Lee & Cegielski 2018, 59), resilience (Dubey, Gunasekaran, Childe, Wamba, Roubaud & Foropon 2021, 120), agility (Srimarut & Mekhum 2020, 187), enhanced supply chain collaboration (Iyer 2011, 38), and greater value from supply chain relationships (Ahmed, Shafiq & Mahmoodi 2022, 784). However, regardless of the recognised benefits of data analytics capabilities, the development of these capabilities especially in PSM remains an understudied area. A more holistic approach for assessing and improving the analytics capabilities in PSM is needed to make sure that organisations can keep up with the quickly changing environment, transform data into actionable insights and sustain their PSM function's competitiveness.

This study aims to increase the understanding of analytics capabilities that are required in a PSM function so that the purchasing professionals would be able to extract the value from data and make better-informed decisions, and therefore be able to better achieve the PSM function's objectives. It has been argued that being aware of the firm's current analytics capabilities also makes the firm better prepared in turning challenges into opportunities (LaValle, Hopkins, Lesser, Shockley & Kruschwitz 2010). Light will be shed on a previously understudied area of PSM analytics capabilities, especially considering the development of such capabilities. Therefore, the results of this study can be of interest to both managers and future research. The theoretical results will be linked to the dynamic capabilities view, while the managerial implications can provide insights to PSM managers who are interested in assessing or improving the analytics capabilities of the function.

1.1 Prior Literature

The adoption of different information and communication technologies in purchasing and supply management has been high for the past decade including enterprise resource planning (ERP), radio frequency identification (RFID), and the Internet of Things (Arunachalam et al. 2018, 416). The modern information and communication technology systems can generate vast amounts of data, that PSM can further leverage to make better decisions, optimise its performance, and predict future outcomes. In addition, external sources of data such as publicly available news and social media channels can be used nowadays to identify

trends and events in the supply market (Wang et al. 2016, 103). These large datasets of both structured and unstructured data are referred to as big data (Beyer & Laney 2012, 2). While they require more sophisticated computational techniques to be stored and analysed than traditional datasets (Arunachalam et al. 2018, 417), the efforts are likely to be rewarded for example with improved supply chain resilience and robustness (Brandon-Jones, Squire, Autry & Petersen 2014, 67), visibility (Barratt & Oke 2007, 1230), and operational performance (Chae, Olson & Sheu 2014, 4704).

One of the first papers considering SCM together with big data analytics was written by Waller and Fawcett (2013). After their call for further research, a growing number of papers have considered analytics capabilities in SCM. The focus is often on the entire SCM function from planning to customer deliveries. Even though many studies from the SCM perspective provide implications for PSM too (e.g., Chae & Olson 2013; Arunachalam et al. 2018; Wamba & Akter 2019; Jha, Agi & Ngai 2020), only very few papers have solely focused on the PSM specific capabilities (Handfield, Jeong & Choi 2019; Öhman et al. 2021). Therefore, prior frameworks for assessing the analytics capabilities were identified both from the SCM and PSM literature. Table 1 summarises the key publications.

Table 1: Key publications

AUTHORS	YEAR	FOCUS
Chae & Olson	2013	Framework for business analytics in supply chain
Arunachalam, Kumar & Kawalek	2018	Big data analytics capabilities in supply chain
Handfield, Jeong & Choi	2019	The current and future state of procurement analytics
Wamba & Akter	2019	Identifying the dimensions of big data-driven supply chain analytics capability and assessing its impact on firm performance
Jha, Agi & Ngai	2020	Identifying the factors that help or prevent organisations from building their big data analytics capabilities in the supply chain
Öhman, Arvidsson, Jonsson & Kaipia	2021	Development of analytics capabilities in purchasing and supply management function

While the early framework of Chae and Olson (2013) mostly focuses on technological capabilities, the study proposes that supply chain analytics that is composed of data management capability, analytical supply chain process capability, and supply chain performance management capability have a positive impact on supply chain performance. These propositions may motivate firms to invest in analytics initiatives.

Arunachalam et al. (2018) propose a framework for measuring big data analytics capabilities on a supply chain level. The model consists of three dimensions, namely data generation, integration and management capabilities, analytics and visualisation capabilities, and data-driven culture (Arunachalam et al. 2018, 424) (Figure 1).

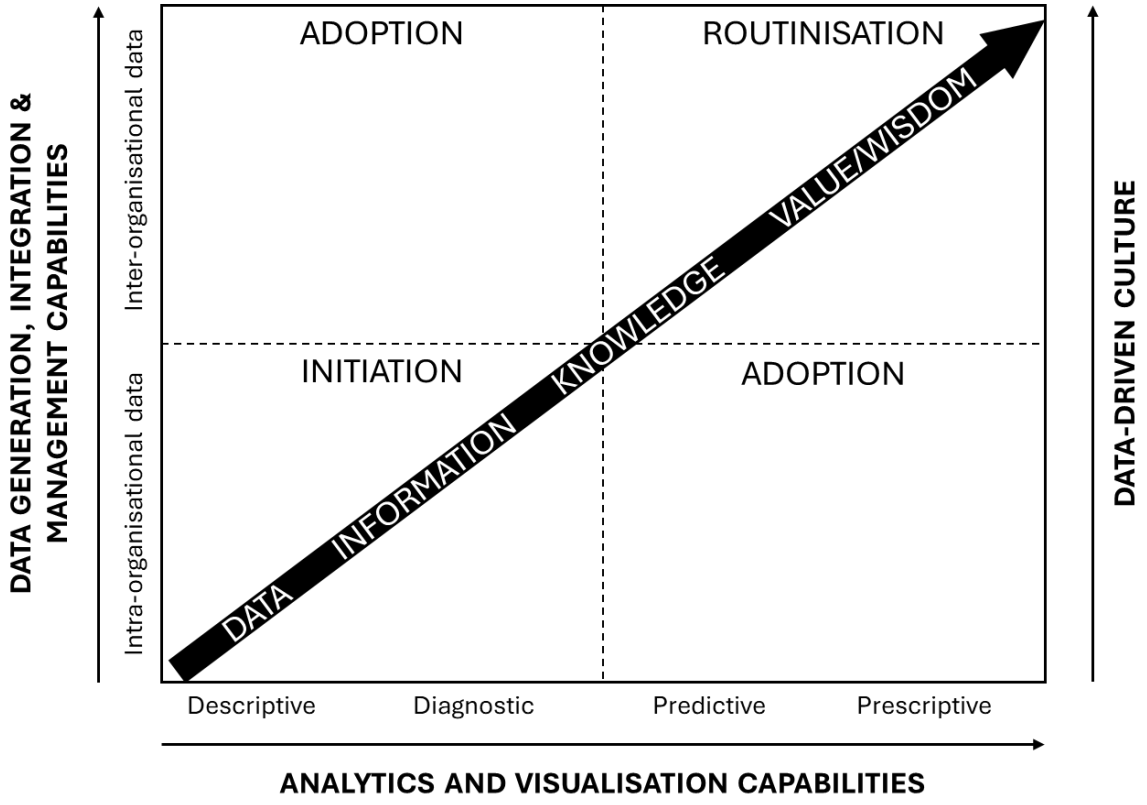

Figure 1: Big data analytics capabilities for supply chain (Arunachalam et al. 2018, 424)

The dimensions form a matrix with four quadrants, that can be used to measure the current state of big data analytics capabilities in the supply chain. The black arrow in the middle describes the value that is gained from the data. In the initiation phase, both the analytics and visualisation capabilities and data generation, integration, and management capabilities are weak. Therefore, the data can only provide information. In the routinisation phase,

organisations are able to extract the value from the data with strong analytics and data handling capabilities.

The model highlights a few important features of analytics capabilities that also apply to PSM. Firstly, data management and data-driven culture as dimensions shift the focus from tangible resources such as technologies and raw data towards the value-providing areas that are as important if not even more important than the tangible resources. Secondly, the model greatly illustrates that all three dimensions (data handling, analytics and visualisation, and culture) must be developed to truly gain value from the data.

Handfield et al. (2019) identified three theoretical constructs that procurement analytics need in transforming the data into insights: talent, information visibility, and real-time data technologies. These constructs contribute to four predicted future procurement analytics areas of data governance and management, spend management, contract and supplier life cycle management, and supply market intelligence and risk (Handfield et al. 2019, 985). The theoretical constructs can be used as a starting point for developing the framework for PSM analytics capability assessment.

Wamba and Akter (2019) developed a two-level framework, that suggests that supply chain analytics capability is comprised of management capability, technology capability, and talent capability. Each area has multiple sub-areas for measurement. The results of the study suggest that all these areas have a significant impact on the supply chain analytics capability. (Wamba & Akter 2019.) Quite similar results were provided by the study of Jha et al. (2020), who suggest that big data analytics capability in the supply chain is comprised of data management and use of advanced software, human resources and training, organisational politics, global integration, and environmental determinism. This analytics capability is proposed to have an impact on the competitive advantage of organisations (Jha et al. 2020).

Öhman et al. (2021) conceptualise analytics capability through four aspects: technology, leadership or governance, culture, and methods. They also identify three themes that can manifest in all four aspects: evidence-based decision-making, collaborative atmosphere, and organisational adaptability. The findings of the study highlight that building the analytics capabilities in the PSM function require decision-makers who are willing to base their decisions on data and facts. Most of the studied firms noted that there was a lack of understanding among the employees on either PSM decisions or analytics. (Öhman et al.

2021, 946-947.) Thus, professionals who have an understanding of both the PSM discipline and analytics would be valuable to organisations.

Similar to Arunachalam's et al. (2018) framework's initiation phase, Öhman et al. (2021, 949) argue that the development of analytics capability in PSM starts from a justification phase, that employs intra-functional solutions and aims to integrate PSM knowledge with analytics. When the process progresses, more cross-functional initiatives are put in focus (Öhman et al. 2021, 949). This progress can be interpreted to move towards the adoption or routinisation phases in Arunachalam's et al. (2018) framework, depending on the development speed of the analytical solutions.

To sum up, prior frameworks suggest that analytics capabilities are constructed from a number of different capability areas. By combining the areas of prior frameworks, three major capability areas were detected: organisational culture, technologies and data, and talent. The previously suggested constructs are further categorised according to the three major areas in Table 2.

Table 2: Categorisation of SCM and PSM analytics capabilities frameworks

	AUTHORS	CAPABILITY AREAS		
		Organisational culture	**Technologies & data**	**Talent**
SCM capabilities	Chae & Olson (2013)		- Data management - Analytical supply chain process - Supply chain performance management	
	Arunachalam et al. (2018)	- Data-driven culture	- Data generation, integration, and management - Analytics and visualisation capabilities	
	Wamba & Akter (2019)		- Technology	- Management - Talent
	Jha et al. (2020)	- Organisational politics - Global integration	- Data management and use of advanced software - Environmental determinism	- Human resources and training
PSM capabilities	Handfield et al. (2019)		- Information visibility - Real-time data technologies	- Talent
	Öhman et al. (2021)	- Leadership/ governance - Culture	- Technology	- Methods

The identified three main capability areas form the foundation of this study, as PSM analytics capabilities are comprised and further studied from these perspectives.

1.2 Key Concepts & Definitions

Purchasing and supply management analytics is defined in this study as a data-driven approach to managing the objectives of the PSM function. PSM is a business function responsible for the operative and strategic processes of acquiring materials and services for the organisation (Schiele 2019, 48). In addition to the basic objectives of ensuring safe supply at appropriate quality and low costs, PSM can facilitate innovation in the buyer-supplier relationships and ensure competitive advantage by designing and maintaining the supply network (Schiele 2019, 49).

Analytics capabilities are considered as the firm's "ability to capture, store, manage, and analy[s]e data" (Clain et al. 2016, 27). As per the conceptualisations in prior literature (Chae & Olson 2013; Arunachalam et al. 2018; Wamba & Akter 2019; Jha et al. 2020; Handfield et al. 2019; Öhman et al. 2021), the analytics capabilities in PSM can be divided into three capability areas: organisational culture, technologies and data, and talent.

PSM analytics capabilities are defined based on the above definitions of PSM analytics and analytics capabilities as using organisational culture, technologies and data, and talent to capture, store, manage and analyse data in order to achieve the PSM function's objectives.

Big data are defined as "high-volume, -velocity and -variety information assets that demand cost-effective, innovative forms of information processing for enhanced insight and decision making" (Beyer & Laney 2012, 2). In the supply chain context, it has been characterised as "structured and unstructured relationship-based information unique to its holder because of the information's volume, velocity, variety, and veracity" (Richey, Morgan, Lindsey-Hall & Adams 2016, 711). Big data are essential for driving performance gains in organisations but not sufficient alone. To leverage big data in improving competitive performance, a set of other tangible and intangible resources are required. (Mikalef, Krogstie, Pappas and Pavlou 2020, 2.)

Dynamic capabilities have been defined as "the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments"

(Teece, Pisano & Shuen 1997, 516). The dynamic capability view disaggregates the dynamic capabilities into sensing opportunities and threats, seizing the opportunities, and maintaining competitiveness by handling tangible and intangible organisational assets (Teece 2009, 4). This paper suggests that developing PSM analytics capabilities that are difficult for competitors to imitate is an opportunity that firms should seize to form the capability into an asset that provides competitive advantage for the supply chain and the entire firm.

1.3 Scope and Aim of the Study

Analytics have different purposes of use in different business functions. Due to the differing needs and capabilities required inside the distinct business and even supply chain functions, the focus of this study is only on capabilities that should be possessed by the PSM function. Therefore, other business and supply chain functions are out of the scope of this study. The aim of this study is to develop a framework for assessing the current analytics capabilities of a PSM function and provide suggestions on how to further develop the capabilities Therefore, the main research question of the study is:

- *How analytics capabilities can be developed in purchasing and supply management?*

The main question is divided into three sub-questions according to the identified capability areas:

1. *What kind of organisational culture supports the development of analytics capabilities in purchasing and supply management?*
2. *What kinds of technologies and data support the development of analytics capabilities in purchasing and supply management?*
3. *What kind of talent supports the development of analytics capabilities in purchasing and supply management?*

Due to the limited number of available PSM-specific frameworks, literature on SCM analytics capabilities will be used as support to explore the capability areas that are applicable to the PSM function. Literature on the three major capability areas will be further examined to gain a comprehensive understanding of analytics capabilities in PSM. The links of these concepts to analytics capabilities in general and to the PSM objectives are illustrated in the conceptual framework below (Figure 2).

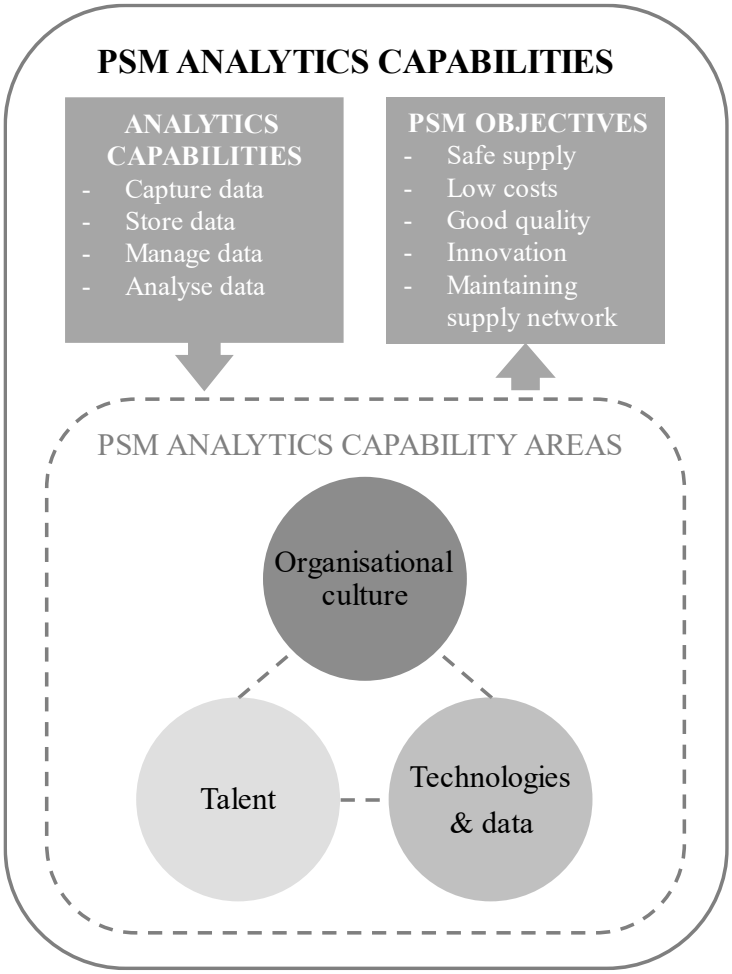

Figure 2: Conceptual framework

To answer the research questions, a similar research approach as in Gudfinnsson, Strand and Berndtsson's (2015) case study will be used. A literature review is conducted to identify the success factors regarding each capability area of organisational culture, technologies and data, and talent. A single case study in a large Finnish technology firm is conducted to validate the framework and analyse the current state of PSM analytics capabilities of the case company. A roadmap for future improvement will be provided. As argued by Öhman et al. (2021, 952), a one-size-fits-all solution for analytics capability development is not likely to exist. Thus, the roadmap of this study is mainly intended for the use of the case firm.

The case selection was based on the following aspects. The study is conducted in a large organisation, as they typically have a purchasing and supply management function that is separate from other business functions such as data analytics, logistics, and warehousing. In

addition, only the context of business-to-business organisations is considered to limit the possible data sources and analytics techniques (e.g., call centre data, customer reviews on a large scale, and consumer demand analysis in demand planning are excluded). The technology sector provides a data-rich business area where many opportunities for analytics exist.

The study will make contributions to the purchasing and supply management literature by increasing the knowledge of PSM-specific analytics capabilities and the development of these capabilities, which currently remain an unexplored area. The study can also serve as a basis for future research by providing the first insights on the topic. The insights can be used in practice by PSM managers to identify, assess and enhance the analytics capabilities of the function.

1.4 Structure of the Study

The paper is structured as follows. The next section will discuss the literature around analytics capabilities in PSM with a focus on the three identified capability areas of organisational culture, technologies and data, and talent. The third section introduces the methodology of the study. The results of the empirical study are elaborated in the fourth section. These are followed by the discussion, where the connections between the developed framework, analysis of the case firm's PSM analytics capabilities and development ideas are illustrated. The sixth chapter concludes the study by summarising the previous chapters, presenting the implications for theory and practice, considering the limitations of the study, and providing suggestions for future research.

2 Developing Analytics Capabilities in Purchasing and Supply Management

This section reviews the existing literature around PSM analytics capabilities, especially focusing on the three main capability areas identified from prior frameworks: organisational culture, technologies and data, and talent. The purpose is to identify the papers that best contribute to the topic considering the scope of the study. As the attention the topic has received in previous literature is limited, papers from the SCM field are used to support in gaining a comprehensive overview. First, the connection between analytics capabilities and the dynamic capabilities view is discussed. Second, the analytics capability areas will be examined in detail.

2.1 Analytics Capabilities as Dynamic Capabilities

This study will use the resource-based view and the dynamic capabilities as the theoretical background to which the results of the study can be linked. Resource-based view posits that to gain sustained competitive advantage, an organisation must possess resources that are valuable, rare, imperfectly imitable, and non-substitutable. Sustained competitive advantage is a value-creating strategy that aims to ensure that the competitors are not able to duplicate the benefits that the focal firm gets. (Barney 1991, 102; 105-106.) It is assumed that PSM analytics capabilities can form inimitable resources that can act as a source of competitive advantage. However, according to Teece and Pisano (1994), the dynamic nature of the business environment is not considered in the resource-based view, which poses a limitation to the use of this theory. This shifting character of the environment is in the essence of the dynamic capability view (Teece & Pisano 1994, 537), which could be seen as an extension of the resource-based view.

Dynamic capabilities are seen as firm resources that can be used to manage competencies in rapidly changing environments (Teece et al. 1997, 516). Mikalef, et al. (2020, 11) found that big data analytics capabilities have a positive impact on the firm's dynamic capabilities and further on competitive performance. Similarly, PSM analytics capabilities could be seen as dynamic capabilities, and thus as a source of sustained competitive advantage, if

organisations are able to create analytics capabilities that the competitors cannot easily imitate or substitute.

It is clear that firms can acquire for example the latest technologies and talented individuals with financial resources (Cadden, McIvor, Cao, Treacy, Yang, Gupta & Onofrei 2022, 1331). However, the role of technology investments or investments in other tangible assets should not be overlooked. For example, technologies may increase the open sharing of information and knowledge that enable better collaboration, which in turn can be an intangible capability (Fawcett, Walin, Allred, Fawcett & Magnan 2011, 52). It is the intangible capabilities such as knowledge or information that are created over time through the organisational culture that are much more difficult for the competitors to imitate (Cadden et al. 2022, 1331). These intangible capabilities are often complex and require time to form and mature (Mikalef et al. 2019, 271).

2.2 Developing Analytics Capabilities Through Organisational Culture

Cadden et al. (2022, 1345) argue that attention should be paid especially to the intangible capabilities when developing analytics capabilities in the supply chain. However, cultural and managerial issues are argued to be among the most significant barriers to the adoption of analytics in organisations (LaValle et al. 2010). Organisational culture is an intangible resource and in accordance with the perspective in this study, it is conceptualised through data-driven culture, top management support and organisational learning. These sub-areas were identified through a literature review to be the most important aspects of organisational culture from the PSM perspective.

2.2.1 Data-Driven Culture

Developing analytics capabilities in PSM requires decision-makers who want to base their decisions on facts (Öhman et al. 2021. 946). Such mentality is referred to as data-driven culture, and it is defined as “an intangible resource that represents the beliefs, attitudes, and opinion of people towards data-driven decision-making” (Arunachalam et al. 2018, 427). When an organisation has a data-driven culture, the decisions are based on insights that are derived from data rather than being based on intuition (McAfee & Brynjolfsson, 2012, 64). Data-driven decision-making is the foundation of analytics capability (Öhman et al. 2021, 949; De Medeiros & Maçada 2022, 968). Management’s mentality also plays a significant

role in analytics capability development. Decision-makers who put greater emphasis on the supplier's nice sales representative rather than on the poor delivery quality percentage hinder the implementation of analytics insights (Richey et al. 2016, 722).

To create business value, it is suggested that data-driven culture should be promoted in the entire supply chain (Arunachalam et al. 2018, 430), which in PSM's case would also include for example the suppliers and internal stakeholders. However, data-driven decisions require understanding of what data the decisions are based on (Öhman et al. 2021, 952). Therefore, the question of whether the decisions should be solely based on data may arise. The data itself cannot always be trusted, as manipulation can happen both unintentionally and on purpose (Richey et al. 2016, 732). This highlights the important role of data governance that must be considered when starting to develop analytics capabilities in organisations.

Building data-driven culture in practice should start from the top management. When executives face important decisions, the questions asked should include:

- "What do the data say?
- What kind of analyses were conducted?
- How confident are we in the results?" (McAfee & Brynjolfsson 2012, 67)

Another impactful way to build a more data-driven culture as a manager is to concede a decision when data disapprove a gut feeling (McAfee & Brynjolfsson 2012, 67). Top management support also has other implications for analytics capability development. These will be discussed next.

2.2.2 Top Management Support

Top management support for analytics initiatives manifests in the promotion and support that analytics receive from the top management, and in the strategic importance that is given to the analytics initiatives in a firm (Chen et al. 2015, 38). Firms in which the top management supports the analytics initiatives have a higher likelihood to adopt big data analytics. It is argued that when the top managers believe in the advantages that analytics can bring for certain business functions, they are more willing to develop the capabilities with financial, technological, and administrative support. (Lai, Sun & Ren 2018, 692.) To achieve higher supply chain and firm performance with big data analytics, top management

must be able to get resources and be committed to the process (Gunasekaran, Papadopoulos, Dubey, Wamba, Childe, Hazen & Akter 2017, 314). If the supply chain or PSM function does not have representation in the top decision-making body of the organisation, it might be difficult to acquire the required resources for developing the analytics capabilities in PSM (Jha et al. 2020, 6).

Öhman's et al. (2021) finding could help PSM managers who struggle with adequate resources. When analytics is new to a firm, the analytics must often justify its existence. By seeking easy-to-implement solutions that have notable business impact, PSM analytics can gain acceptance both inside the function and in the eyes of the top management. This may encourage the firm to invest in more resources for analytics. (Öhman et al. 2021, 948-949.) It has also been shown that organisational readiness and competitive pressure have a positive impact on top management support for analytics use. In other words, top management is more supportive towards the analytics initiatives when adequate human and IT resources are believed to be in place or can be readily developed, and when the external environment puts pressure on the firm or shows successful adoption of analytics. (Chen et al. 2015, 18-19; 26.) Therefore, PSM may be able to gain better support from top management by showing that the current human and IT resources support the adoption of more advanced analytics initiatives or by bringing the success stories of suppliers or competitors to the attention of the top management.

2.2.3 Organisational Learning

Organisational learning in the supply chain context is defined as a function that emphasises cross-functional teamwork, shared vision, mutual dependence, the value of learning and the distribution of supply management knowledge (Hult, Ketchen & Nichols 2003, 544). Cadden et al. (2022, 1335) measured organisational learning in the supply chain context through the holding of cross-functional workshops and having cross-functional teams, having effective reporting structures and communication guidelines in enhancing the understanding of the supply chain players. Such conceptualisation could also hold true for PSM. Organisational learning plays a key role in overcoming the integration barriers of analytics initiatives (Cadden et al. 2022, 1345).

It is argued that the "learning by doing" approach is essential in building a culture that favours analytics. Such an approach requires management that encourages experimenting,

tolerates failures, and allows lessons to be learned. (Handfield et al. 2019, 992.) Joint workshops with suppliers, cross-functional analytical teams and both formal and informal reporting can help in building a culture of learning and performance improvement (Cadden et al. 2022, 1345). Function-specific centralised analytics development teams can create visibility, enhance the allocation of resources, and enable better leveraging of analytical skills. These teams could lead the key analytics initiatives in PSM and other business functions. (Handfield et al. 2019, 993-994.)

2.3 Developing Analytics Capabilities Through Technologies and Data

The role of technologies and data in building analytics capabilities is highlighted in all prior frameworks (Table 2) (Chae & Olson 2013; Arunachalam et al. 2018; Handfield et al. 2019; Wamba & Akter 2019; Jha et al. 2020; Öhman et al. 2021). The importance of this capability area is obvious, as there would be no analytics without data and technologies. However, having data and technologies available is not sufficient alone, as capabilities in capturing, storing, and managing data, and having access to it are fundamental in turning data and technologies into a capability (Chae & Olson 2013, 13). Wang's et al. (2016, 99) twofold perspective on big data analytics in supply chain management implies that organisations must be able to both process data and gain insights from it. Therefore, this chapter discusses what kinds of technologies are available for collecting and analysing the data in PSM, and what is the role of PSM in data quality concerns.

2.3.1 User-Friendly & Process-Supporting Technologies

Multiple technologies are used in PSM to manage the objectives of the function but also to store the data. Examples include ERP, procure-to-pay, contract management and inter-organisational systems (Chae & Olson 2013, 13; Handfield et al. 2019, 974). Chae and Olson (2013, 13) name ERP as one of the most important resources for storing the data in supply chain, as it allows enterprise-level data to be collected in one place. In addition, the use of external data sources has been gaining relevance in PSM. A survey with procurement executives implies that currently the most important sources of data are spend, contract, ERP, and financial data, followed by online news, supplier websites and social media (Handfield et al. 2019, 982). However, most PSM technologies have limited functionalities for data analysis, which requires the data to be accumulated from multiple sources and

reports before insights can be gained (Handfield et al. 2019, 980). In this study, the technologies that combine data from the required sources are referred to as reporting technologies.

It is vital for PSM professionals to be able to utilise the transformed data in decision-making. Thus, reporting technologies that are easy to use and that support the PSM processes are needed. Wamba and Akter's (2019, 909) technology capability is comprised of connectivity, compatibility, and modularity of the technologies. Connected technologies bring together the data from the entire organisation and have no bottlenecks in communication when sharing analytics insights. Compatibility refers to the seamless sharing of insights across the organisation, while modularity aims to provide applications that meet the needs of multiple users by allowing self-customisation. (Wamba & Akter 2019, 909.)

Technologies that are connected, compatible and modular can be summarised as being user-friendly. Such technologies are required for performance management, meaning that key performance indicators that are linked to the PSM processes should be visualised in dashboards and scorecards. The visualisations guide individual decision-makers, who then can monitor the achievement of PSM's strategic goals. (Chae & Olson 2013, 17-18.) Arunachalam et al. (2018, 426) suggest that the capabilities in utilising the tools to deliver data-driven insights in a timely manner are one of the key dimensions of analytics capabilities. This of course depends on the capabilities of the technologies available. Therefore, technologies that can visualise large amounts of data in an understandable way are a central element when developing analytics capabilities.

The survey conducted by Handfield et al. (2019, 948) suggests that the most wanted features in PSM technologies currently are drill-down, prescriptive (cognitive) analytics, real-time uploads of data, customised reports, and user experience. In the future, PSM technologies are expected to be able to give real-time risk alerts, manage issues, and prevent fraud. This can be achieved for example by merging internal purchase order data and external weather data to create alerts for possible delays. Prescriptive analytics tools are expected to be able to create visual maps, predict scenarios and analyse patterns. (Handfield et al. 2019, 981; 984.)

Practitioners plan technology investments in cloud technologies, the Internet of Things, intelligent data capture and third-party spend analytics (PwC 2023). In addition, blockchain

technologies are seen as one of the latest innovations that can transform supply chains (Handfield et al. 2019, 994; Schmidt & Wagner 2019, 1). Investments in new technologies may increase the number of different systems that are simultaneously in use in organisations. The increasing number of systems is likely to pose a new challenge, as it has been recognised that when data is stored in multiple systems, issues with data quality and redundancy arise (Richey et al. 2016, 721), decreasing the quality of the insights that can be drawn from the data. The next chapter discusses the role of PSM in data quality and data management.

2.3.2 Having High-Quality Data That Is Adequately Managed

Multiple studies emphasise the management of data as one of the most significant factors in analytics capability development (e.g., Chae & Olson 2013, 13; Arunachalam et al. 2018, 425; Jha et al. 2020, 4). Data integration and management refers to the acquisition, integration, transformation, and storage of data and it is fundamental to the analytics success (Chae & Olson 2013, 13; Arunachalam et al. 2018, 425). Data that comes from multiple sources can only be used after it has been collected, cleaned, re-organised, and stored (Chae & Olson 2013, 14). While the re-organisation and storing are often done by the IT or analytics function in large organisations, PSM processes require a variety of data to be entered into different systems. The data should be correctly captured and coded when it is entered into a system or database (Handfield et al. 2019, 991-992), as accurate insights can only be drawn from good quality data (Arunachalam et al. 2018, 425).

PSM still heavily relies on structured data from internal sources to make the main decisions (Moretto et al. 2017, 94). Thus, it is vital to have high-quality data in the internal systems so that the generated insights represent the truth. This can be illustrated with the example of De Oliveira and Handfield (2019, 1582):

> *"[M]aterial requirement planning (MRP) systems that have incorrect data on product bill of materials, material lead-time, and on-hand inventory will generate incorrect ordering policies and managerial decisions, leading to stock-outs or excess inventory holdings."*

It has been reported that some firms have not been able to reach their goals in integrating advanced analytics tools due to a lack of organised data (Jha et al. 2020, 4). Still, some organisations report that users tend to enter incorrect information for example to purchase orders and procure-to-pay systems, which degrade the data quality (Handfield et al. 2019,

988). Therefore, the PSM function must recognise its role in improving and maintaining the data quality in the organisation. Integrating and transforming data into actionable insights requires both data from different PSM technologies, and reporting technologies that can combine the data from multiple sources (Handfield et al. 2019, 974). Scattered data is not likely to provide a single point of truth, which complicates the decision-making (Arunachalam et al. 2018, 426).

Jha et al. (2020, 5) propose that analytics capabilities are better developed in firms that have a dedicated approach to data management. Therefore, appointing a data manager to ensure the quality of the data in a PSM function could be considered (Jha et al. 2020, 4). A holistic data governance strategy is suggested so that firms can realise the benefits of their analytics initiatives (Handfield et al. 2019, 988). Richey et al. (2016, 723) also suggest that hiring personnel that have big data knowledge is beneficial for firms, as such employees can monitor and improve the collection of the data.

2.4 Developing Analytics Capabilities Through Talent

Even though firms would have the supporting culture, data, and technologies available, no analytical insights can be gained without talent. Recently, the shortage of talent has been seen as one of the major challenges in the adoption of digital technologies and analytics both by practitioners and academics (e.g., Schoenherr & Speier-Pero 2015, 123; Richey et al. 2016, 733; KPMG 2022, 13; PwC 2023). Wamba and Akter (2019, 898) found that out of the capability dimensions, talent is the strongest construct in supply chain analytics capability development. PSM professionals should be able to combine business knowledge with analytical, technological, and management knowledge to gain benefits from analytics. Therefore, these areas of talent will be discussed next to gain an overview of the topic.

2.4.1 Analytical Talent

Having data to analyse is vital when implementing analytics initiatives. However, PSM professionals must also be able to recognise the possible types of data and analytics techniques that can be used in order to benefit from the available data. Commonly, two types of data are discussed in the literature: structured and unstructured. Structured data can be easily classified into variables and parameters and stored as tables in a database (Handfield et al. 2019, 974). According to Moretto et al. (2017, 94), structured data support the PSM

sourcing process. On the contrary, unstructured data is mostly unorganised and more difficult to group in recurring fields (Chen et al. 2015, 8). Examples of unstructured data include news, social media platforms, images, and videos (Ahmed et al. 2022, 777). Most types of big data are unstructured in their nature. In PSM, unstructured data is proposed to support especially forecasting, risk management, performance monitoring, negotiations, and supplier selection (Moretto et al. 2017, 94-95). An emerging data source that could be utilised in PSM is supplier-owned data, such as emission data and data regarding the supplier's capacity.

PSM processes can be supported with a variety of different analytics techniques. Many analytics-related studies categorise the types of analytics based on the depth of the analysis (e.g., Souza 2014; Wang et al. 2016). Such categorisation is comprised of three levels starting from descriptive analytics followed by predictive analytics and prescriptive analytics. Descriptive analytics answers the question of what is happening, and it can be used to identify opportunities or problems in PSM processes (Souza 2014, 596; Wang et al. 2016, 99). Descriptive analytics mostly operate on structured data, while the techniques include but are not limited to statistics, visualisations, and algorithms (Handfield et al. 2019, 974).

As the name suggests, the aim of predictive analytics is to predict future outcomes and the reasons behind those. This is often done by discovering patterns in the data using mathematical algorithms and programming. (Wang et al. 2016, 99.) Souza (2014, 597) suggests time-series methods, regressions, and data-mining techniques for predictive analytics. Prescriptive analytics is the most advanced form of analytics, and it can be used to make complex decisions through multi-criteria decision-making and simulations (Wang et al. 2016, 99). Handfield et al. (2019, 947) refer to such technologies and techniques as cognitive analytics. For more detailed descriptions of different analytics techniques, interested readers can refer to Chae and Olson (2013) or Souza (2014).

To provide some practical insights, extant literature offers multiple suggestions for different PSM processes where big data and analytics can be utilised to enhance the process. The respective PSM tasks, purposes of analytics use, and examples of the sources of data are shortly summarised in table 3.

Table 3: PSM tasks and analytics use (Moretto et al. 2017; Li & Liu 2019; Stenzel & Waichman 2023)

PSM TASK	PURPOSE OF USE	DATA SOURCES
Sourcing planning & forecasting	- Identify the best planning strategies - Identify correlations between component and commodity prices - Determine the best procurement timing and quantity	- ERP - Bills of material - Price histories - Social media - Internet
Risk management	- Identify supply risks and detect supply disruptions	- ERP - Internet
Reverse marketing	- Assess the current supply base - Detect opportunities for innovation	- Supplier relationship management system - Internet
Spending analysis	- Spend rationalisation among the suppliers	- ERP - Internet
Contract negotiations and management	- Define a negotiation strategy - Contract compliance - Reminders of expiry dates	- ERP - Internet - Contract management system
Supplier evaluation	- Monitoring quality though sensors - Monitoring supply chain emissions	- Sensor data - Supplier-owned emission data
Supplier selection	- Select the best possible suppliers - Monitor supplier capacity to allocate resources	- ERP - Supplier relationship management system - Internet - Social media - Supplier-owned capacity data

Even though the potential of more advanced analytics has been recognised in prior literature, only few commercial PSM technologies provide advanced tools for data analysis (Handfield et al. 2019, 974). For this purpose, firms may have to invest in separate analytics tools. As analytical technologies along with databases are seen as important enablers of data management capability (Chae & Olson 2013, 13), firms with less talent in this area may have to rely on talented individuals and consulting firms to effectively use these tools.

2.4.2 Technological Talent

PSM professionals need technological skills in understanding the basics of data and the used technologies to be able to properly enter data into the information technology (IT) systems and utilise the analytics tools to gain relevant insights. The results of Jha et al. (2020, 5) suggest that analytics capability development may be faster in firms that adopt user-friendly technologies that the employees are already familiar with. Therefore, it is assumed that constantly introducing new analytics tools based on new unfamiliar platforms can hinder the analytics capability development. In addition, the cost of retraining the current employees and a lack of access to skilled new employees are sometimes seen as roadblocks in adopting new technologies (Jha et al. 2020, 5). These roadblocks can slow down the PSM analytics capability development. Collaborating with academics or consultants may help firms to come up with innovative ideas, while an even more innovative way to tap to the potential of outside experts is crowdsourcing platforms, where talented individuals can offer their solutions to specific problems for firms to use (Byrum & Bingham 2016, 44).

To strategically leverage big data, individual employees should have the necessary knowledge in both handling the IT resources and combining them with business knowledge and firm-based skills. Certain behaviours such as information security and policy compliance are also necessary. (Tan 2018, 34.) Öhman et al. (2021, 941) interviewed firms that were advanced in their PSM analytics capability development. The interviews reveal that these firms have tried either to increase the data analysts' PSM knowledge or PSM employees' knowledge of analytics (Öhman et al. 2021, 947). Thus, increasing cross-functional knowledge could benefit the PSM analytics capability development. This could for example enhance the PSM employees' capability to request new and develop existing analytics tools, as they would possess the basic knowledge on how the tools work and what kind of analytics opportunities exist.

2.4.3 Management Talent

Management talent can refer to both self-management that is required from all employees and managerial talent that is required from the management level employees in a firm. The results of Wamba and Akter (2019, 898) suggest that improving firm performance through analytics capabilities is heavily dependent on the decision-makers. Thus, management skills play a critical role in analytics capability development. This area applies to all PSM

employees regardless of their position in a firm. De Oliveira and Handfield (2019) suggest that talent is required in business, statistics, and information technology to develop real-time supply chain capabilities. Business knowledge refers to the individuals' tendency to base their business decision on data and use analytics tools. Talent in statistics is the ability to describe and forecast business scenarios and derive actions using analytics, while talent in information technology is the ability to exploit the data that is available in a single access point and make sure that the quality is protected. (De Oliveira & Handfield 2019, 1588.)

Wamba and Akter (2019, 908) suggest a set of skills that supply chain managers should possess. Out of these, planning, decision-making, and coordination are PSM related. Planning skills are manifested in recognition of innovative opportunities for the strategic use of analytics, plans for introducing and utilising the analytics, systematic and formalised planning processes, and frequent adjustment of plans to adapt to changing conditions. When investing in analytics, managers should consider the impact the investments have on the employees' work and ability to make quicker decisions but also recognise the cost of training and time required for change management. (Wamba & Akter 2019, 908.) Handfield et al. (2019, 996) also note the importance of managing change. The increase in digital interfaces, new analytics opportunities, searchable databases, and real-time information availability require a transformation to the earlier ways of working, and this transformation should be managed by creating a realistic vision and analytic culture in PSM (Handfield et al. 2019, 996). Coordination refers to the cross-functional collaboration between PSM and analytics personnel, who should meet frequently and share information (Wamba & Akter 2019, 908). The findings of Öhman et al. (2021, 948) support the need for cross-functional collaboration in analytics capability development. However, Jha et al. (2020, 5) mention that many executives are still unaware of the potential that the use of analytics tools and technologies have. Management should give support to the implementation of solutions and ideas that were derived from the analytics insights. It is also important for firms to hire individuals who can implement these ideas. (Richey et al. 2016, 723.)

2.5 Literature-Based Framework for Assessing PSM Analytics Capabilities

The previous sections in this chapter have discussed the development of analytics capabilities through three main capability areas: organisational culture, technologies and data, and talent. Eight sub-areas were identified and further elaborated. These areas together

form the literature-based framework for assessing PSM analytics capabilities. Figure 3 below presents the initial framework.

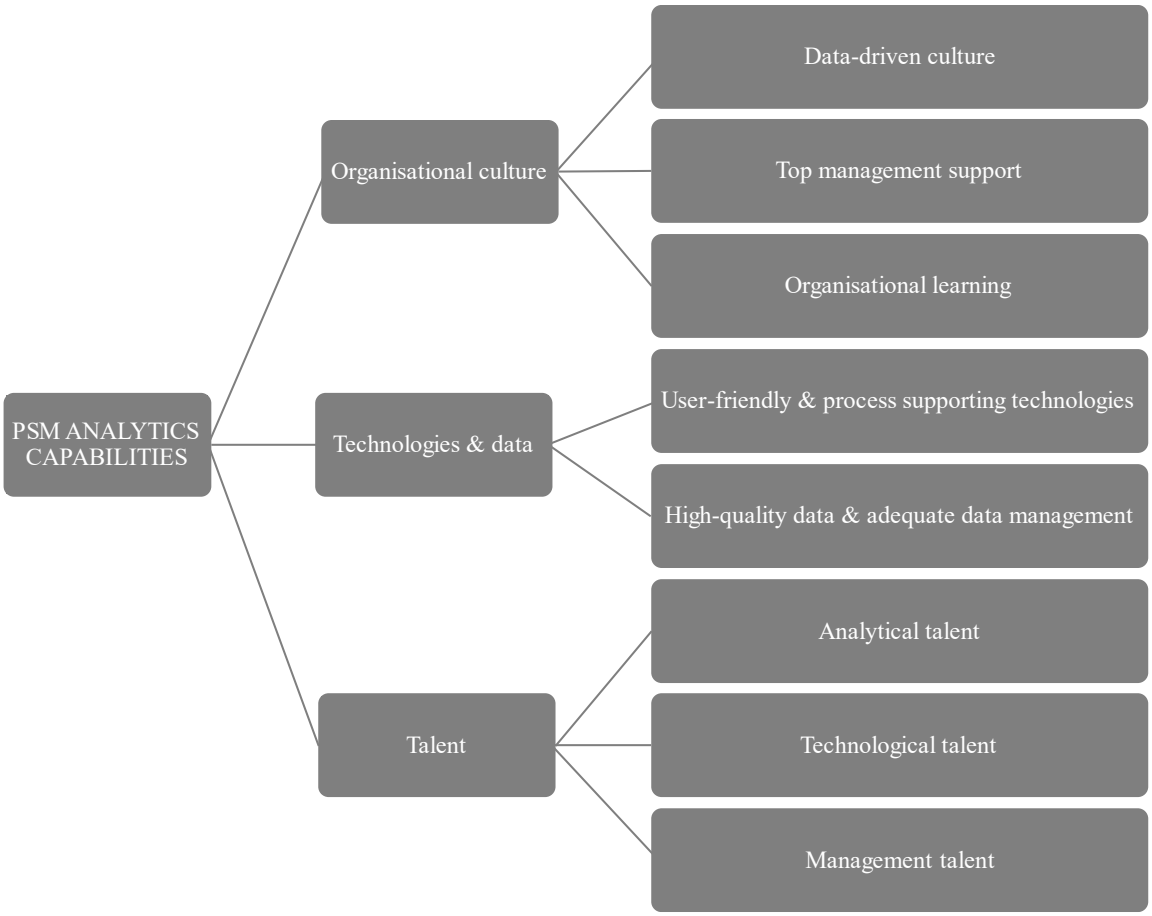

Figure 3: Literature-based framework for assessing PSM analytics capabilities

The capability areas enable each other. Thus, it is necessary to invest in all of them when developing PSM analytics capabilities. Next, the methodology of the study will be introduced. The framework presented here will be further developed in the fourth section which presents the results of the empirical study.

3 Methodology

This chapter explains the research methodology. First, the research design and case selection are discussed. Next, data collection and analysis methods are explained more in detail. Finally, a short case description is given at the end.

3.1 Research Design & Case Selection

The study will be conducted as a mixed method single case study, that will address a context-specific phenomenon. Case studies are well suited in investigating characteristics of real-life events in a holistic way (Yin 2003, 2). The popularity of this method stems from its ability to present complex issues in an accessible format (Eriksson & Kovalainen 2008, 116). Case studies can be used to build new, elaborate current or test existing theory (Piekkari & Welch 2020, 200). This study intends to elaborate existing theory by combining the PSM-specific aspects of analytics capabilities from previous literature and validating the findings with a case firm. It is important to build the research on existing theory and review the emergent ideas against it (Voss, Tsikriktsis & Frohlich 2002, 216).

The literature review conducted as a first step of the research is expected to give a good understanding of the existing literature and thus provide suitable grounds for refining the theory. The literature review was executed by searching analytics capability related academic articles from the Scopus database that were written in English. The theoretical constructs used in prior frameworks in regard to analytics capability measurement or construction were identified and categorised under the three major capability areas to identify the most important sub-areas.

The chosen case is expected to be a representative example in its industry. As per the definition by Yin (2003, 41), a representative case can aim to capture the features of a typical case. The research design is intensive in nature, meaning that the focus is on finding as many insights as possible on the chosen case instead of mapping common patterns across different cases (Eriksson & Kovalainen 2008, 119). The analysis includes three distinct purchasing teams of the single business function. Single case studies are argued to provide greater depth of the analysis compared to multiple case studies (Voss et al. 2002, 203). Dyer and Wilkins

(1991) provide multiple arguments to support single case studies. An in-depth single case study can lead to finding new theoretical relationships and provide deeper insights with rich descriptions in comparison to multiple case studies. It is argued that instead of focusing on the number of cases, the key is to understand and be able to describe the phenomenon in its context. (Dyer & Wilkins 1991, 614-616.)

3.2 Data Collection

Case studies allow a variety of empirical data to be used (Eriksson & Kovalainen 2008, 125). The data of this study was collected through a few semi-structured interviews and a survey, that are typically used as prime sources of data in case studies (Voss et al. 2002, 204). Triangulation with the interview and survey materials and thus with the qualitative and quantitative research methods was used to increase the validity. The aim of the interviews was to validate the results of the literature review and refine the theory. In addition, opinions and information about the current state and recently implemented or upcoming plans for development regarding the PSM analytics capabilities were collected from the interviewees to be able to provide more realistic development suggestions that are aligned with the company's strategy and vision.

In total, 5 online interviews with the case firm's PSM managers were carried out in April 2023. All interviews were conducted in Finnish, audio-recorded and transcribed afterwards. The lengths varied between 30 to 57 minutes per interview. The interview questions are presented in Appendix 1. Table 4 below gives additional details.

Table 4: Details of the interview data

INTERVIEWEE	LENGTH	REFERENCE IN TEXT
PSM Manager 1	37 minutes	I1
PSM Manager 2	57 minutes	I2
PSM Manager 3	40 minutes	I3
PSM Manager 4	30 minutes	I4
PSM Manager 5	52 minutes	I5

Purposeful sampling was used when selecting the interviewees. This ensured that the participants have sufficient knowledge of the studied area so that they are able to provide reliable validation to the framework and reflect on how the theoretical constructs manifest in practice. Multiple viewpoints were gathered to provide a more holistic overview.

An online survey was sent to all members of the three procurement teams to assess the current analytics capabilities of the PSM function. The survey questions were constructed with the help of previous literature and the questions related to the three analytics capability areas of organisational culture, technologies and data, and talent. The respondents assessed their agreement on different statements on a five-point scale. All survey questions are presented in Appendix 2. The results are used as a starting point for the analytics capability development roadmap that will be provided for the case firm.

3.3 Data Analysis

In business-related case study research, a variety of techniques are suggested to be suitable for analysing the data, including but not limited to content analysis, discourse analysis and critical incident analysis (Eriksson & Kovalainen 2008, 130). The interview data of this study were analysed using content analysis, that was abductive in its nature. Qualitative content analysis in general aims to build a description of the specified phenomenon by systematically describing the meaning of the data (Schreier 2012, 3). In abductive content analysis, the extant theory has a supporting but not a fully guiding role (Tuomi & Sarajärvi 2018, 80). This allows previously unknown findings to appear and thus provide a more comprehensive answer to the research question. Content analysis is conducted by categorising the data according to a coding frame (Schreier 2012, 1), that in this study was formed based on the extant theory to guide but not limit the process. Categorisation tables of the results are provided in the appendices of the paper to increase transparency (Appendix 3 & Appendix 5).

As the content analysis focuses on *what* the interviewees said instead of *how* or *why*, the interview data were transcribed into clean verbatim transcription to ease the readability. Data analysis tools were not used to analyse the interview data. The transcriptions are in Finnish, while the quotations presented in this study were translated into English.

The survey results are analysed in Microsoft Excel to provide descriptive statistics. The survey was sent to 34 persons in total and 26 responses were received. Thus, the response rate was 76 %. Means and standard deviations were calculated for the survey statements to determine the current state of analytics capabilities in PSM. Distributions of the responses are visualised to give a comprehensive picture of the survey data. As the survey statements are assessed on a scale from 1 to 5, the means vary between these numbers. The minimum and maximum values, means, and standard deviations for all individual statements can be examined in Appendix 4.

3.4 Case Description

The case organisation is a large international industrial equipment developer and supplier with its headquarters in Finland. The name and other details from which the company could be identified are concealed for confidentiality. The importance of digitalisation development in business growth is recognised in the case firm's current strategy.

This study will be conducted in the procurement function of one of the five business units. The function consists of a procurement director, three distinct procurement teams with senior managers, a few data management employees, an assistant, and a development manager. The procurement teams consist of 10 to 15 employees. Procurement is a distinct function from category management in the case organisation. In addition, other functions are responsible for providing business intelligence tools for the use of procurement and taking care of data warehousing. Procurement's role in analytics is to enter data into the internal IT systems, use the provided analytics tools in the decision-making, and communicate the need for possible new tools or technologies to other functions such as analytics development or top management.

The author of this thesis is an employee of the case organisation. The results are reported as objectively as possible. However, it must be noted that the author's experience in working for the company may have impacted the interpretation of the results.

4 Empirical Study

This section presents the results of the empirical study. First, the framework that was developed through the literature review is validated with the interview data. Next, the case organisation's current PSM analytics capabilities will be assessed according to the framework.

4.1 Framework for Assessing PSM Analytics Capabilities

The framework for assessing PSM analytics capabilities was validated through the interviews. All three capability areas were separately discussed first without explaining the initial model, and then by showing the categories suggested by the literature review. The possible importance of the areas that did not come up before showing the model was discussed. The next sections present the results of the discussions and explain the modifications made to the initial model. A comprehensive categorisation table of the interview data can be reviewed in Appendix 3.

4.1.1 Justification for the Sub-Areas of Organisational Culture

Out of the three sub-areas of organisational culture, data-driven culture and organisational learning were frequently mentioned before the initial model was shown to the interviewees. Thus, it may be interpreted that these areas are well manifested in practice and can be seen as important factors in analytics capability development. When asked what kind of organisational culture the interviewees believed would support the development of analytics capabilities, for example the following ideas were mentioned:

> *"Organisational culture should be the kind that we utilise the available data in operative management."* (I1)
>
> *"Overall, a culture in which the data is valued."* (I2)
>
> *"It (decision-making) should not be based on intuition."* (I3)
>
> *"Organisational culture should be the kind that we trust in managing with evidence and facts-based statistical methods."* (I4)

Top management support was not mentioned by any of the interviewees before showing the initial model. However, all interviewees agreed that such support is an important factor in the development of analytics capabilities. Top management is expected to show an example of being data-driven (I1). On the other hand, especially the role of granting adequate resources was frequently mentioned:

> *"If we think about data analysis and introducing new technologies, the support from whether it is the PSM director or whoever, is needed."* (I2)

> *"If we think about the resources… If we come up with the idea of developing our analytics capabilities on the lower level without having time, money, or resources from the top, it is quite difficult."* (I3)

> *"In many cases, we could talk about the resourcing and that we can get resources. (…) For sure it (top management support) helps."* (I5)

Different forms of organisational learning came up in all interviews. Especially appropriate employee training, knowledge sharing, learning by doing and cross-functional collaboration were seen as important factors:

> *"The organisation should support and encourage, and especially train the employees so that they will and are able to utilise the available data."* (I1)

> *"Sharing knowledge is very important in an organisation of this size."* (I2)

> *"I think the kind of organisational culture that has a "try it out" mentality will help in implementing new technologies. If we are horrified to make mistakes or have no courage to try new things, that type of culture is not very fruitful in developing the capabilities."* (I3)

> *"Then of course if we introduce new things and try new things, also the organisational culture should be innovative and willing to experiment."* (I4)

> *"Another thing that I think is important, when correctly used, is cross-functional collaboration as you have written there, and that the interfaces can be better handled."* (I5)

In addition, recognising opportunities with the help of data and considering the common vision across the functional boundaries were highlighted in the interviews (I2 & I5).

4.1.2 Modifications for the Sub-Areas of Technologies & Data

Various features were mentioned in the interviews when discussing technologies that would support analytics capability development in PSM. User-friendliness-related attributes were mentioned by three interviewees:

> *"When people find that the technologies make their working easier, they adopt them more easily."* (I1)

> *"How we could use EDI for example in transferring purchase order data and order confirmations to suppliers and vice versa, which could probably be easier for the supplier than our current [supplier portal] system."* (I3)

> *"But we should get into a situation where the rumbustious idea-rich buyer could collect information from the ERP or other system close to purchasing by him/herself and use it for different purposes. Some kind of flexibility and user-friendliness."* (I5)

Most of the discussions were centred around descriptive technologies, where information can be filtered and visualised to support decision-making. Technologies that can do more than just describe the data (e.g., predict scenarios and risks, and create simulations) are seen as beneficial for analytics capability development, especially in the future (I4, I5). The following changes were made to the initial framework: (1) "Process-supporting" was removed from the technology-related features, as a more describing area was discovered; (2) Technology types (descriptive, predictive, and prescriptive) were listed in the framework to better highlight the features that are required from process-supporting technologies.

All interviewees strongly highlight the importance of high-quality data before the model based on the literature review is discussed. This area plays a key role in the development of analytics capabilities, as the insights gained from the data are only as reliable as the data is. For example, the following was said regarding the quality of data:

> *"Of course, the data should be correct and error-free, trustworthy in other words."* (I2)

> *"I think an important aspect in the data is that it reflects the truth."* (I4)

> *"It (data) should be correct, adequate for our purposes, and modifiable to different shapes. And understandable."* (I5)

In addition, having data that is updated in real-time and that is available in a single source was seen as beneficial for the development of analytics capabilities (I1). Adequate data management practices were also highlighted by two interviewees:

> *"Data that are frequently and systematically managed (support the development of analytics capabilities)." (I1)*

> *"Managing data in the system is in the essence."* (I2)

Therefore, the sub-areas of high-quality data and data management were kept in the framework without changes.

4.1.3 Modifications for the Sub-Areas of Talent

The two most often mentioned sub-areas regarding talent were analytical talent and technological talent, which were both mentioned in multiple interviews before the initial model was discussed. Understanding of statistics and data analysis were often mentioned in discussions regarding analytical talent:

> *"We should increase our talent in understanding and analysing the data."* (I1)

> *"Another useful skill to have would be the understanding of statistical methods, and variation and deviation and so on, so that these things could be interpreted from the data."* (I4)

> *"We must understand why we measure something and from where."* (I5)

Technological talent is especially required in utilising the reporting tools. Understanding the background processes of the IT systems at least to some extent and being able to interpret the analytical reports are seen as important in PSM.

> *"We need talent in knowing what must be done in the IT systems, why, and how."* (I1)

> *"Overall, those who use the information should be able to use the reports and tools. That is a minimum requirement."* (I4)

In addition to the technological talent, firm-based knowledge was added to the framework, as it was mentioned by multiple interviewees:

> *"I find it very important that we have process knowledge and knowledge regarding the things that we measure, so that accurate things that are important for purchasing and supply management are correctly measured."* (I2)

> *"I think using the data is important but we must remember that we may have problems in the process in which the raw data does not reflect the reality. For this, we need the purchasing responsible's, for example the buyer's, expertise to explain the background."* (I2)

> *"We must understand the relation between the business process and the system."* (I1)

> *"Yes, and actually one important area is process understanding. In order to make sense of the data, the processes in the background that create the data must be understood."* (I3)

A less considered and, in some cases, slightly divisive category was the management talent. This may be due to the Finnish translation (*johtamistaidot)* that was used in the interviews, which refers more to managerial talent and less considers self-management talent. One of the interviewees mentioned:

> *"Management talent I think is related to this, but is it that necessary with this topic? I would probably replace it with the process understanding."* (I3)

While some of the interviewees mentioned self-management-related topics before seeing the initial model, managerial talent was not brought up by any of the interviewees. However, as the other interviewees supported having management talent in the framework after seeing the initial model, the difference between self-management and managerial talent was further highlighted in the modified framework by replacing management talent with self-management and managerial talent.

4.1.4 Final Framework

This chapter shortly concludes the above-explained modifications to the initial framework. Regarding organisational culture, ideas or comments that would have required new categories to be generated in addition to the areas of data-driven culture, top management support, and organisational learning were not found in the interview data. Thus, the sub-areas of organisational culture remain unchanged.

The sub-capability areas regarding technologies and data were slightly modified by giving a more focused definition to the supportive technologies. The sub-areas in the modified framework are user-friendly technologies with descriptive, predictive, and prescriptive capabilities, high-quality data, and adequate data management. Some refinement was also done to the technological talent by adding firm-based knowledge to the framework to highlight its importance. To reduce confusion, management talent was renamed to self-management and managerial talent, as the original term seemed to overemphasise the managerial side. The final model is illustrated below (Figure 4).

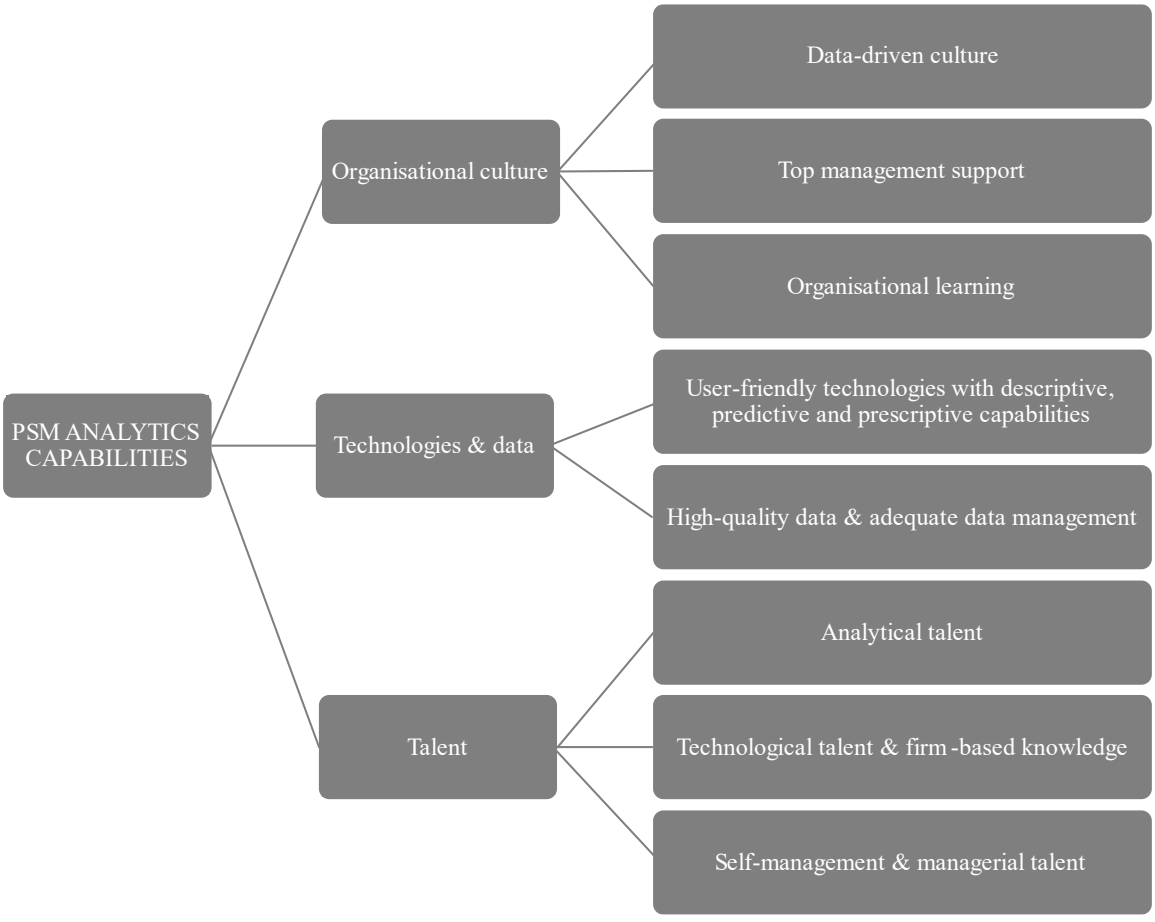

Figure 4: Final framework for assessing analytics capabilities in PSM

Next, the case organisation's PSM analytics capabilities are analysed using the framework presented above. As firm-based knowledge was added to the framework after conducting the survey, it was not possible to consider this aspect in the analysis. However, this is suggested to be considered in future studies.

4.2 Analysis of the Case Organisation's Current PSM Analytics Capabilities

The results of an analysis regarding the case firm's current state of PSM analytics capabilities are presented in this chapter. The responses of the online survey are used as the primary data, while some comments regarding the management's perspective and recently implemented or already ongoing or planned development actions have been collected from the interview data. For the full content analysis categorisation table of the interview data considering the current state of the analytics capabilities, see Appendix 5. Multiple figures are used to visually present the results. As all statements in the questionnaire were answered on a scale from 1 to 5 (1 – strongly disagree, 3 – neutral, 5 – strongly agree), the means vary between these numbers. Descriptive statistics for all individual statements can be examined in Appendix 4.

Figure 5 below illustrates the means of each capability area as rated by the case firm's procurement teams. The closer the values are to 5, the more respondents agreed with the statements. Means below 3 indicate that more respondents have disagreed with the statements than agreed. Regarding organisational learning, item OL2 was removed from the mean in Figure 5 due to inaccurate question design and therefore unclear responses.

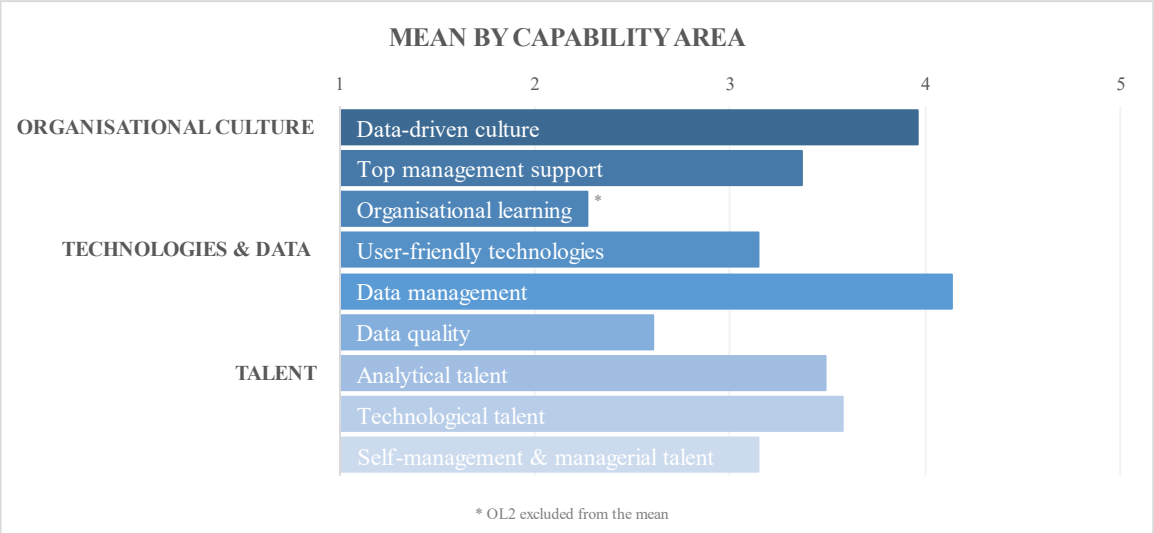

Figure 5: Means by the capability areas in the case organisation

The overview of all analytics capability areas suggests that while data-driven culture and understanding of data management are on a rather good level (mean approximately 4), all

areas have room for development. Statements regarding organisational learning and data quality received the lowest agreement among the employees. All areas of talent were agreed more than disagreed, as the means are above 3.

To get an overview of the background, the respondents were asked to rate how much they believe each capability area prevents the PSM from exploiting analytics in the case organisation (Figure 6).

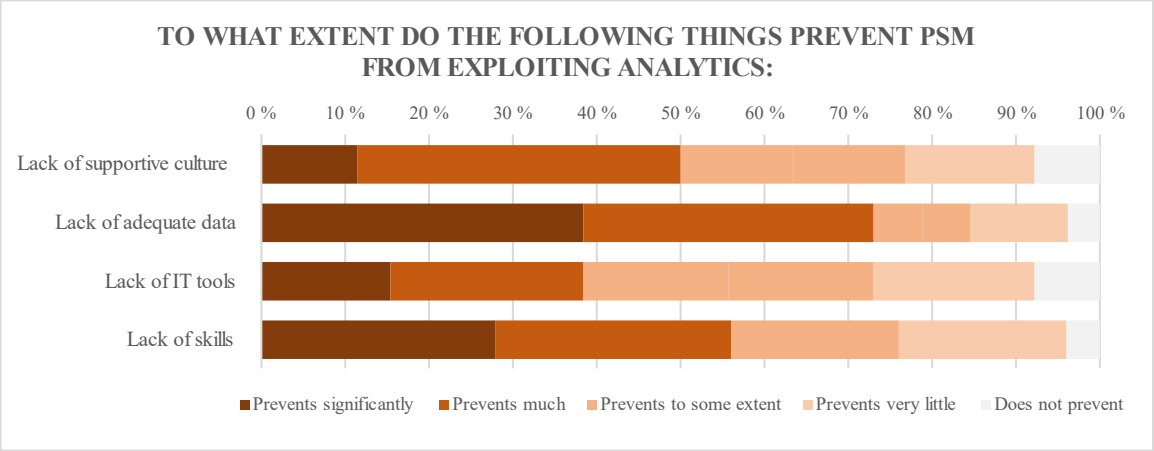

Figure 6: The extent to which the capability areas prevent PSM from exploiting analytics

The lack of adequate data is believed to prevent the case organisation the most (most responses in "prevents significantly") in analytics use, followed by the lack of skills, lack of supportive culture and finally lack of IT tools. Only a very small percentage of the respondents (4-8 %) believed that none of the areas prevents the case firm's PSM from exploiting analytics. Next, the analysis results regarding each capability area will be further elaborated by drilling down to the individual statements under the capability areas.

4.2.1 Organisational Culture in the Case Firm

The survey data regarding each capability area has been illustrated in a similar way in every chapter. First, a summary that presents the distribution of the responses across different categories is given. Next, the responses to the individual statements inside each sub-area are illustrated. Appendix 2 can be used to check which item belongs to which sub-area. The disagreement is illustrated on the left side of each figure, while the neutral responses are divided into both sides of the vertical line in the middle. The agreement is shown on the right

side of each figure. The number of responses is calculated as a percentage. For technical reasons, the percentages are negative values on the left side of the figure.

The organisational culture in the case firm appears to be data-driven (Figure 7), which is a great advantage for the analytics capability development. In the interviews, the aim to base decisions on data was mentioned multiple times. For example, one of the interviewees said:

> *"I think it (organisational culture) is getting better. We are aiming to base the situation awareness more on the system information and data. And then also find areas of improvement."* (I4)

Slight room for improvement was still found from the motivations of data analysis by one of the survey respondents. A similar observation was made by one of the interviewees:

> *"I think it (organisational culture) has gotten better. The data analysis tools are better, but as I said, I think we focus too much on the problems. Which in certain cases is ok, but some curious examining of the opportunities that the data analysis could bring without having a major issue could be on the better state."* (I2)

Based on the survey data, the case organisation also seems to have adequate top management support for the use of analytics in PSM (Figure 7). The interview data confirm the support, as all managers found the use of data and analytics in PSM very important. However, the interview data also indicates that PSM may lack resources in the development efforts in the analytics area (I2 & I4). Significant improvements could also be done regarding organisational learning, which received the greatest disagreement in the survey.

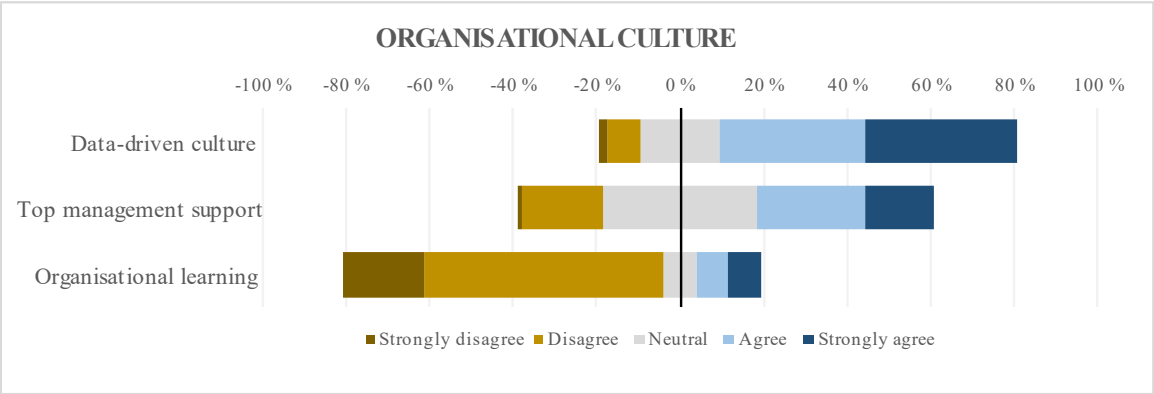

Figure 7: Survey summary: Organisational culture

The distribution of the responses across the individual statements is presented in Figure 8. The results indicate that 96 % of the respondents use available data to support their decisions. In addition, 46 % claim that when the data and their intuition suggest a different decision to be made, they base their decision on data. An ongoing development action regarding data-driven culture in the case firm is to unify the operative management practices across the three procurement teams by implementing a visual dashboard, that combines data from multiple sources into one easily accessible view (I1).

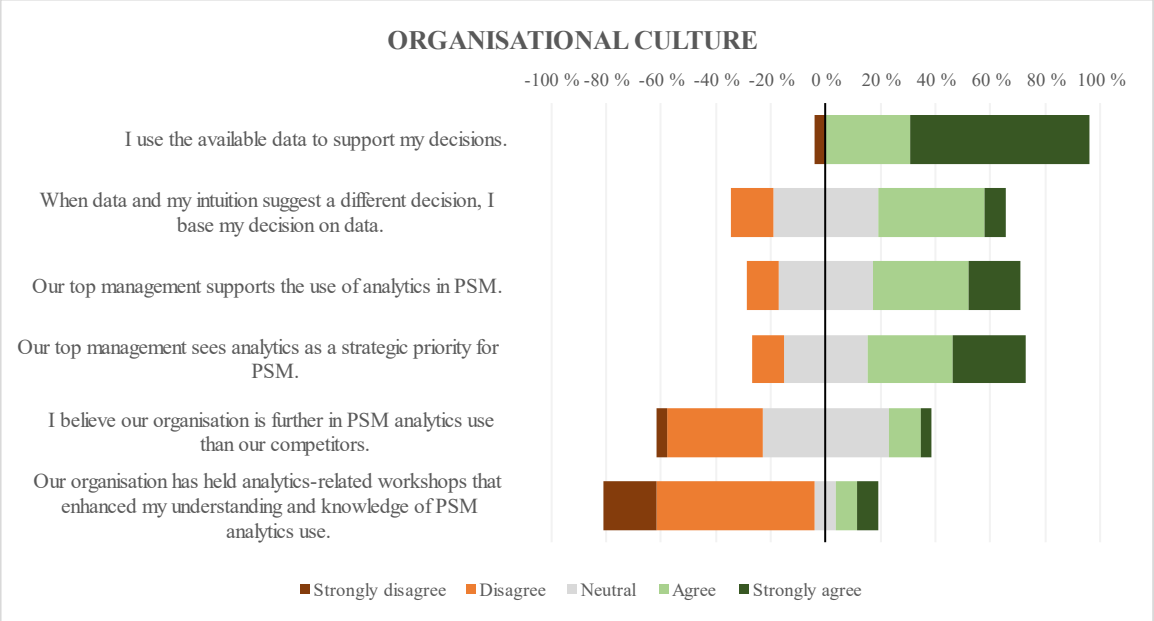

Figure 8: Responses by item: Organisational culture

The first two statements regarding top management support received very similar responses: approximately 55 % agree that top management supports the use of analytics in PSM and sees it as a strategic priority. However, 34-38 % of the responses were neutral. The lack of a proper digitalisation and analytics strategy was mentioned in one of the interviews (I2). Only 15 % of the respondents believe that the case organisation is further in the PSM analytics use than the competitors, while 38 % disagree. Almost half of the respondents (46 %) do neither agree nor disagree with the statement.

When it comes to organisational learning, 77 % of the employees disagree that the case organisation would have held analytics-related workshops that enhanced their understanding and knowledge of PSM analytics use. In addition, only 3 out of 26 employees reported that

they are or have been a part of a cross-functional team or project that focuses on the creation, development, or discussion of PSM analytics.

4.2.2 Technologies and Data in the Case Firm

Overall, the lack of adequate IT tools was seen as the least preventing factor when considering PSM analytics use (Figure 6). This was also reflected in the interview data, as all interviewees believed the already available technologies to be good. The room for improvement regarding technologies was more related to the ability to use them effectively (I4 & I5). Figure 9 summarises the agreement and disagreement across the three sub-areas regarding technologies and data: user-friendly technologies, perceived quality of data, and the agreement on the PSM's role in data management. The greatest area of improvement in the case firm is data quality, which was recognised both in the survey and the interviews.

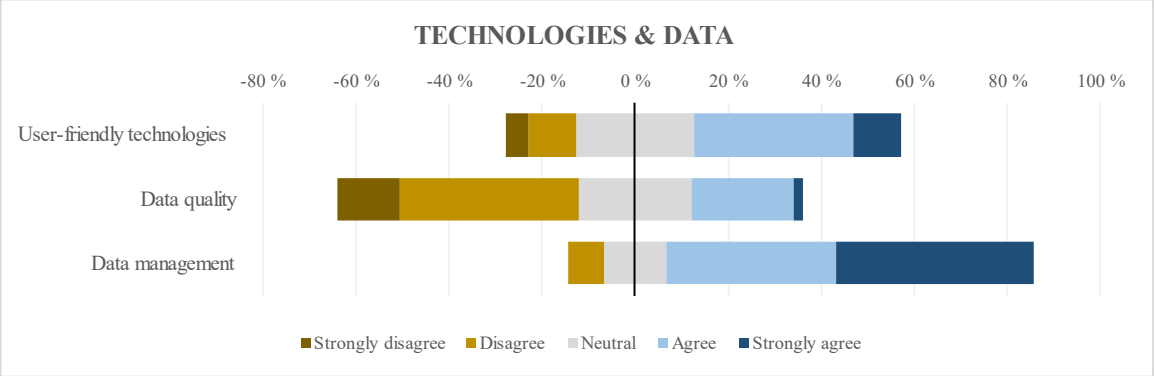

Figure 9: Survey summary: Technologies & data

When drilled down to the individual statements, it appears that one-third of the respondents did neither agree nor disagree whether the technologies in the case firm are up to date (Figure 10). The readability of the analytical reports received a rather high disagreement (39 %). While the helpfulness of the analytical reports was agreed or strongly agreed by 53 % of the respondents, the need for more predictive reports was mentioned in the open comments section of the survey:

> *"With the current way of measuring the late purchase orders, the disruptions have already occurred. Deviations in the metrics in earlier stages would enable us to react with corrective actions and contribute to the successful end results."*

Consistent with the comment above, one of the survey respondents noted a lack of utilising data to succeed in the processes and saw the use of data and analytics as passive in the case organisation.

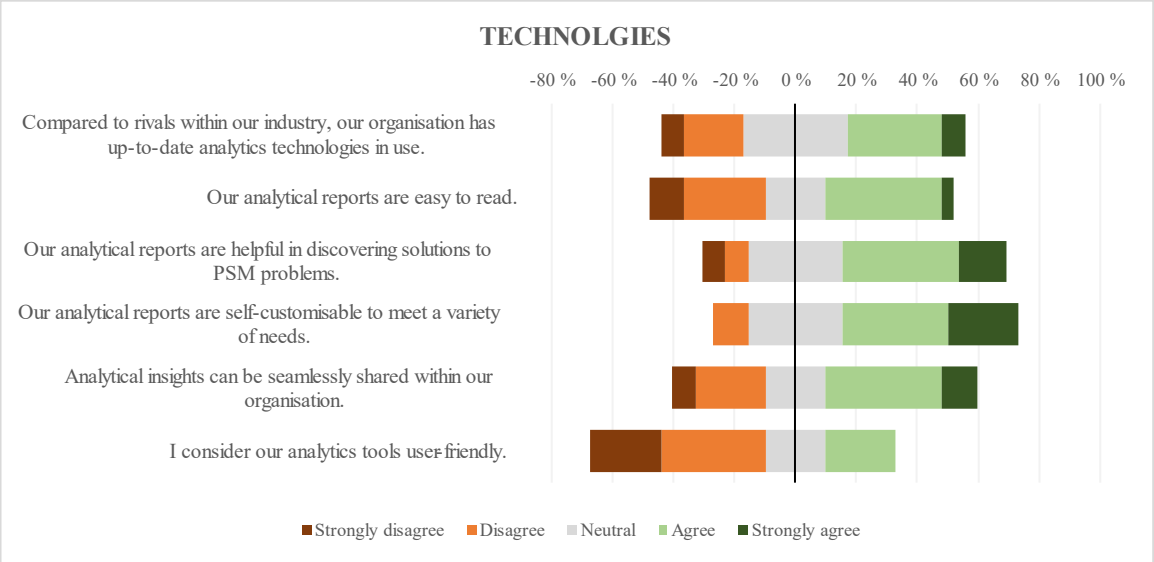

Figure 10: Responses by item: Technologies

Self-customisation of the analytical reports was agreed by 58 % of the respondents. Some development efforts could be aimed towards easing the sharing of analytical insights, as 31 % of the respondents disagree or strongly disagree with the statement. A significant percentage of the respondents (58 %) disagreed with the analytics tools being user-friendly. In addition, the 24-hour delay in data refresh was criticised by one of the survey respondents in the open comments.

The case organisation has multiple development actions both ongoing and upcoming regarding the technologies. Some time ago, the firm implemented a new ERP system that allows better collection of transaction data (I4). Currently, they have an ongoing business line level development project for enhanced information flow and accessibility (I5). In addition, the upcoming actions include a process-wide management system for one product type as well as investigating the possibility to write time-stamped data into the cloud (I1 & I4).

Overall, the quality of PSM data in the case firm is perceived as poor (Figure 11). According to the background questions, the lack of adequate data was also seen as the most preventing

factor in PSM analytics use in the case firm (38 % believed that it significantly prevents) (Figure 6). The statements regarding data quality indicate that the trustworthiness of PSM data was disagreed by 50 % of the respondents, and the quality of data by 54 %. Four out of five interviewees believed that there would be room for improvement in the data quality and trustworthiness.

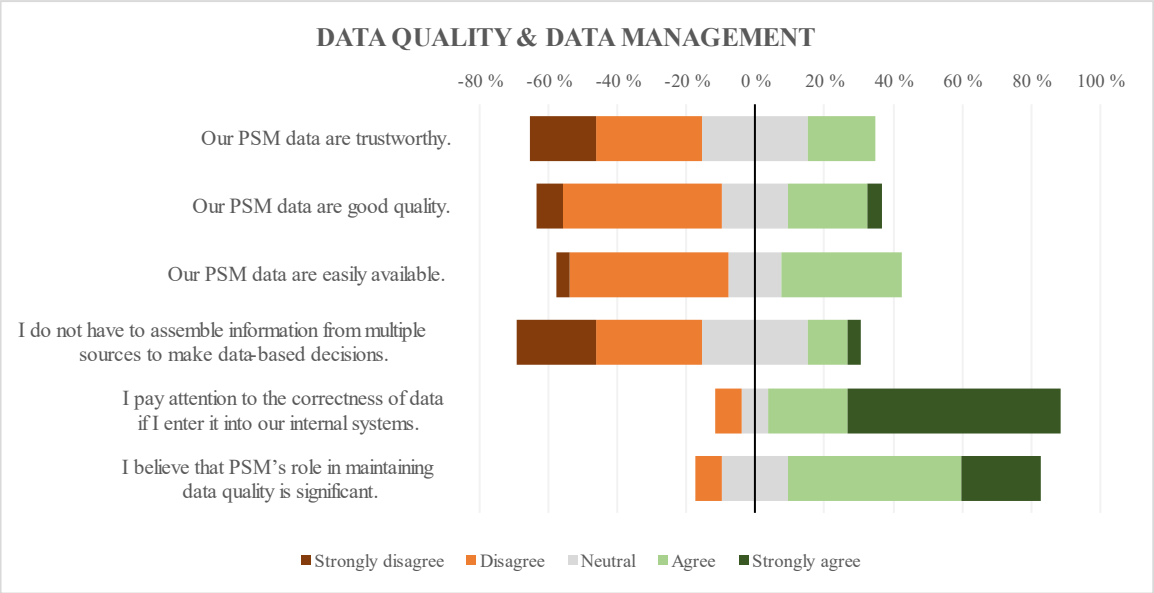

Figure 11: Responses by item: Data quality & data management

The easy availability of data was disagreed by half of the respondents. The highest strong disagreement was given to the data being available in a single source (23 %). While the quality of data is a great area of improvement for the case firm, the employees seem to recognise their role in data management. 85 % of the respondents pay attention to the correctness of data when they enter it into the systems. In addition, 73 % believe that PSM's role in maintaining the data quality is significant.

A great number of development actions that enhance the data quality and management have already been implemented or planned. Centralised supplier on-time delivery monitoring and increasing the focus on utilising data and having the responsibility for its correctness in PSM have already been implemented (I1, I2). Recently, some development efforts in the PSM have been aimed towards having higher-quality data and collecting the data into a single source. A systematic manual management of purchase order data is currently ongoing (I1, I3, I4, I5), and a software robot is being tested in increasing the item data quality (I4). The

already discussed visual dashboard for procurement management is also related to data quality and management, as it increases access to the data from a single source (I1, I4). An upcoming improvement is to increase the suppliers' possibilities to update purchase order data in the supplier portal (I4), which should automatically update the information into the ERP and thus decrease the manual work in procurement.

4.2.3 Talent in the Case Firm

Overall, 56 % of the survey respondents believed that lack of skills prevents the case organisation's PSM in analytics use significantly or much (Figure 6). The percentage was the second highest in the measured areas. Accordingly, only one of the five interviewees believed that the case firm's PSM already have enough talent (I5), while the others saw room for development in multiple areas.

In the survey, the understanding of different data sources was used to measure the level of analytical talent in PSM. The measurement scale was similar to the other statements in the survey (1 – do not understand at all, 5 – understand perfectly), but for better readability, the responses with the greatest understanding are presented on the left side of the figure. Overall, understanding the different sources of data in the case organisation is on a rather good level. The internal data that is most often in the structured format is clearly better understood than the external and unstructured sources of data (Figure 12).

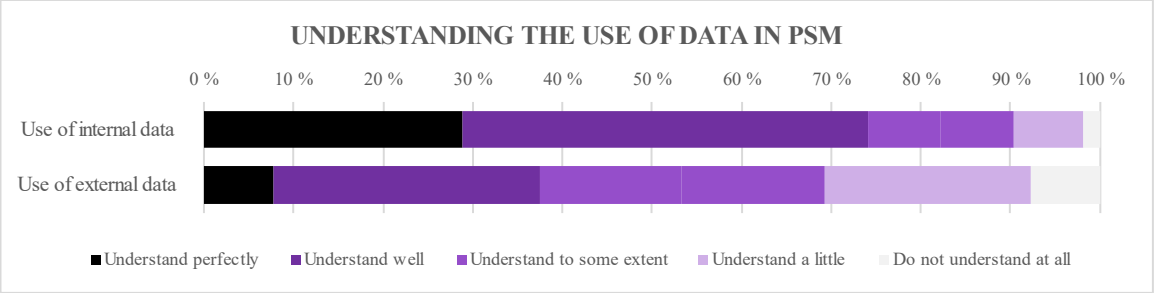

Figure 12: Survey summary: Understanding of data types

The interview data indicate that currently the case firm mostly uses internal data in their analytics (I4), which may explain the employees' low level of understanding regarding external data. Some of the interviewees also believed that analytical talent should be increased in the case firm (I1 & I4).

Other areas of talent are summarised in Figure 13 below. The distribution of the responses is quite even. Managerial talent has the highest disagreement percentage, while the highest agreement is with the statements related to technological talent. An ongoing development action regarding talent in the case firm is to continuously hire individuals with different backgrounds to increase the variety in talent (I5).

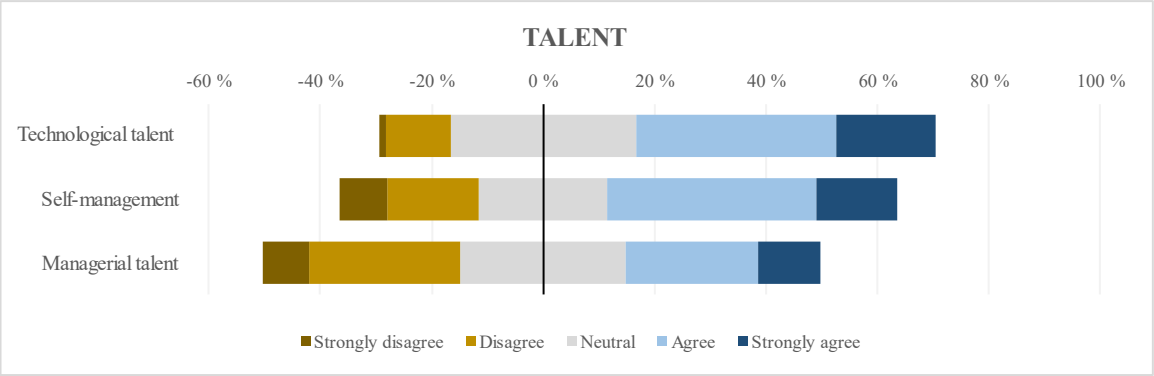

Figure 13: Survey summary: Talent

Interesting insights can be gained by examining the individual statements that measured talent. In Figure 14, the understanding of the sources of internal and external data is presented in greater detail. The division between internal and external data is the following. Internal sources are ERP data, bills of material, supplier relationship data and contract data, while external sources include the internet, supplier-owned data, social media, and sensor data. The better the employees understand the data sources, the more responses on the left side, and the darker the colour in the figure.

Figure 14 indicates that ERP is the most understood source of data (81 % of the respondents understand well or perfectly). The percentages of understanding well or perfectly with other internal sources of data are the following: bills of material and contract data 77 %, and supplier relationship data 61 %. Out of the external sources of data, the internet and supplier-owned data are understood well or perfectly by 54 % of the respondents. The least understood sources of data are social media (20 %) and sensor data (23 %).

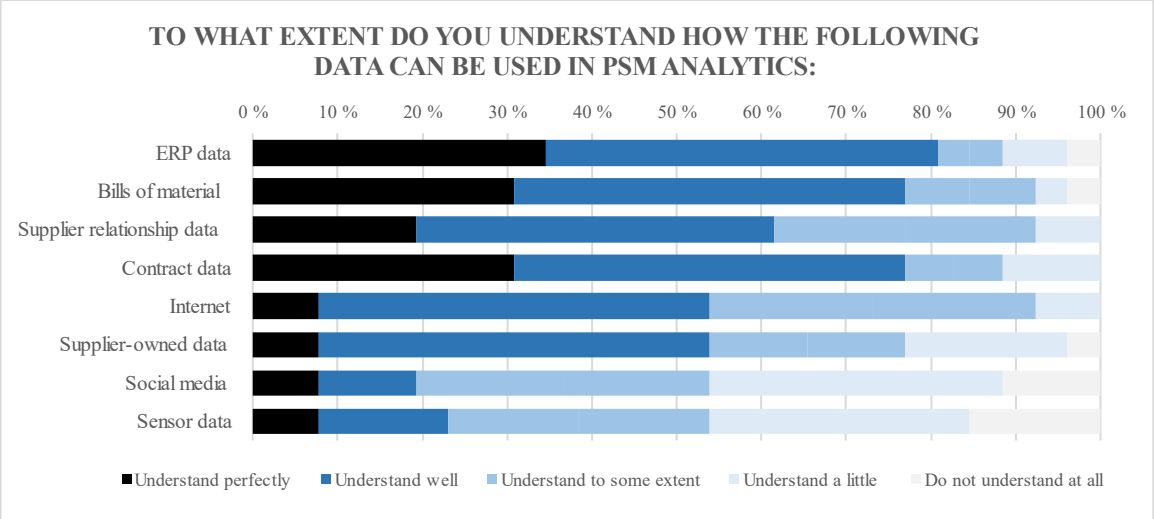

Figure 14: Analytical talent: Understanding the sources of data

Individual statements and the responses regarding technological talent are illustrated in Figure 15 below. The majority of the employees (66 %) agree or strongly agree that learning new technologies is easy for them, while only 4 % disagree. In addition, the respondents' ability to use the available analytical tools seems to be on a good level (46 % agree or strongly agree). However, 38 % did neither agree nor disagree with the second statement. Interestingly, most of the interviewees saw that there is a lack of technological talent in the case firm's PSM (I1, I3, I4).

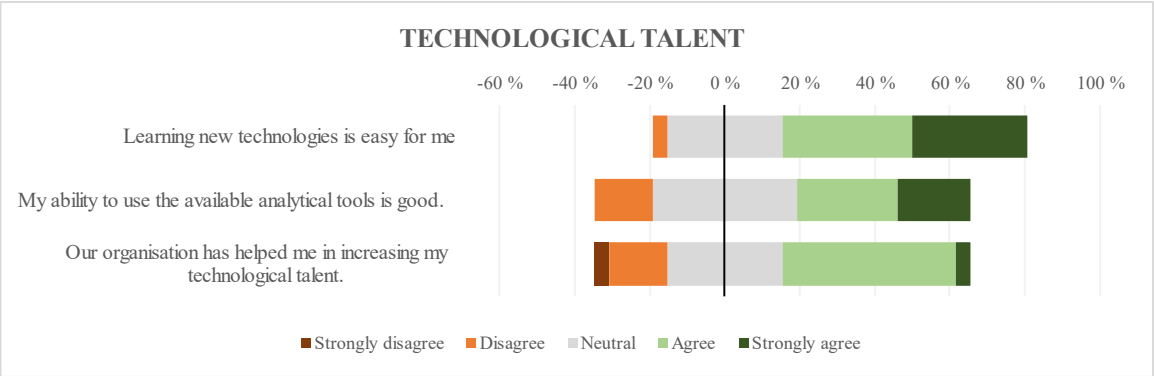

Figure 15: Responses by item: Technological talent

Half of the respondents agree that the organisation has helped them in increasing their technological talent. However, 19 % disagree. After the collection of the survey data, targeted IT system training sessions regarding the data visualisation system have taken place

in two of the three procurement teams (I1, I2, I4), which are believed to further increase the technological talent in PSM.

Responses regarding self-management are illustrated in Figure 16. Overall, the use of analytics for different purposes is at a moderate level. 39 % of the respondents agree or strongly agree that they use analytics in decision-making to describe business scenarios or problems. The percentage of neutral responses is rather high (34 %). Forecasting with analytics is agreed by 42 %. The agreement increases with the last two statements, as 57 % agree or strongly agree that they use analytics to anticipate business problems. As many as 69 % agree with using analytics to drive actions. The highest disagreement is given to the second statement: using analytics to forecast business scenarios is disagreed by 35 % of the respondents.

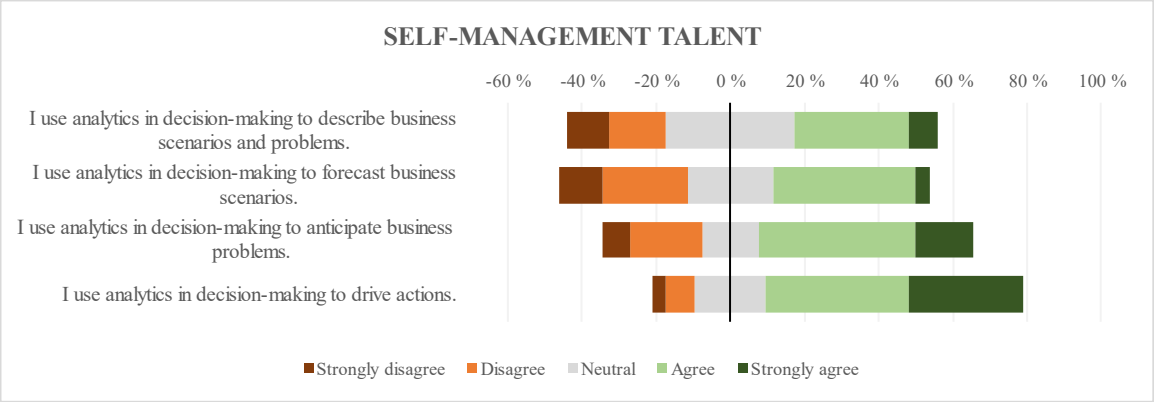

Figure 16: Responses by item: Self-management talent

Managerial talent statements and the responses are illustrated in Figure 17. According to the first three statements, approximately half of the respondents agree or strongly agree that management is putting efforts into examining (50 %), introducing and implementing (52 %), and adapting to changing conditions (43 %) in regard to analytics in PSM. Nobody strongly disagrees.

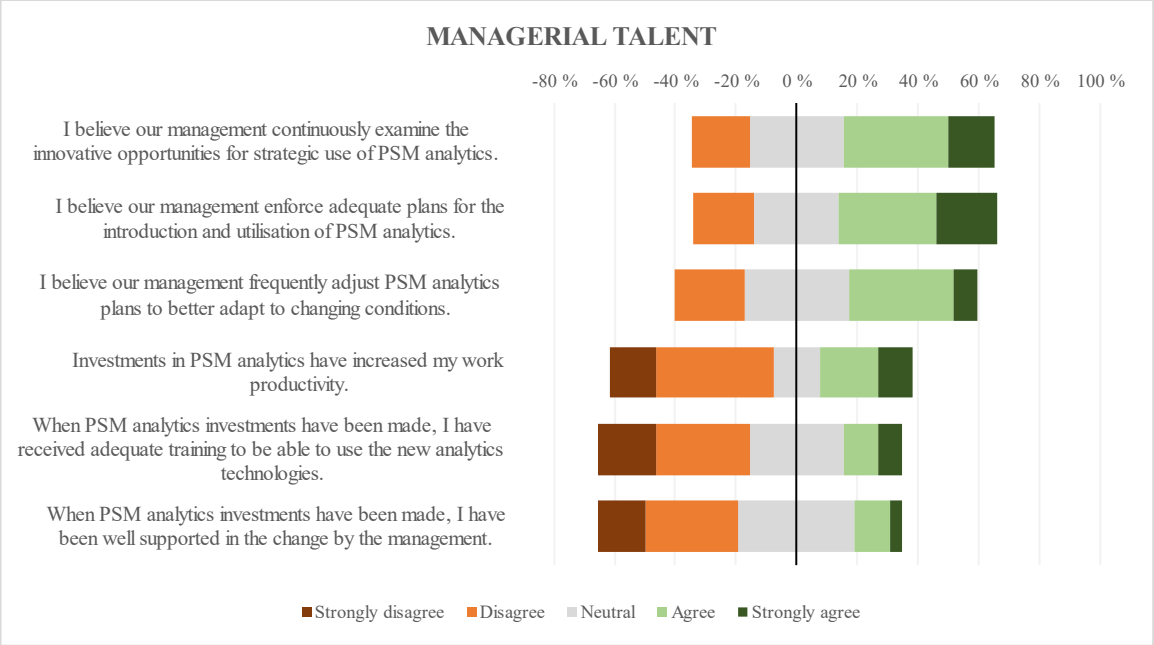

Figure 17: Responses by item: Managerial talent

Most criticism is given to management practices related to analytics investments. The employees seem to feel that the analytics investments have not increased their productivity, as 53 % disagree or strongly disagree with the statement. Adequate training is disagreed or strongly disagreed by 50 % of the employees. Change management could also have been better implemented, as 46 % of the employees disagree or strongly disagree with the statement. No upcoming development actions were mentioned in the interviews regarding this area.

5 Discussion

A framework for assessing the analytics capabilities in PSM was developed with the help of a literature review and the conducted interviews. The interview data were used to validate and modify the initial framework. The final framework is constructed from three capability areas and eight sub-areas in total. The validation revealed that the role of firm-specific knowledge in PSM analytics capability development may have been overlooked in the prior frameworks. The final framework was used to analyse the current state of PSM analytics capabilities in the case firm. This section reviews whether the results are in line with previous research and derives development suggestions for the case firm.

5.1 Organisational Culture

The framework suggests that supportive organisational culture for analytics capability development in PSM would be data-driven, analytics would have top management support and the culture would value organisational learning. Overall, the case organisation seems to have a data-driven culture. However, sometimes data may be more used to highlight problems than detect opportunities. Management practices in the PSM have recently been unified with a visual management system, that is likely to have a positive impact on the data-driven culture, as making data-driven decisions was made easier. The current practice is consistent with the findings of Handfield et al. (2019, 988), who suggest that in most organisations, data must be integrated from multiple sources before procurement can make informed decisions. Despite that, there was a difference of 50 percentage points in the survey responses between using data to support decisions (96 % agree) and basing decisions on data even though the intuition would suggest a different decision to be made (46 % agree). This may be due to the perceived poor quality of data but also indicate that the value of data is not fully recognised among the employees. To gain acceptance and more easily welcome the change, easy-to-implement solutions that provide evident enhancements to the employees' ways of working could be implemented (Öhman et al. 2021, 949).

It has been noted that developing analytics capabilities often require significant resources (Ahmed et al. 2022, 776), while the returns may be difficult to measure in monetary terms. Therefore, existing top management support plays a key role in analytics capability

development so that the required resources can be secured. Top management support for analytics in the case firm is likely to be there, but the high number of neutral survey responses indicate that the development efforts regarding PSM analytics may have been started just recently. On the other hand, there may either be a gap in communication or a lack of dedicated focus in PSM analytics by the top management. As the PSM is not directly represented in the top management of the case firm, PSM managers may face difficulties in acquiring the resources for analytics capability development (Jha et al. 2020). To gain the resources, Jha et al. (2020) propose that competitive pressure from clients and competitors together with regulations may act as motivation for analytics investments. Benchmarking the external environment in the case firm could give motivation to new investments for analytics capability development.

The value of organisational learning may not be yet recognised in the case firm. High disagreement was given to the statement "Our organisation has held analytics-related workshops that enhanced my understanding and knowledge of PSM analytics use" in the survey. This might be the case either because no workshops have been held or because the quality of the workshops held have not met the expectations of the employees. The lack of cross-functional teams could imply that feedback from the end users is not often requested or utilised when developing PSM analytics and that cross-functional collaboration may not be currently exploited to its full potential. The "learning by doing" approach could be valued more. Internal and external analytics success stories could be presented to create wider interest and motivate both the management and the employees (Öhman et al. 2021, 946). Cross-functional collaboration could be increased especially with the analytics function to develop the analytics tools in PSM. On the other hand, analytics tools can facilitate the collaboration between PSM and other business functions (Öhman et al. 2021, 948) such as production planning and production, warehousing, and project management in the case firm.

5.2 Technologies & Data

When considering technologies, the framework suggests that user-friendly technologies with descriptive, predictive, and prescriptive capabilities would support the development of analytics capabilities. In addition, the data that is handled and processed in these systems should be of high quality and appropriately managed, so that reliable insights can be gained. The case organisation has a sufficient number of technologies in use. The development

potential lies especially in making the available tools and reports more user-friendly for example by enhancing the readability of analytical reports and making the insights easier to share. The ongoing development actions in the case firm are likely to increase the number of advanced technologies in the firm but also enhance the flow of information and access to data. Making time-stamped data available in could enable the firm to perform process mining activities that can further enhance the PSM processes.

Many employees seem to not know whether the available analytics technologies are up to date. This may be the case due to the differing levels of technological talent and knowledge. In line with the findings of Handfield et al. (2019, 995), also the case organisation is in the early stages of building its PSM analytics capabilities. Thus, the current analytical reports mostly focus on describing the internal data. Predictive and prescriptive analytics tools are not in use, which may make it more difficult for the PSM managers to gain more resources for the development from the top management. This is the case because often analytics must justify its existence by showing solutions that have a notable business impact (Öhman et al. 2021), that in turn can more easily be shown with predictive and prescriptive tools that look forward and drive actions instead of looking back and describing what has already happened. Future potential is detected in the integration of external data and tools with more advanced capabilities to analyse patterns, predict future scenarios and gain supply market intelligence (Handfield et al. 2019, 987). Such a shift towards more advanced technologies is likely to improve the decision-making capabilities of the organisation (Arunachalam et al. 2018, 426), and increase the efficiency of the PSM function.

High-quality data could be seen as an antecedent for all analytics projects (e.g., Chae & Olson 2013; Handfield et al. 2019; Jha et al. 2020). Poor data quality hinders the development of analytics capabilities in the case firm. Luckily, this has already been noted in the company and a great number of development actions are already ongoing that are likely to increase the data quality. Another piece of good news is that the PSM employees already recognise their role in managing the data, which is the first step in increasing the data quality. Consistency is found with the findings of Handfield et al. (2019, 986) and Jha et al. (2020), who emphasise the importance of data governance and management in future PSM analytics. A data governance strategy would make addressing the data quality issues easier for the case firm. Nevertheless, the case organisation follows the current common practice in data management: PSM data is mostly manually cleansed and managed. More

advanced solutions could use learning algorithms, machine-based learning or other tools that require less human touch in data management. (Handfield et al. 2019, 987; 991.) Some firms have tackled the issue by appointing a data manager who is responsible for creating a data management strategy and observed a significant increase in the quality of their analyses (Jha et al. 2020).

5.3 Talent

The final capability area in the framework considers talent. According to the framework, possessing analytical and technological talent, having firm-specific knowledge, self-management skills and managerial talent support the development of analytics capabilities in PSM. Overall, the case firm aims to hire individuals with different backgrounds to increase talent, as suggested by Richey et al. (2016). Regarding analytical talent, while the sources of internal data are understood at least on a moderate level, the case organisation may lack awareness of the potential that external data and modern analytics technologies have. Similar unawareness was observed in multiple other firms interviewed by Jha et al. (2020). Thus, the PSM employees and management may also not be able to request for more advanced tools to be implemented and the strategies for moving towards such technologies may turn out to be outdated. A gap between the current state of analytics in PSM and the potential of modern tools was also observed by Handfield et al. (2019, 982). Analytics capabilities development is proposed to be enhanced in firms with analytics training programs (Jha et al. 2020), which could also be considered in the case firm.

Technological talent from the employees' perspective is rated as moderate in the survey, while the management saw a great area of improvement in this. A majority of the employees agree that learning new technologies is easy for them. Still, less than half of the respondents consider themselves to be good at using the analytical tools. Lack of willingness or time to learn the technologies may explain the results. As the user-friendliness of the technologies and the readability of the analytical reports were disagreed by quite many employees, they may have less motivation to learn more about the current analytical tools. Adequate time should also be reserved for the employees to learn the new technologies.

Self-management measured by the use of analytics for different purposes seems to be on a great level in the case firm. The rather high disagreement with using analytics for forecasting

is likely to be due to a lack of tools for such a purpose. Managerial talent was somewhat criticised by the employees. A couple of reasons could explain the answers. First, as the analytics development in the case firm is still in the early stages, solutions that highlight the value of analytics especially for (top) management may have been implemented first. Such focus may have caused an overemphasis on management tools that do not increase the productivity of the buyers. On the other hand, due to the lack of high-quality training, it may also be difficult for the employees to see the benefits in their daily work as the talent to utilise the newest technologies may have not yet reached very high maturity. Finally, consistent with the findings of Jha et al. (2020), the lack of talent in analytics in general may have prevented the employees and management from suggesting tools that could increase the employees' productivity. Better change management actions could be taken by the PSM management. Creating a realistic vision and promoting the analytic culture are found to be helpful (Handfield et al. 2019). The evolving external environment and technology development in general should be considered when developing the strategy.

5.4 Roadmap for Analytics Capability Development

To sum up the discussion of the previous chapters, the connections between the developed framework, the case firm's current state with PSM analytics capabilities and the suggestions for development are illustrated as a roadmap. As argued by Handfield et al. (2019, 994), a well-defined roadmap is helpful in navigating the changing environment that is observed in the field of technology and analytics. In addition, the interconnectedness of multiple areas can be easily illustrated in the form of a roadmap. The visualisation is presented in Figure 18 on the next page.

Each capability area and the identified sub-areas have their own suggested actions and goals. The actions are illustrated with white rectangles and goals with green rectangles. In addition, the arrows illustrate the connections between the actions and goals, also highlighting the interconnectedness of the capability areas. All actions and goals aim towards gaining better value from data. The horizontal axis represents a timeline to show a logical order of the actions and goals in relation to each other. The grey vertical line with the green indicator at the bottom determines the current state of the roadmap implementation in the case firm. The nine starting points for different paths are marked with black numbered circles.

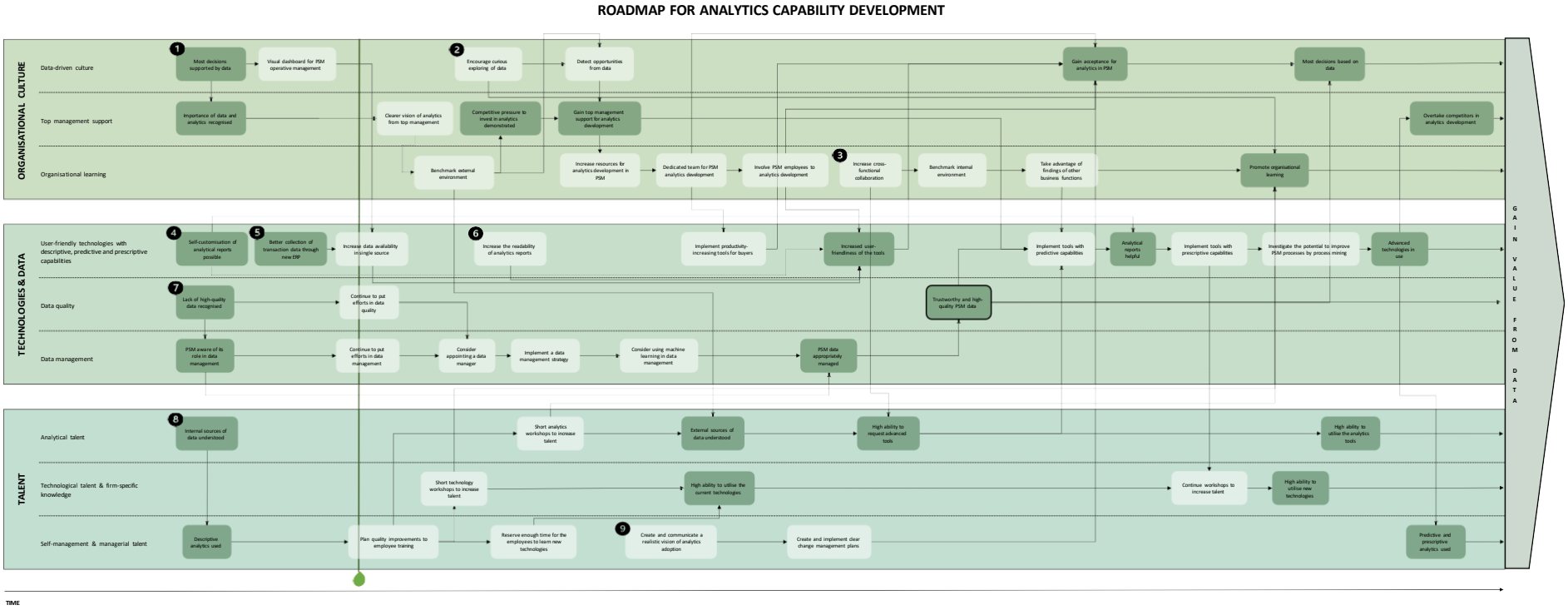

Figure 18: Roadmap for analytics capability development

A great number of suggestions for development were derived for the case firm to improve its PSM analytics capabilities. The key development ideas regarding each capability area can be summarised as follows. Top management could be asked to clarify the vision regarding the analytics in the case firm and the external environment (competitors, customers, suppliers) could be benchmarked to support the future vision and to gain innovative insights. This would illustrate the likely existing competitive pressure to invest in more analytics, which in turn would increase the top management support for analytics development and further provide the required resources. A dedicated team for PSM analytics development would enhance the allocation of resources in developing tools that increase the productivity of the buyers and help in gaining analytics acceptance in PSM, while tools with predictive capabilities would increase the productivity of the entire function. Increasing cross-functional collaboration would promote organisational learning and help in taking advantage of development ideas that have already been implemented in another business function or business line in the case firm.

Efforts to increase the data availability in a single source, improvements in analytical reports (e.g., unifying terminologies, increasing access to support documentation, replacing old visualisations with more informative types), and involving the PSM employees in analytics development increase the user-friendliness of the tools and help in gaining the analytics acceptance. Continuing to put efforts into data quality and management are seen as beneficial. Appointing a data manager who is responsible for implementing a data management strategy would benefit the case firm in these efforts. More advanced options in data management, such as machine learning could be considered to increase efficiency. These actions would help in managing the data appropriately and thus ensuring the high quality of data in PSM.

Quality improvements in employee training regarding analytics and technologies are recommended. After that, workshops to increase both the technological and analytical talent are likely to enhance the employees' ability to utilise the technologies and tools and communicate the need for more advanced tools in PSM. Better communication of the analytics vision on the PSM level and clear change management practices are additional ways for the management to increase the analytics acceptance.

5.5 Connection to the Dynamic Capabilities View

PSM analytics capabilities can be seen as dynamic capabilities. The analytics capability areas could provide competitive advantage for firms in the following ways. First, organisational culture is an intangible capability that is very difficult to be imitated by competitors (Cadden et al. 2022). Making data-driven decisions is a mentality, and changing the beliefs, attitudes, and opinions of employees is a complex task that takes time. Similarly, building a culture that values organisational learning is a difficult and time-consuming but essential task in developing analytics capabilities. The learning-by-doing approach may require changes in attitudes and beliefs, which cannot be readily bought from the market. Thus, certain features in organisational culture can be seen as valuable, rare, imperfectly imitable, and non-substitutable capabilities that can provide competitive advantage to organisations.

Even though technologies and data management tools can be purchased readily from the market, and those would be easy for the competitors to duplicate, it is the knowledge and information created through these technologies that provide the competitive advantage (Fawcett et al. 2011). Thus, investing in analytics tools that for example provide information and knowledge to facilitate cross-functional collaboration, that in turn provide better grounds for information visibility and enhanced strategic decision-making can create valuable inimitable capabilities. These again are likely to act as a source of competitive advantage.

Talent in some areas can also be purchased with financial resources. However, multiple reasons support the statement that talent can act as a source of competitive advantage. Firstly, individuals who have talent in all required areas are difficult to find especially in smaller cities or countries (Jha et al. 2020). Second, replacing all employees of an organisation at the same time is an unrealistic scenario but would also result in losing all the firm-specific knowledge, processes and organisational culture that has been developed over time. Therefore, the accumulated talent that is gained over time in multiple areas by the employees is not possible to be purchased from the market.

6 Conclusion

This thesis has examined the assessment and development of analytics capabilities in purchasing and supply management. In prior research, the topic has received only limited attention. The current understanding of PSM analytics capabilities was advanced by developing a framework that defines three interdependent capability areas, on which firms should focus when assessing and developing their PSM analytics capabilities. The framework was developed by integrating prior literature and views from the practice. A literature review was conducted first to create an initial model, that was validated and further improved by interviewing PSM managers in a case organisation. In addition, the case organisation's current state of PSM analytics capabilities was assessed according to the framework and development suggestions were provided to assist the firm in developing those capabilities. Other large organisations that wish to develop their analytics capabilities and gain value from data could benefit from the results of the study. It is argued that well-developed PSM analytics capabilities can act as dynamic capabilities and thus provide competitive advantage to organisations.

The main research question of the study was "How analytics capabilities can be developed in purchasing and supply management?" Before the capabilities can be developed, the current state should be measured. The framework developed in this study provides the areas for assessment and development in PSM. It can be concluded that three capability areas, namely organisational culture, technologies and data, and talent should all be considered when assessing and developing the PSM analytics capabilities. An organisational culture that supports the development of analytics capabilities is data-driven, analytics have top management support, and the value of organisational learning is recognised. Supportive technologies are user-friendly and have descriptive, predictive, and prescriptive capabilities, while data must be of high quality and appropriately managed. Insights from the data are derived by talented decision-makers, who have analytical and technological skills, complemented with firm-based knowledge and self-management skills. Managerial talent is required from the management level employees. The developed framework enables firms to prioritise their efforts when aiming towards the development of analytics capabilities in PSM. If the capability areas in an organisation do not yet meet the suggested conditions, suggestions for development were provided in this study.

6.1 Implications for Theory

This study increases the existing knowledge of analytics capabilities in purchasing and supply management. A mixed method single case study was conducted in a Finnish technology firm to propose a framework and development ideas. Contributions are made to PSM literature in the form of the framework, that can be used to assess and improve analytics capabilities of a PSM function. The framework also provides grounds for future research to test the significance of the three capability areas of organisational culture, technologies and data, and talent in forming the PSM analytics capabilities.

The study extends the discussion on dynamic capabilities by suggesting that PSM analytics capabilities could act as dynamic capabilities that provide sustained competitive advantage to the PSM function and further to the entire organisation. Especially the intangible capabilities developed through tangible resources, such as a supporting organisational culture, information and knowledge, and accumulated talent are seen as valuable, rare, inimitable, and difficult for competitors to duplicate.

6.2 Implications for Practice

Significant increase in the available data together with quickly developing technological tools have increased the need for firms to transform data into value in order to stay competitive. The findings of the study provide important implications for management especially in the purchasing and supply management function but also on the corporate level for the top management. The goal of this study was to provide foundations for taking advantage of data in PSM. Therefore, analytics capabilities were studied from the PSM perspective, and the results of the study propose a framework for assessing and developing these capabilities.

The framework provides benefits for PSM managers by identifying specific areas where improvements can be made. The case-specific development ideas provided in this study may serve as an inspiration for other large companies in their efforts to develop their PSM analytics capabilities. On the corporate level, the results provide implications for top management especially regarding organisational culture, where top management plays a key role. In addition, adequate resourcing for developing analytics capabilities is up to the top management. The results of this study provide focused areas that firms can develop to most

benefit from all the available data nowadays, putting the allocated development resources to efficient use.

The general view on analytics typically considers solely the technological tools and data. The results of this study emphasise that even the greatest tools alone are not sufficient in gaining value from data. The role of supporting organisational culture and talent that is required in multiple areas should not be overlooked. In addition, high-quality data and appropriate data management are essential when reliable insights from the data are intended to be gained.

6.3 Limitations and Future Research

A set of limitations is to be considered when interpreting the results of the study. The lack of empirically tested frameworks in previous literature (e.g., Chae & Olson 2013; Handfield et al. 2019; Jha et al. 2020) may have decreased the validity of the findings. In addition, when studying the topic in one organisation alone, the generalisability of the results is limited to the context of the study. The chosen case is expected to be a representative example in its industry. If the interpretation of the representativeness is wrong, the results of the study may be questionable in the wider context. However, the results are mainly intended for the use of the case firm. Future research is required for empirically testing the framework in a wider context before more generalisable results can be derived.

The study was conducted by only one author, which may decrease the validity and reliability of the results of the content analysis due to subjectivity (Schreier 2012, 19). Personal biases may shape what is seen, heard, or recorded (Voss et al. 2002, 210). Considering the nature of the study, it was not possible to involve more authors in the process. This also resulted in the lack of resources in conducting a more extensive multiple case study, that could have produced more holistic results. The results of the study also greatly depend on the quality of the interviews, that in turn depend on the skills of the interviewer (Voss et. al 2002, 207). The interviewer's lack of experience may have posed a slight limitation. The reliability was increased by careful documentation of the research process and data analysis.

To derive more generalisable results, it would be important to understand whether the capability areas presented in this study are the core areas required for analytics capability development and study the influence of each area. Therefore, more empirical studies around

PSM analytics capabilities are called for. In addition, only one industry, firm size and geographical location were represented in this study. Organisations different to the case firm could be studied to review the applicability of the findings in different contexts.

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Appendices

Appendix 1: Interview Questions

Provided definitions before the interview:

PSM analytics capabilities *Using culture, technologies and data, and talent to capture, store, manage and analyse data in order to achieve the PSM function's objectives.*

Topic	Questions
Background	In your opinion, how important it is to use data and analytics in PSM?
Organisational culture	What kind of organisational culture do you believe would support the development of analytics capabilities in PSM? If the answer to the above question does not mention: - data-driven culture, - top management support, - or organisational learning, discussion about the possible importance of these aspects How well do you believe the current organisational culture supports the development of analytics capabilities in your PSM function? Are there any culture-related actions planned in the near future that would help in the development of this area?
Technologies & data	What kind of data do you believe would support the development of analytics capabilities in PSM? If the answer to the above question does not mention: - data quality, - or data management, discussion about the possible importance of these aspects How well do you believe the currently available data support the development of analytics capabilities in your PSM function? Are there any data-related actions planned in the near future that would help in the development of this area? What kinds of technologies do you believe would support the development of analytics capabilities in PSM?

	If the answer to the above question does not mention: - process-supporting, - or user-friendliness, discussion about the possible importance of these aspects How well do you believe the current technologies you have in use support the development of analytics capabilities in your PSM function? Are there any technology-related actions planned in the near future that would help in the development of this area?
Talent	What kind of talent do you believe would support the development of analytics capabilities in PSM? If the answer to the above question does not mention: - analytical skills - technological skills, - or management skills, discussion about the possible importance of these aspects How well do you believe the PSM function's current talent support the development of analytics capabilities in your PSM function? Are there any talent-related actions planned in the near future that would help in the development of this area?

Appendix 2: Survey Questions

Provided definitions in the survey:

PSM analytics *a data-driven approach to manage the objectives of a PSM function.*

Topic	Sub-area	Item	Questions	Sources
Other	Background		To what extent do the following factors prevent PSM from exploiting analytics in your organisation:	
		BG1	- Lack of supportive culture	
		BG2	- Lack of adequate data	
		BG3	- Lack of IT tools	
		BG4	- Lack of skills	
Organisational culture	Data-driven culture	DD1	I use the available data to support my decisions.	De Oliveira & Handfield (2019); Cadden et al. (2022); Chen et al. (2015)
		DD2	When data and my intuition suggest a different decision, I base my decision on data.	
	Top management support		Our top management:	
		TM1	- Supports the use of analytics in PSM	
		TM2	- Sees analytics as a strategic priority for PSM	
		TM3	I believe our organisation is further in PSM analytics use than our competitors.	
	Organisational learning	OL1	Our organisation has held analytics-related workshops that enhanced my understanding and knowledge of PSM analytics use.	
		OL2	I am/have been a part of cross-functional team(s) or project(s) that focus on the creation, development, or discussion of PSM analytics.	
Technologies & data	Technologies	TE1	Compared to rivals within our industry, our organization has up-to-date analytics technologies in use.	Wamba & Akter (2019); De Oliveira & Handfield (2019)
			Our analytical reports are:	
		TE2	- Easy to read	
		TE3	- Helpful in discovering solutions to PSM problems	
		TE4	- Self-customisable to meet a variety of needs	
		TE5	Analytical insights can be seamlessly shared within our organisation.	
		TE6	I consider our analytics tools user-friendly.	
	Data quality & data management		Our PSM data are:	
		DQ1	- Trustworthy	
		DQ2	- Good quality	
		DQ3	- Easily available	
		DQ4	- Available in a single source (no need to be assembled from different sources to make decisions)	
		DM1	I pay attention to the correctness of data if I enter it into our internal systems.	
		DM2	I believe that PSM's role in maintaining data quality is significant.	

Talent	Analytical talent		To what extent do you understand how the following data can be used in PSM analytics	Moretto et al. (2017); De Oliveira & Handfield (2019); Wamba & Akter (2019)
		AT1	- ERP data	
		AT2	- Bills of material	
		AT3	- Supplier relationship data	
		AT4	- Contract data	
		AT5	- Internet (e.g., websites, news)	
		AT6	- Social media	
		AT7	- Supplier owned data	
		AT8	- Sensor data	
	Technological talent	TT1	Learning new technologies is easy for me.	
		TT2	My ability to use the available analytical tools is good.	
		TT3	Our organisation has helped me in increasing my technological talent.	
	Self-management & managerial talent		I use analytics in decision-making to	
		SF1	- Describe business scenarios and problems	
		SF2	- Forecast business scenarios	
		SF3	- Anticipate business problems	
		SF4	- Drive actions	
		MT1	I believe our management continuously examines the innovative opportunities for the strategic use of PSM analytics.	
		MT2	I believe our management enforces adequate plans for the introduction and utilisation of PSM analytics.	
		MT3	I believe our management frequently adjusts PSM analytics plans to better adapt to changing conditions.	
			When PSM analytics investments have been made, I have:	
		MT4	- Been able to increase my work productivity	
		MT5	- Received adequate training to be able to use the new analytics technologies	
		MT6	- Been well supported in the change by the management	

Appendix 3: Content Analysis Categorisation Table for the Framework

Capability area	Sub-area	Quotation
Organisational culture	Data-driven culture	All kinds of reports are requested, and we are interested in seeing the data from different perspectives. (I5)
		I believe that these younger generations, who bring this different culture to us and have been around information technologies since they were born. And that supports us in it (development of analytics capabilities) the most, and it might even force us towards that. (I5)
		I have been working in firms that have managed the data well in the big picture. And I think that it is strongly dependent on the culture. (I5)
		It (decision-making) should not be based on intuition. (I3)
		Organisational culture should be the kind that we trust in managing with evidence and facts-based statistical methods. (I4)
		Organisational culture should be the kind that we utilise the available data in operative management. (I1)
		Overall, a culture in which the data is valued. (I2)
	Top management support	I think resources are needed for the development of these things, we know that in this situation these things may cross the minds of all managers and buyers (…) but still resources would be needed for the analysis and development. (I2)
		I think that top management support would be there through examples. (I1)
		If we think about data analysis and introducing new technologies, the support from whether it is the PSM director or whoever, is needed. (I2)
		If we think about the resources… If we come up with the idea of developing our analytics capabilities on the lower level without having time, money, or resources from the top, it is quite difficult. (I3)
		In many cases, we could talk about the resourcing and that we can get resources. (…) For sure it (top management support) helps. (I5)
		Of course, we should first see the utilisation of the data as important, but the second thing is that (…) we should also be able to see the benefits of the data analysis and through this be able to allocate the appropriate resources. (I2)
		This is surely something that is behind both the supervisors and the organisational culture, that how we encourage people to use the tools that utilise the data. We should have an encouraging perspective to it (…) We should make people interested in these tools that I think are very good. As soon as people are brave enough to learn and use them. (I2)
		Usually top management support is required in this (culture where statistical methods are trusted and decisions are based on data). (I4)
		We could be more curious in finding out how other firms utilise it (data), so intense benchmarking. (…) Find examples of how data is utilised. (I2)
	Organisational learning	Another thing what I think is important, when correctly used, is cross-functional collaboration as you have written there, and that the interfaces can be better handled. But it is important... (...) In here we are much worried if the other employee has done this and that. And it is a good thing, but it can backfire if we are too worried. (I5)
		A culture that supports the listed areas (cross-functional collaboration, shared vision, the value of learning, learning by doing, information and knowledge sharing), I think it is exactly like that. (I2)
		I think the kind of organisational culture that has a "try it out" mentality will help in implementing new technologies. If we are horrified to make mistakes or have no courage to try new things, that type of culture is not very fruitful in developing the capabilities. (I3)
		Sharing knowledge is very important in an organisation of this size. (I2)

		The culture should be the kind that we recognise opportunities with the help of the data and not only highlight problems. (I2)
		The organisation should support and encourage, and especially train the employees so that they will and are able to utilise the available data. (I1)
		Then of course if we introduce new things and try new things, also the organisational culture should be innovative and willing to experiment. (I4)
		We need more communication from the procurement top management, and between us and the category management so that we understand what kind of decisions are based on the data on the business level and in category management, how it is utilised. (I2)
		We should have a common understanding regarding the use of data, we should understand the benefits that are achieved. (…) If we turn some project items into warehouse items, the warehouse and inventory management increase the workload and responsibilities in logistics. (...) This emphasises cross-functional collaboration and achieving the common vision and goals. (I2)
Technologies & data	User-friendly technologies	All the data is pretty much in the ERP. And then maybe somewhere else, so we have to have a few tools that can combine the data from multiple systems. (I5)
		But we should get into a situation where the rumbustious idea-rich buyer could collect information from the ERP or other system close to purchasing by him/herself and use it for different purposes. Some kind of flexibility and user-friendliness. (I5)
		How we could use EDI for example in transferring purchase order data and order confirmations to suppliers and vice versa, which could probably be easier for the supplier than our current [supplier portal] system. (I3)
		Information (in reporting tools) should update automatically when something is updated (in ERP). (I1)
		Processing the transaction data between [the company] and the suppliers is a challenge. (I3)
		What I think do not support (the development of analytics capabilities) are these certain additional systems such as [a supplier portal] and such. It should be kept very simple. (I5)
		When people find that the technologies make their working easier, they adopt them more easily. (I1)
	Descriptive technologies	I think new technologies (such as software robots) and reporting tools in which the data can be utilised by filtering. (I2)
		If we talk about our large subcontractors, it would be great to be able to dig deeper, for example to understand how much they have resources and capacity. (I5)
		Of course, systems that are related to visualisation that can handle the data. Those would be supporting technologies. (I4)
		The other side is that we deliver reports that show whether [a buyer] has bought everything yesterday and what is the delivery reliability of his/her suppliers, and whether the adequate discussions have been had with suppliers who at the time perform poorly. And we should have these, but they are hard and based on facts and this is just reporting. (I5)
		Visualising the data (supports the development of analytics capabilities). (I1)
		We are discussing how the (analytical) reports are read and how data can be filtered out of them. But I think the next should be that how we will visualise the data and make it support the decision-making. (I3)
	Predictive technologies	And then other analytics matters that we have discussed in our team with [buyer], related to cost modelling. Should we have some own capabilities to do the cost modelling? And cost analysis towards the suppliers, there are also a certain data and technology that it is related to. (I3)

		I have said this, it is a stupid phrase, but it (technology) should be IT sexy. What I mean is that there should be some "wow factor" for young people (who were born with the technologies in their life). (I5)
		Some kind of predictive tools for example related to forecasting. Those would be (supportive) in the future. (I4)
	Prescriptive technologies	It should be possible to simulate things in the tool. (I5)
	Adequate data management	Data that are frequently and systematically managed (support the development of analytics capabilities). (I1)
		Managing data in the system is in the essence. (I2)
		Regarding the data quality and correctness, if I think about us as purchasing employees, our human resource allocation and employees' responsibility in managing the data is much related to that. (I2)
	High-quality data	Collecting data in one place (supports the development of analytics capabilities) (I1)
		Data should be handled in one place as much as possible. (I1)
		I think an important aspect in the data is that it reflects the truth. (I4)
		It (data) should be correct, adequate for our purposes, and modifiable to different shapes. And understandable. (I5)
		Of course, the data should be correct and error-free, trustworthy in other words. (I2)
		The correctness of data is important especially as we are a major part of the delivery process. (I2)
		The data should be standardised in the sense that a software robot could utilise it. (I3)
		What kind of data supports the development of analytics capabilities, well, real-time. (I1)
		With a large amount of data, it is of course essential that the data are correct. (I1)
Talent	Analytical talent	And then of course we need those people, but in lower quantities, who can actually use the systems and create different things, build correlations and so on. (I5)
		Another useful skill to have would be the understanding of statistical methods, and variation and deviation and so on, so that these things could be interpreted from the data. (I4)
		The management talent in practice is how the information is used in the management. Regarding both the practical things and people. (I4)
		Then in some sense we must have the ability to see the relations and relationships between things. So that we can look from the upper corner, and everyone should have this. (…) A certain helicopter perspective and understanding. (I5)
		We must understand why we measure something and from where. (I5)
		We should increase our talent in understanding and analysing the data. (I1)
	Technological talent	In this case the newest and coolest technology may not bring the bliss. (…) We must recognise the potential of the already available technologies. And base ideas on that. (I5)
		One area is ERP and MRP knowledge. Understanding of how the MRP calculations work and how the materials are managed, and then through that, how it is done in the ERP. That is one area. (I3)
		Overall, those who use the information should be able to use the reports and tools. That is a minimum requirement. (I4)
		The second area is then this reporting platform, utilisation of [data visualisation tool] and visualisations when we have conversations with the suppliers about their performance. So the data should be utilised, and on the other hand, also the own analyses r
		We need talent in knowing what must be done in the IT systems, why, and how. (I1)

		We need talent in teaching how the available technologies work. (I2)
		We should have an adequate number of people who can utilise these technologies that visualise and use the data. (I4)
	Firm-based knowledge	I find it very important that we have process knowledge and knowledge regarding the things that we measure, so that accurate things that are important for purchasing and supply management are correctly measured. (I2)
		I see the cost modelling and the related talent as a third area, and then also how the data can be brought there to support the modelling. (I3)
		I think using the data is important but we must remember that we may have problems in the process in which the raw data does not reflect the reality. For this, we need the purchasing responsible's, for example the buyer's, expertise to explain the background
		We must understand the relation between the business process and the system. (I1)
		Yes, and actually one important area is process understanding. In order to make sense of the data, the processes in the background that create the data must be understood. (I3)
	Management talent	Also regarding the data and technology investments in a firm of this size, it would be good to understand that when proceeding, the usefulness of all investments should be assessed on the organisational level and not only considering one function. (I2)
		I personally need the ability to analyse data according to the reports that we have. And be able to centrally manage our conduct. (I1)
		I think the first thing is that we must be interested. (I5)
		I think this is also a management matter, that we should encourage and give support if needed, and train people. Also, we should create accurate data management reports. (I2)
		In that sense maybe one term that could be there is a certain self-determination. Because it is important in the development of this analytics capability, that people must be interested in utilising it. It is not enough that managers are interested. (I3)
		Maybe the management talent is involved in the sense that we can manage the operative tasks in a way that time is reserved also for development and analysis? So that all focus would not go into putting down the fires and clicking through transactions. (I3)
		We have many new systems that have data inside (…), those are put to use but then the training is mostly the functions' responsibility. And that creates variation in how the systems are used and how capable people are in using them. (I1)
		We must make sure that we have a limited number of technologies, so it does not get out of hands. (I2)

Appendix 4: Descriptive Statistics of the Survey Items

	Sub-area	Item	Mean	SD	Min	Max
Background	Organisational culture	BG1	3.31	1.12	1	5
	Data	BG2	3.92	1.16	1	5
	IT Tools	BG3	3.19	1.17	1	5
	Skills	BG4	3.56	1.23	1	5
Organisational culture	Data-driven culture	DD1	4.54	0.86	1	5
		DD2	3.38	0.85	2	5
	Top management support	TM1	3.62	0.94	2	5
		TM2	3.73	1.00	2	5
		TM3	2.77	0.86	1	5
	Organisational learning	OL1	2.27	1.12	1	5
		OL2*	-	-	1	5
Technologies & data	Technologies	TE1	3.12	1.07	1	5
		TE2	2.96	1.15	1	5
		TE3	3.46	1.10	1	5
		TE4	3.69	0.97	2	5
		TE5	3.23	1.18	1	5
		TE6	2.42	1.10	1	4
	Data quality & data management	DQ1	2.50	1.03	1	4
		DQ2	2.69	1.05	1	5
		DQ3	2.81	0.98	1	4
		DQ4	2.42	1.10	1	5
		DM1	4.38	0.94	2	5
		DM1	3.88	0.86	2	5
Talent	Analytical talent	AT1	4.00	1.06	1	5
		AT2	3.96	1.00	1	5
		AT3	3.73	0.87	2	5
		AT4	3.96	0.96	2	5
		AT5	3.54	0.76	2	5
		AT6	3.35	1.02	1	5
		AT7	2.69	1.09	1	5
		AT8	2.69	1.16	1	5
	Technological talent	TT1	3.92	0.89	2	5
		TT2	3.50	0.99	2	5
		TT3	3.31	0.93	1	5
	Self-management & managerial talent	SF1	3.08	1.13	1	5
		SF2	3.00	1.13	1	5
		SF3	3.38	1.20	1	5
		SF4	3.85	1.08	1	5
		MT1	3.46	0.99	2	5
		MT2	3.52	1.05	2	5
		MT3	3.27	0.92	2	5
		MT4	2.73	1.28	1	5
		MT5	2.58	1.17	1	5
		MT6	2.58	1.03	1	5

***** Inaccurate question setting prevented the use of mean and standard deviation of OL2.

Appendix 5: Content Analysis Categorisation Table for the Current State

Area	Quotation
Organisational culture	Nowadays all the data enables us to analyse the problems we have, what kind of problems they have been and recognise the areas of issues more in detail. (I1)
	Yes, we are trying (to base decisions on data), as the higher we go in the organisational structure, the more decisions and interpretations are made based on the data. (I1)
	I think in [this company] and this [this business line] it (data) is utilised. In recent years we have implemented these tools, the [data visualisation tool] and so on that help in it. (I2)
	I think it (organisational culture) has gotten better. The data analysis tools are better, but as I said, I think we focus too much on the problems. Which in certain cases is ok, but some curious examining of the opportunities that the data analysis could bring without having a major issue could be on the better state. (I2)
	I think it (organisational culture) is getting better. We are aiming to base the situation awareness more on the system information and data. And then also find areas of improvement. (I4)
	I have many times wondered that we have, if we think about the data management tools and others, in comparison to earlier, the PSM development resources (...) are quite limited. (I2)
	We currently do not have the strength to build such (predictive) tools. (I4)
Technologies & data	We can get much data from the [ERP] and see what the situation is, and also the logs so who has updated the information. (I1)
	I think it (the situation with current technologies) is fine. (I2)
	I do not necessarily think that there would be any issue with the current technologies. We have quite good platforms under them. I think it is more about being able to effectively use them and have the strength to do the required fine-tuning to make them work with our data and processes effectively. (I3)
	There is room for improvement in the technological tools. (I4)
	If we think about visualisation, our [visualisation tool] reports. The tool itself is good, but the question is what we have built with it. (I4)
	I would say that we have a lot of technologies. And we should be able to use them as well as possible. And at the same time actively search for new. We do not need a high number of new technologies before we are able to effectively use the ones we currently have. (I5)
	The focused data management that we have been doing of the purchase order date data since October or November still only ensures that we do not have outdated information in history, but we should also be able to update the data for future orders. (I1)
	Yes (the data is trustworthy and high quality), as I report it forward as it is. (I1)
	When we measure things, for example procurement performance, are we measuring the things correctly? (I2)
	The pure transaction data in the system is not on a good level. Our reality is not reflected in what the system says. (I3)
	Our data quality is still poor for doing such (predictive) analysis. (I4)
	We have enough data available, as soon as it is good enough by the quality. (I5)

Talent	No, we do not have (enough talent). It has a lot of variance. I think overall, we should enhance and increase our talent in using different systems. (I1)
	And data and data analysis would require more talent. (I1)
	It (talent) surely has room for development. I think we have been improving in it. Of course, we still have improvements to be made so that we understand the importance of correct data and data management. To make correct decisions, for example regarding the delivery reliability or late purchase orders, managing the data plays a key role. (I2)
	We have individuals who may not be ready for it (being data-oriented and having a "try it out" mentality) or there may not be talent for that. On the other hand, we have individuals who are very excited and ready to develop their skills, and also teach others and deepen their understanding of the tools. (I3)
	(There is) quite much room for development regarding talent. (I4)
	Our technological talent in the larger perspective is still weak. It should be developed and then also understanding data and analytics types would be one. (I4)
	In the time that procurement has been reporting for me, our talent and understanding regarding this topic has significantly improved. (…) I think we currently have enough talent. (I5)
	We are now building reports that only show the data but we should also be able to go one step further and gain insights from the data. (I4)