Lauri Halonen

Utilization of data-analytics in the field of procurement

School of Technology and Innovations

Industrial Management Master's thesis

Industrial Management program

Vaasa 2023

VAASAN YLIOPISTO
School of Technology and Innovations
Tekijä: Lauri Halonen
Tutkielman nimi: Utilization of data-analytics in the field of procurement
Tutkinto: Kauppatieteiden maisteri
Oppiaine: Industrial Management Master's Program
Työn ohjaaja: Ahm Shamsuzzoha
Valmistumisvuosi: 2023 Sivumäärä: 60

TIIVISTELMÄ:

Hankintatoimen merkityksen kasvaessa osana yritysten päivittäistä liiketoimintaa, kasvaa myös sen kehittämisen tarpeellisuus. Tämän pro-gradu tutkielman tavoitteena on luoda parempi kokonaiskuva hankinnasta ja data-analytiikasta. Tavoitteen saavuttamiseksi kerätään kattava teoriapohja hankinnan ja data-analytiikan käsitteistä, sekä analysoidaan suomalaisen valmistavan teollisuuden yrityksen hankintaosaston data-analytiikan hyödyntämisen nykytasoa.

Tutkielma pitää sisällään kirjallisuuskatsauksen ja empiirisen tutkimuksen. Kirjallisuuskatsaus hyödyntää hankinnan ja data-analytiikan klassikko teoksia. Hankinnan data-analytiikan tutkimisessa on hyödynnetty uusimpia tutkimuksia aiheesta. Empiria osassa hyödynnettiin puolistrukturoituja haastatteluja ja moni osaista kyselyä.

Tutkielman tuloksissa havaittiin, että hankinnan data-analytiikan ja sen hyödyntämisen rooli kasvaa koko ajan merkittävästi ja siihen käytetyt resurssit ovat hyvin yritys- ja toimiala riippuvaisia. Merkittäväksi tekijäksi hankinnan data-analytiikan tehokkaan hyödyntämisen kannalta todettiin selkeän datan hallinta mallin luominen ja datastrategian liittäminen osaksi yrityksen liiketoimintastrategiaa. Myös resurssien mahdollistaminen havaittiin merkittäväksi tekijäksi hankinnan data-analytiikan tehokkaan hyödyntämisen ja kehittämisen kannalta. Kokonaisuudessaan hankinnan data-analytiikka ja sen tehokas hyödyntäminen ovat merkittävässä osassa hankinnan kokonaisvaltaista kehittämistä.

Avainsanat:
hankinta, data-analytiikka, hankinnan data-analytiikka, data, data governance, lisäarvo

VAASAN YLIOPISTO
School of Technology and Innovations
Author: Lauri Halonen
Title of thesis: Utilization of data-analytics in the field of procurement
Degree: Master of Science in Economics and Business Administration
Subject area: Industrial Management Master's Program
Instructor: Ahm Shamsuzzoha
Graduation year: 2023 Number of pages: 60

ABSTRACT:

As the importance of procurement as part of companies' daily business grows, so does the need to develop it. The aim of this pro-graduate thesis is to provide a better overview of procurement, data-analytics, and data-analytics in procurement. To achieve this goal, a comprehensive theoretical basis on the concepts of procurement and data-analytics is collected, and the current level of data-analytics utilization in the procurement department of a Finnish manufacturing company is analyzed.

The thesis includes a literature review and an empirical study. The literature review utilizes classic works on procurement and data-analytics. The study of data-analytics in procurement draws on the latest research on the topic. The empirical part utilized semi-structured interviews and a multi-part survey.

The results of the thesis showed that the role of procurement data-analytics and its use is growing significantly, and the resources devoted to it are highly company and industry dependent. An important factor for the effective use of procurement data-analytics was found to be the creation of a clear data management model and the integration of the data strategy into the business strategy of the company. Enabling resources was also identified as a significant factor for the effective use and development of procurement data-analytics. Overall, procurement data-analytics and its effective use are an important part of the overall development of procurement.

Keywords:

Procurement, data-analytics, procurement data-analytics, data, data governance, added value

Table of contents

Figures

Tables

1 Introduction

In recent years, procurement development has become one of the most important business development projects for companies. The importance of this topic cannot be overemphasized, as the competitiveness and cost-effectiveness of the external activities that a company procures play a very important role in the overall competitiveness of its business. Significant progress in procurement can only be achieved if it is seen as a strategic part of a company's business. Digitalization, on the other hand, is the greatest transformational force of our times. Its significant efficiency-enhancing effects on different areas of business activity have long been recognized as a reality (Alomar & De Visscher 2017). The benefits of digitalization in terms of procurement strategy and development are also very significant. This sets some new requirements for procurement in general and how effective it can be.

The main focus of the theoretical part of this study is to define and collect information of sufficient and sufficiently comprehensive quality on the topics identified as relevant to the objectives of the thesis. Procurement, data-analytics and procurement data-analytics, which are the largest in scope, will not be explored beyond the depth required to achieve the objectives of the thesis, but their main message will be used to answer the research questions. Given the constructivist nature of the thesis and the critical action research method, the main task of the thesis is to produce knowledge that can be utilized, with the aim of changing or developing something, i.e. creating something concrete.

1.1 Main objectives

This study seeks to gather a comprehensive theoretical basis of data-analytics and data-analytics in the field of procurement. It also examines, what industry 4.0 has to offer and how it can affect the field of procurement. The aim of the study is therefore to build on previous research to determine how data-analytics in the field of procurement is seen

as part of the procurement activities and what are the key drivers on the development aspect of it. Thesis also includes an analysis of a case company's current state of procurement analytics. Based on the analysis the thesis proposes suitable next steps to develop the data-analytics methods to further enhance the procurement function of the case company.

Study only mentions topics such as procurement strategy, measuring the procurement performance etc. but does not explain them thoroughly.

1.2 Research questions

Three research questions were created to guide the research to meet the objectives of the study. All the research questions are equally important for the study. The research questions were also refined through the process of research and writing, after a few iterations to the format:

1) How to exploit data-analytics in procurement and what kind of added value data-analytics enables to procurement management?
2) What is needed to utilize data-analytics effectively in case of procurement management?
3) What is the level of data-analytics at the case company's procurement department and what could be done to reach the level which creates the most additional value for the company?

1.3 Limitations

Single-case study combines abstract and concrete elements into a research format (Yin 2010, 40-41, 55-56). Findings from single-case studies are usually referred as generalized because they can be applied and enlarged to other contexts as well (Saunders et al.

2007, 158; Eriksson & Kovalainen, 2008). This research has been conducted as qualitative single-case study around procurement organization in one specific manufacturing company. Procurement organization is part of a Finnish global manufacturing company. Case-study is limited to procurement organization, so it is necessary to leave other functions of the supply chain out of the scope. Thus, generalization of the results is linked to procurement organization, so it is challenging to transfer the results into other parts of the case company. Furthermore, the case environment is not static, which suggest that the organization and its structure is changing in time. Therefore, the current state of the organization is discussed in its present condition, and the results will be less valid in the future which makes the study more limited.

The actual practical level of data-analytical computing is not addressed, but the study aims to clarify what data-analytics is and what it essentially involves. Nor does this study deal with the technical side of data management in concrete terms, such as data transfer, data storage or data management policy.

1.4 Outline of the study

The first chapter of the report is an introduction. It provides a brief outline on how the research topic was created and explains the study's topic. The second chapter of the report deals with procurement and data-analytics in general. The final subsection of the second chapter deals with data-analytics in procurement. The third chapter discusses the study methodology and how the case study was conducted. The fourth chapter introduces the case company and its procurement organizations current level of data-analytics. It also deals with the research questions of this thesis, i.e., how data-analytics can be exploited in a way that it brings the most value for the company's procurement organization and what is needed to create that value. The final section contains the conclusions of the study, which aims to summarize the issues raised in this report and to briefly answer the research questions again. Managerial implications are part of the final section, where the potential development ideas are given for the case company.

2 Literature review

2.1 Procurement

Depending on the viewpoint that is highlighted in the literature, the meaning of procurement frequently differs. The term "procurement" has historically been used to refer to a variety of tasks involved in acquiring products or services. This concept places a strong emphasis on the value of procurement to businesses and its contribution to revenue. The fact that a corporation pays for the goods, services, or rights obtained in exchange for payment is still one of the essential components in the definition of procurement (Lamming, 1993; Weele, 2010).

About 30 years ago, Lamming (1993) emphasized that the procurement function is evolving into a strategic one, with the primary responsibility of ensuring that the organization has the most suitable external resources for each circumstance. The phrase "external resource management" was subsequently proposed by Cox and Lam-ming (1997). Additionally, it emphasizes the range of ways in which external resources, such as suppliers and supplier marketplaces, can be influenced. This refers to the comprehensive management of the supplier landscape while taking the needs of the final consumer into account.

Definition of procurement according to van Weele (2010):

> "Procurement is the management of a firm's external resources so that the goods, services, capabilities and information necessary to perform, maintain and manage the firm's primary and support functions are secured for procurement on terms most favorable to the firm."

Iloranta and Pajunen-Muhonen (2008) define procurement as:

> "Procurement is the management of an organization's external resources. The operation, maintenance, management, and development of an organization require a variety of products and services and a variety of skills and knowledge from outside the organization. Procurement seeks to exploit opportunities in the supplier market so that the needs of the end customer are met in a way that maximizes the overall value of the business."

2.2 Procurement organizations

Procurement can be divided into strategic, tactical, and operational activities Strategic procurement places a strong emphasis on planning and developing activities, choosing suppliers, assessing them, building partnerships with them, and forecasting. Contract negotiations and budgeting are both part of tactical procurement. On the other side, operational procurement concentrates on standard tasks like placing orders, reviewing invoices, and keeping an eye on deliveries. In recent years, procurement has seen significant transformation. Its evolution has been attributed to a number of factors, including changes in the management structure and industry. (Huuhka, 2019; Weele, 2010; Iloranta, 2008)

Globalization is thought to be one of the key driving forces behind the evolution of procurement, since it has accelerated and intensified industrial competitiveness between 1970 and 2000. China and South-East Asian nations are appealing choices for businesses to use as production bases due to lower production costs. Moreover, shorter product life cycles and consumer behavior have led to a global market harmonization. Additionally, technological advancements have been unprecedented. Businesses and its contacts can now function in completely new ways thanks to developments in information and communication technologies. As a result of the development of ERP systems, information availability has expanded, and information management has grown in im-

portance as a competitive advantage for many businesses. Most impacted are the industrial and service sectors. For instance, a lot of players in the logistics sector have used ICT to gain a global market position. (Huuhka, 2019)

The strategic importance of procurement in organizations' businesses has been influenced by management techniques and mindsets. Benchmarking, supply chain management, supplier classification and development, overall quality management, and lean and just-in-time production management are all related ideas.

2.3 Development of procurement

With various descriptions of development phases and development cycle models, the development of procurement has been made concrete. Reck and Long (1998) outline a four-stage model for the evolution of procurement, which is depicted in Figure 1. According to this approach, procurement advances in stages from passive to strategic to integrated procurement, increasing the firm's profitability and competitiveness.

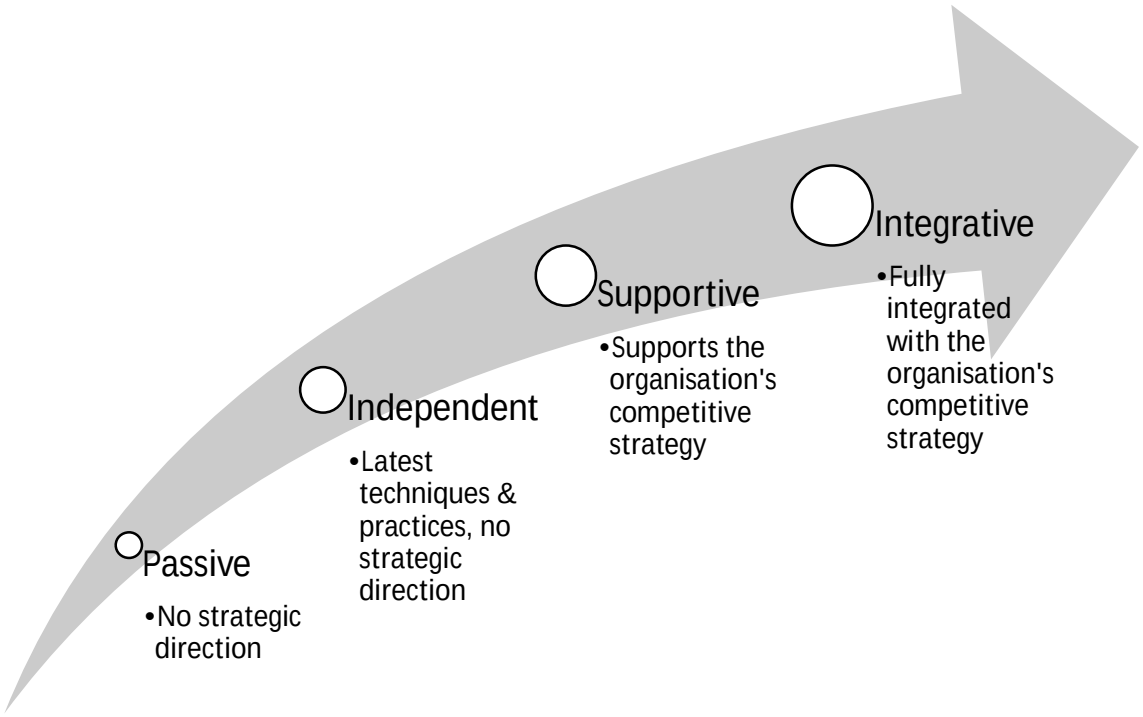

Figure 1. Reck & Long's model for developing the role of procurement (Weele, 2010)

The purchasing function lacks strategic direction during the passive phase. It responds to the demands of other activities, and the majority of the buyers' time is spent on mundane tasks (e.g., placing orders). Vendors are only chosen based on availability and price. At this point, purchasing is not very prominent or visible in the rest of the business's operations. (Weele, 2010; Huuhka, 2019)

The purchasing function employs new methods and features to manage procurement more effectively throughout the autonomous phase. Although there is currently no connection between the purchasing function and the firm's strategy, its significance for the performance of the organization has been acknowledged. (Weele, 2010; Huuhka, 2019)

In the supporting phase, the purchasing department uses fresh purchasing strategies to aid the business's competitive strategy. Buyers are treated with greater respect and have their abilities, drives, and attitudes respected. The inclusion of customers on the sales staff of the business characterizes this stage. Analysis of markets, suppliers, and goods is ongoing. (Iloranta & Pajunen, 2008; Weele, 2010; Huuhka, 2019)

The purchasing strategy and the company's strategy, which is supported by the purchasing department, are linked as the business becomes more integrated. Cross-organizational training is provided to customers in order to help them comprehend every aspect of the business. Strategic components are the main emphasis of skill development. By how it affects the performance of the company, purchasing performance is evaluated. (Iloranta & Pajunen, 2008; Weele, 2010; Huuhka, 2019)

The model developed by Reck and Long paints a clear picture of the function of procurement and its development. The stages of the evolution of procurement can be explained in a variety of distinct ways. Many opinions exist on the importance of strategic variables in procurement, as well as the growth of operational activities.

The primary goal of procurement is to add value for the business and its clients. The goal, according to the conventional definition, is to purchase the appropriate amount of a good or service from a provider who satisfies the requirements, of the agreed quality, at the agreed price, delivered at the appropriate time and location. (Iloranta & Pajunen, 2008; Weele, 2010; Huuhka, 2019)

It is possible to view procurement as a strategic role as well as an expense. Procurement organizations play a crucial role in business operations on a daily basis, and their growth has been quick. The growth of procurement appears to be accelerating rather than going down. Businesses are searching for fresh approaches to generate value for society, their employees, and their shareholders. It might be more profitable items, higher-quality

goods, or more environmentally friendly goods. One of the main forces behind attaining the objectives is procurement and its development.

2.4 Data-analytics

There are no analytics without the data. Data is collection of known facts such as numbers, words, measurements, observations or even just description of things (Sedkaoui, 2018, p. 3-5). Oxford dictionary defines data as:

> *"the quantities, characters, or symbols on which operations are performed by a computer, which may be stored and transmitted in the form of electrical signals and recorded on magnetic, optical, or mechanical recording media".*

There can be all kinds of data which requires different tools and techniques to extract the relevant info out of it (Sedkaoui, 2018, p. 3-5).

Sedkaoui (2018, p.44) defines analytics as "a process that involves the use of statistical techniques, information system software and operations research methodologies to explore, visualize, discover and communicate patterns or trends in data". The uncovered patterns and trends can be utilized in the decision making (Kennedy, 2020). Businesses are typically seen to use two types of analytics.

- Descriptive: focus on reporting on what happened in the past
- Predictive: use of past data to try and predict the future events (Sedkaoui, 2018, p. 45)

Delen and Demirkan (2013) noted that perspective analytics utilizes the big data and the data from the previous two methods to recommend and action that must be taken within a precises time window to reach the wanted end-result. Diagnostic analytics uses the data to find the causality of past performance. There are many types of analytics which can be seen from the figure XXX below.

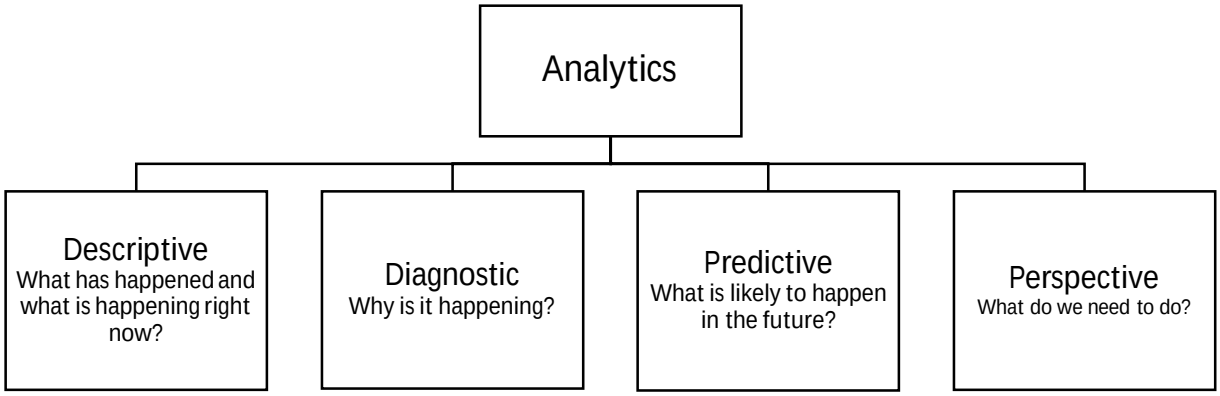

Figure 2. Different categories of analytics

Data-analytics is seen as a valuable tool to assist with product development and operations development. It can boost the business performance and improve the bottom line (Gottge et al., 2019). Companies can gain insight into their operations when analyzing the data collected from various sources, it also helps with the target setting and enables better forecasting of future demands. Data-analytics in the field of procurement is analyzed more thoroughly in chapter 2.5.

2.4.1 Data-analytics technology

Machine learning algorithms, automation, and other capabilities are key factors in today's data-analytics techniques (Hallikas et al., 2020). More accurate insight extractions from the data are available as the volume of the data is growing all the time and the analytics technologies are evolving with a rapid pace. Future decisions and immediate

decisions can be done based on the insights created by the different data-analytics technologies and processes (Hallikas et al., 2020). Key technologies that enable the data-analytics for business:

- Machine learning
- Artificial Intelligence
- Data Visualization
- Data Virtualization
- Data Integration
- Distributed Storage
- Data Preprocessing
- Predictive Analytics
- Stream Analytics

2.4.2 Industry 4.0

The newest phase of industrial revolution is commonly referred as Industry 4.0.
Industry 4.0 has a strong focus on connectivity, automation, machine learning and real-time data (Lin et al., 2018). Companies focused on manufacturing and supply chain management are seeking ways to develop their physical production and operations, there Industry 4.0, sometimes called as intelligent manufacturing comes to play as it combines the production part with intelligent digital technology, machine learning, and mass data to create a holistic and more connected ecosystems (Nazir and Shavarebi, 2019; Lin et al., 2018). Automation and increased amounts of accessible data are key factors in Industry 4.0. Flexible planning is further enabled by real-time information sharing and enhanced data processing (Weyer et al., 2015). The need to connect and access real-time visibility across processes, partners, products, and people is a common challenge across different businesses and organizations. Industry 4.0 is about revolutionizing the way the business works and grows, not just about investing in new technologies and tools to increase manufacturing efficiency. (Lin et al., 2018; Glas and Kleemann, 2016)

2.4.3 Requirements to run effective data-analytics

It is always worth starting with how data can benefit your business. To answer this question, you need people who understand not only analytics, but also business. Additionally, the business using data-analytics needs to have certain policies in place that outline how it should be used and the kinds of data it should produce. The organization must have clear data management and governance policies and procedures that are part of the data strategy in order to use data-analytics effectively. To safeguard the increasingly important and sensitive asset, data, data strategy should incorporate data security and governance plans (Beyond, 2022). Teams should be able to access, use, and store the data so that they can innovate and use it for their work. Good data management and storage should also foster a culture of inquiry, discovery, and cooperation across teams (Holly & Ho, 2020).

2.4.3.1 Data integrity and quality

Data integrity is the quality, reliability, trustworthiness, and completeness of a data set, providing accuracy, consistency, and context. Data integrity is based on four main components, which are:

- Data integration: Regardless of the original source, data must be fully integrated to ensure that all information is displayed in a timely manner.
- Data quality: Data to be useful for decision making, it must be complete, unique, valid, timely, and consistent
- Location intelligence: The geographical layer of the data, such as, demographics, traffic, or weather
- Data enrichment: Adding context, nuances, and meaning to internal data by enriching it with data from external resources. Adding business, consumer, or location information gives a more complete and contextualized view of the data for more powerful analysis (O'Connor, 2020, Morrow, 2021)

Data quality refers to the state of qualitative or quantitative pieces of information. When data is seen as high-quality it should meet the following standards:

- Complete: The data presented is a large percentage of the total amount of data needed
- Unique: Unique datasets are free of redundant or irrelevant entries
- Valid: Data conforms to the syntax and structure defined by the business requirements
- Timely: Data is sufficiently up to date for its intended use
- Consistent: Data is consistently represented in a standard way throughout the dataset

If data is lacking one of the previous aspects, it could compromise any data-driven initiatives (O'Connor, 2020; Morrow, 2021).

2.4.3.2 Data governance

The Data Governance Institute defines data governance as "a system of decision rights and accountabilities for information-related processes, executed in accordance with agreed-upon models which describe who can take what actions with what information, and when, under what circumstances, using what methods" (Wende, 2007). Data management can be planned and managed at a high level through data governance. Data governance is a supplement to data management, not a replacement for it (Ruithe et al., 2019). Effective data governance can be used to address a variety of business problems with data and information. Data governance can be used to organize and record the obligations for an organization's data quality (DeHaes, 2008). According to Prinzo and T. P. Group (2012), enterprises need an enterprise-wide data strategy and governance in order to gain a competitive advantage. Organizations that do not implement data governance models frequently lose their competitive edge, according to Panian (2010) and Prinzo (2012), as the data used for decision-making might be unreliable and result in damaging decisions. Effective data governance demands the full support of sen-

ior management and the dedication of every employee. There is no one-size-fits-all approach to implementing data governance because each business is different and requires a different set of thresholds (Ruithe et al.2019).

Leaders and advocates of data governance are frequently challenged to show that the money spent on these projects is yielding measurable outcomes (Gupta & Cannon, 2020). The degree of data maturity is one of the crucial elements in achieving the goals of data governance. The term "maturity" in the context of data governance refers to current organizational governance practices that are aimed at fulfilling the strategic and tactical aims and objectives of data governance. The maturity of the organization's data governance system changes along with its procedures. Ad hoc, formal, monitoring predetermined metrics, and full optimization are all examples of how the quality and efficiency of processes change through time (Gupta & Cannon, 2020). An evaluation model that is used to evaluate the present situation should take into account every component of the data governance ecosystem. Regular organizational evaluations are similar to evaluations of data governance. Successful data assessment depends on many internal and external stakeholders giving their time, attention, and thoughtful participation. Prior to the assessment, the organization should have a clear understanding of the assessment initiative's final goal. According to Gupta & Carron (2020), there are three main factors that aid organizations in determining the goal of an assessment program.

- Integration
- Integrity
- Insights

These three key drivers are interrelated and overlapping concepts. Better insights can be gained from data integrity and integration. Data insights can lead to new ways to integrate and analyze data. Pursuing one driver can certainly have a positive impact on the other two drivers. (Gupta & Carron, 2020).

2.4.3.3 Data maturity

Data maturity refers to the present organizational governance process aimed at accomplishing the strategic and tactical data governance goals and objectives, as was briefly addressed in the previous chapter. (Ruithe et al., 2019; Gupta & Carron, 2020). The exceptional and priceless insights into the general health and well-being of the organization and its units can be obtained by periodically evaluating how the organization as a whole is using its data to accomplish its mission and goals. Several maturity models can be used to assess an organization's current status. The assessment team must examine the models, adapt them for the intended use and purpose, and top-coat them with particular elements and cultural norms that are relevant to a particular business in an efficient and successful manner (Gupta & Carron, 2020).

2.5 Data-analytics in the field of procurement

With the use of data-analytics, procurement organizations can be more autonomous and have more say in decision-making. The process will become more transparent and swifter, which can give decision-makers valuable information and assist the business accomplish its goals (Bizclick, 2022). Although there are many different business analytics programs, the fundamental concept is the same—a data-driven approach to finding answers to supply management-related problems (Heidari, 2018). Companies work to attain cheap cost, high quality, and low risk while achieving synergies for increasingly personalized products by utilizing purchasing potentials (Huuhka, 2019).

Budget and spending management, cost cutting, supplier management, cost modeling, category market information, supplier evaluation, procurement-led innovation, market strategies, supply chain risk, and stakeholder value enhancement are common issues (Monczka et al., 2016). A set of technological tools, referred to as procurement technology, is needed to approach and resolve these issues. These tools include a device for clustering data from various sources, such as ERP systems, the internet, procure-to-pay

systems, contract management systems (CMS), and third-party providers, processing and presenting information to users so they can act on it. Past studies have demonstrated a direct correlation between overcoming digitalization-related obstacles and overall performance, which can be assessed in terms of both process efficacy and dynamic capabilities.

According to the consultancy reports, there are not many difficulties with Industry 4.0. According to Pellengahr et al. (2016), approximately one-third of German manufacturing companies who have adopted Industry 4.0 technologies have adjusted their purchasing practices. The procurement process, where actual changes at the level of individual subprocesses can be observed, can be used to investigate how this development would affect purchasing. Bals et al. (2019) recommended focusing more of an emphasis on the digitalization of the procurement process in order for businesses to remain competitive.

Utilizing data-analytics to coordinate supply chains and procurement is a critical area of development, as supply chains entail large volumes of different types of data about the firm and its operations (Bals et al. 2019). One of the numerous innovations addressing the need to manage the enormous volumes of data made possible by the expansion of digital technology in supply chains is business analytics (Lamba & Singh, 2018). The supply chain generates large amounts of data from numerous sources and/or applications through transactions and operations.

By assessing supply market trends and suppliers, creating sourcing plans, and anticipating supply interruptions, utilizing analytics and Big Data to study purchasing processes can help with strategic purchasing (Bals, 2019). Gains at the company level from data-driven decision making require proven knowledge conversion inside the company and fluid information flow between functions; these components are only available if the analytics capabilities are closely correlated with the business plan (Aryal et al., 2018; Akter et al., 2016). By automating corporate operations and making good use of data,

digitization is projected to give businesses a variety of competitive advantages and advantages.

By giving procurement professionals easy access to consistent, accurate, and integrated information, various procurement systems create integrated information management (Hallikas et al. 2021). The creation and execution of the procurement procedures rely greatly on integrated processes and data-analytics.

2.5.1 How has data-analytics been exploited in procurement

According to Farzipoor Saen (2010), supplier selection is one of the most important tasks of a company's purchasing department, as the purchase of materials and services represents the bulk of the cost of the final product. For a typical manufacturer, 60% of turnover is spent on the purchase of raw materials, materials, semi-finished products, and components. In the automotive industry it is around 50%, and for high-tech producers it can be over 80%. If a company is able to choose the most optimal supplier for its needs, direct cost savings and synergies can be achieved. The performance of suppliers varies considerably. Some suppliers provide raw materials at lower prices, while others are able to deliver on time or with better quality products. These criteria need to be weighed and optimized before the final decision on supplier selection is made. This situation highlights the importance of analysis and selection model, as criteria and weightings vary between and within industries. (Lamba & Singh, 2017)
According to Bradley (2021) a well-organized analytics system can be utilized to evaluate and rank vendors on all relevant aspects of their services to find the most effective vendor solution.

According to Nicoletti (2020), data-analytics can be used to estimate procurement costs very accurately by generating cost summaries and increasing cost transparency. The information on costs provided by analytics enables their categorization and improves transparency. This can then be used to optimize and anticipate procurement contracts,

budget, and plan for the impact of inflation and other macroeconomic factors on procurement and its costs. A procurement leader can combine several data sets using big data-analytics to look for possibilities to reduce spending, which will immediately impact a company's bottom line (Jones, 2020). PPG Industries was able to centralize visibility and control of over 95% of indirect spending, which resulted in 10% savings in overall costs (Jones, 2020). PPG industries is a fortune 500 company and global supplier of paints coatings and specialty materials. As soon as a data-analytics program was put into place, Owens Corning was able to use the information it collected to negotiate savings of over $2 million by consolidating vendors, promoting contract compliance, and standardizing terms and conditions in vendor contracts (Jones, 2020). Owens Corning is a fortune 500 company developing and manufacturing insulation, roofing, and fiberglass composites.

In order to boost the accuracy of demand forecasting for the benefit of the procurement organization and the company, data-analytics can be utilized to link together both predictable and unexpected external factors (Bradley, 2021). According to Hofman & Rutchmann (2018), straightforward time series forecasts can only be applied to demand forecasting in recurrent and short-term situations. Often, also depending on the situation, demand may vary significantly, requiring different criteria for demand forecasting.

Su & Lin (2015) propose a framework for procurement risk management that makes use of internal as well as external data within the firm. Internal data comes from quality control, product structures, lead times, accounting, financial records, and human resource management. By external data, they mean data from public sources such as news, politics, weather, statistics on natural disasters and social media. Wang et al. (2016) propose using data-analytics as a risk management tool, whereby analyzing publicly available data from news, social media, supplier performance and procurement markets, it is possible to improve the risk management status of procurement. The key is to use the updated data and respond to changes where necessary.

The application of data-analytics can provide insights into a supplier's risk profile. Analytics in general, reduce supply chain risks and helps to prepare for problems, such as stock outs, quality deviations in materials and increase in prices (Lamba & Singh 2017). Collecting data on supplier performance, contracts, changes, and total contract value can support procurement contract negotiations. Comprehensive information on suppliers also facilitates stakeholder engagement and enables early response to potential problems (Nicoletti, 2020).

Identifying, extracting, and using relevant information becomes more difficult if it is spread across different systems. Therefore, information about the procurement process should be centralized in data-driven applications, making it easily accessible (Nicoletti, 2020). According to Sanders (2014), bringing data together in one integrated system, using the same standards and procedures, allows companies to exchange information regardless of location. Big data enables applications to visualize larger databases and transform them into a more understandable format, it provides an accurate picture of the market in which a company operates can be obtained (Sanders, 2014).

2.5.2 Challenges to utilize data-analytics in procurement effectively

Decision-making based on facts, figures and analysis requires data management and analytical skills. Data management involves a great deal of technical issues such as data storage, processing, and management. Data analysis, on the other hand, requires a professional workforce. The main challenge in creating procurement analytics is the data management capability, which emphasizes data inaccuracy, timeliness, and governance. In addition, the large amount of data scattered across different systems makes data management difficult (Rafati & Poels, 2015).

According to Rafati & Poels (2015), there are five different problem areas in combining procurement and data-analytics. First, procurement data is usually fragmented and distributed across enterprise systems and not integrated into the enterprise. The second problem is the complexity of the data. Not all data on procurement and suppliers may be in digital format, which makes it difficult to use. A third problem is the consolidation of contracts, suppliers and cost data and the lack of a platform to handle these data sources. The fourth problem is the lack of tools and skills to handle the data, depending on the type of organization. The fifth is the problem of making the data understandable, i.e., visualizing the data. Data must be visual and understandable to draw more accurate conclusions.

In addition to the general challenges, there are also challenges related to the ownership and privacy of Big Data. In general, global supply chains are not owned by a single company but involve multiple actors working together. This poses challenges for the use of data. Some stakeholders may be reluctant to share data, because of the loss of privacy and competitive advantage. Big Data would require a centralized system where it is accessible to all (Wang et al. 2015).

Surajit (2016) identifies the lack of suitable manpower in firms as a major problem. Processing Big Data requires experts and professionals to be effective and this puts pressure on recruitment and training of staff. Connaughton & Sawchuk (2014), in a study for the Hackett Group, found that the procurement department should work closely with the HR department to create new roles as procurement technologies evolve. Hackett Group is a strategic consultancy firm focusing on benchmarking and research advisory. It is listed in the NASDAQ.

Integrating data-analytics into the procurement process will enable the entire supply chain to improve performance. However, a separate strategy for integration needs to be developed to achieve the best possible outcome. Integrating data-analytics into a company's procurement strategy requires resources and investment from the company.

The potential cost savings and benefits, if achieved, are highly rewarding. (Lamba & Singh 2017) Shamim et al. (2018) identify the main challenges in using data-analytics as challenges related to leadership, talent utilization, culture, and technology management.

3 Study Methodology

The aim of this chapter is to outline the methodological decisions of this study. This chapter discusses the chosen methodology, data collection, data analysis and the reliability and validity of the study. This study is carried out as a qualitative study as it is the most appropriate way to approach the research questions and objectives. Basic information is collected through eight-part questionnaire and semi-structured interviewees, as well as observations of the way of working by the researcher and information from other data sources. First the methodology is discussed, then the data collection and analysis of the data. Chapter ends with analysis of the reliability and validity of the research.

The study has been carried out as a qualitative case study. Quantitative and qualitative research are often perceived to be opposing approaches in scientific research. At the early stage the researcher must choose which method he/she will use to conduct the research. But nevertheless, as Yin (2012) has noted, qualitative and quantitative research share many fundamental concepts. Although different methods can be used to conduct the same research and handle the same materials, they should be viewed as complementary. A case study is a research technique that seeks to comprehensively depict complex events (Moore, Lapan & Quartaroli 2012, 243).

Both qualitative and quantitative methods have been utilized in this study. Qualitative data was collected by interviews and the observations of the researcher while he was employed by the case company. Quantitative data was collected by eight-part questionnaire where the portion of the questions were quantifiable questions. The purpose of the quantitative information was to simplify the analysis of the current state of procurement analytics in the procurement organization of the case company.

3.1 Data Collection

The literature review of the thesis was conducted by using the databases in Finna portal, such as ABI Inform and SCOPUS. Also, traditional textbooks and Google Scholar were used. Aim was to use both classical publications as well as newest literature published in the journals like international journal of operations & production management and international journal of physical & distribution & logistics management.

Data for the study was collected with two different approaches, via questionnaire and semi-structured interviews. Questionnaire created quantitative data while interviews created qualitative data for analysis of the current level and assessment of future requirements.

3.1.1 Questionnaire

Questionnaire was sent to the case company's procurement organization which has been divided into three units. Each unit has their own procurement process. Indirect procurement covers those materials and services that are utilized to produce Case Company's products. In practice, Indirect procurement includes all materials and services that are not part of the end products the Case Company produces. Indirect strategic procurement encompasses tendering, contracting and supplier management for all organizations in the Case Company. Operative procurement facilitates Case Company's everyday activities with actual buying of materials, services, tools, and other necessities for the company to run its production and operations. Additionally, the operative procurement organization is responsible for self-service buying from the internal eShop and handling of purchase requisitions.

Direct procurement is responsible for global purchasing and sourcing for the case company and its subsidiaries manufacturing. Process includes sourcing, agreements, risk and

cost management, category strategy and development, supplier relationship management and performance.

External supply operations (ESO) covers the finished products that the case company does not manufacture itself, but sources globally from external suppliers. ESO organization is responsible for managing the entire supply chain process of externally sourced products, including supply chain management and product availability, total cost, quality, and compliance. The ESO process collaborates with more than 150 suppliers globally and is considerable part of the case company's sales.

Data collection for the thesis was made via Microsoft Forms questionnaire. Questionnaire contained eight questions in total. First question was about which part of the procurement organization the responder worked. Next six questions were quantifiable questions regarding the current state of the data-analytics in the organization. Question areas were based of the IBM Maturity Model. Some changes were made to the wording to better suit the purpose of the thesis. The eight question was to leave open feedback regarding the current level of data-analytics in the procurement organization. IBM Maturity Model and its subject areas are opened below. The IBM Maturity Model measures the data health of an organization along six dimensions and five levels of ranking.

- Strategy: This dimension of the assessment model explores and evaluates if data strategy is an ad hoc standalone strategy or if it is integrated and embedded in the core business strategy.
- Information: This assessment phase examines the role and contribution of information to organizational success and market power.
- Analytics: This assessment dimension explores the level of usage and the strategic nature of analytics in decision making.
- Culture and Execution: The scale shows how culture can influence the ability and intent to use analytics for competitive advantage.

- Architecture: This refers to the data architecture and technology architecture concepts.
- Governance: This dimension focuses on the extent to which data governance policies, procedures, processes, and systems have become embedded in the organization.

IBM Maturity Model allows an organization to not only assess its status but to also follow the trajectory of progress that it can make. (Sedkaoui, 2018)

Questionnaire was sent to four different distributions lists, which consist of the email addresses of the employees working in the procurement organization. In total the potential reach was 54 persons from three different procurement units. 20 from the finished goods procurement, 18 from the indirect procurement and 18 from the direct procurement organization. In total there were 18 (n = 18) answers, 5 from ESO, 6 from indirect procurement and 7 from the direct procurement unit. Answer percentage for the questionnaire was 33,33. The number of answers were limited but the deviation between different units was great. ESO had answer percentage of 25, while indirect had the same as the whole organization, 33,33 percentage. Direct procurement had the highest response percentage at 38,9.

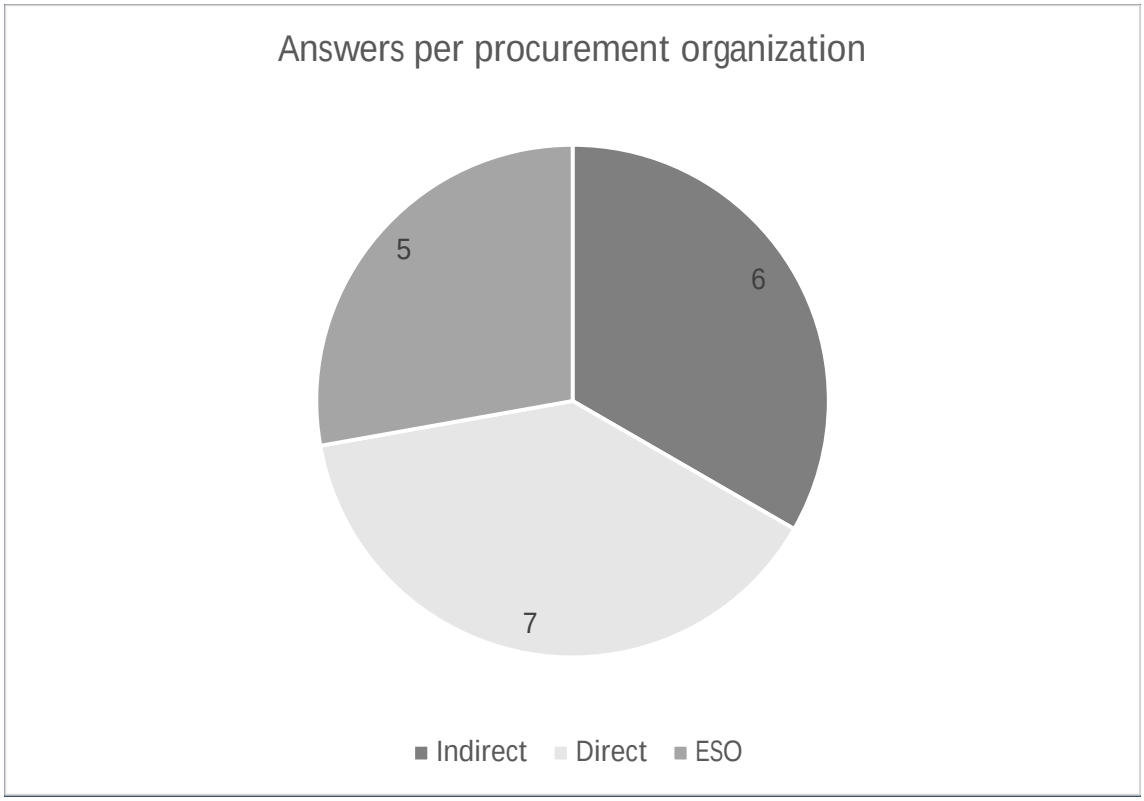

Figure 3. Answer distribution between different procurement organizations

3.1.2 Interviews

One semi-structured interview within the case company was conducted to gain better understanding of the current analytical processes and tools in the procurement organization. The interview had two participants who were identified beforehand to have thorough knowledge of the analytical activities in the procurement organization. Interview was recorded and later transcribed to fully analyze the current state of the data-analytics in the case company's procurement organization. Interview had 5 different topics with two to three guiding questions under each topic. Further details regarding the interviewees and the interview can be found from the table 1.

Table 2 comprises the details regarding the six semi-structured interviews which were conducted to gain better understanding of what the procurement organization's management team sees as the potential additional value for the procurement organization and what kind of analytical tools they see valuable for their units. Interviews were started with the short introduction to the previous research focusing on how the data-analytics could be utilized and the results of the questionnaire analyzing the current state was introduced as well. Interviews had a preset question pool with 7 main questions. Questions were shaped to be open ended to really find the future analytical needs for the procurement organization. All the interviews were recorded and transcribed. Tables below indicate the interviewee, their working title, duration of the interview and when the interview was conducted.

Persons	Working Title	Years of experience at the case company	Duration	Time
E & G	Head of Operative Procurement & Head of Procurement and Logistics, Own Production	E: 6 years G: 13 years	39 minutes	08.06.2022

Table 1. Current level of procurement data-analytics interview details

Person	Working Title	Years of experience at the case company	Duration	Time
A	Director, Supply Chain & Procurement	7,5 years	38 minutes	17.08.2022
B	Head of Indirect Procurement	15 years	31 minutes	17.08.2022
C	Business Process Lead	21 years	24 minutes	19.08.2022
D	Head of Direct Procurement	16 years	20 minutes	19.08.2022
E	Head of Operative Procurement	6 years	34 minutes	23.08.2022
F	Director, External Supply Operations	15 years	38 minutes	24.08.2022

Table 2. Procurement management team interview detail compilation

3.2 Data Analysis

The data analysis process of this study started with the transcription of the interviews and analysis of the questionnaire results. First, a separate analysis of each interview was conducted to identify unique opinions and experience of each interviewee. This made it possible to analyze and mirror theories as well as compare the responses of several interviewees.

In addition to the information gained from the interviews, responses to the questionnaire were exported to Excel and further on to the Power BI to facilitate the analysis of the answers. Also, Power BI was identified to be more effective tool to create different graphs and visualizations of the questionnaire results. Analysis of the current level was created based on the questionnaire results and interview regarding the current level of procurement analytics. The analysis process is presented in figure 4 below.

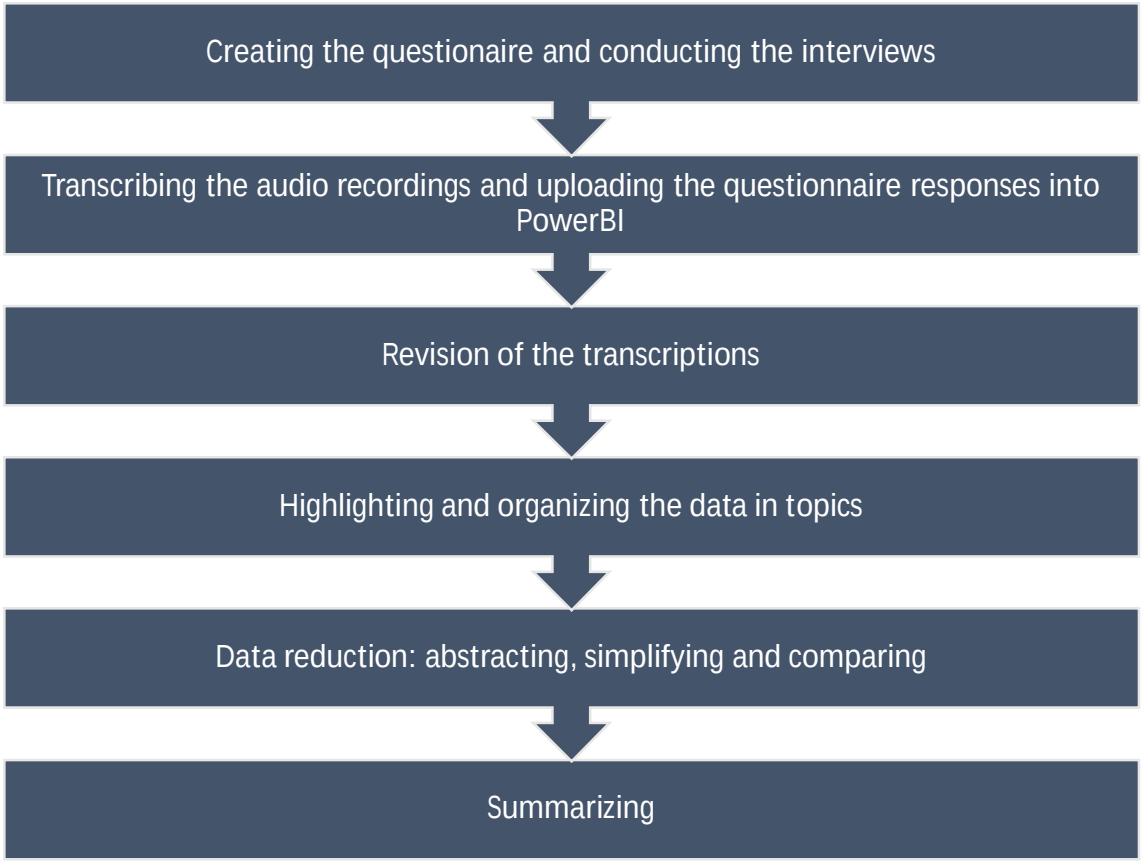

Figure 4. The data analysis process

With all the units included the current level was close to 2,5 out 5 in all the measurement categories. Highest level being in the Information and lowest level being in the Architecture and Strategy categories.

However, when you compare the levels of each unit on the categories measured, the results vary much more. Direct procurement scored over 2.5 in all the categories. Also, information and culture & execution reached the score of 3. In comparison ESO unit scored below 2.5 in all the categories. Lowest one being the strategy with score of 1.6. Indirect procurement scored in between Direct procurement and ESO on the categories measured and was close to the levels of total sampling.

All in all, it is fair to say that each unit agrees with each other about what part is on the highest level and what needs the most improvement. The average of each theme is

shown on the table 3 below. Individual themes are further evaluated in the chapter four of this thesis with the comparison between each procurement unit.

Organiza-tion	Analytics	Architecture	Culture & Execution	Governance	Information	Strategy
Average	2,44	2,33	2,67	2,50	2,83	2,39

Table 3. Current level in the entire procurement organization

3.3 Reliability and Validity

Reliability and validity are the two key concepts when carrying out qualitative research since they determine the objectivity of the research. They can be seen as two different measurement instruments that illustrate the level of trustworthiness and credibility of a research. In this thesis, answers to the research questions were sought using a qualitative research method. As is typical of qualitative research, the aim was to find out people's subjective experiences and perceptions of the phenomenon under study. Qualitative research focuses on the experiences, thoughts, feelings and opinions of the subjects and the meaning of the subject matter. Qualitative research does not aim to make statistical generalizations, but rather to describe a phenomenon or event, to understand the activity being studied, or to find a theoretically meaningful interpretation of the issue. Qualitative research aims to gain an in-depth understanding of a phenomenon, create new theories and models, and describe the phenomenon as well as possible.

The reach of the questionnaire was thorough, and all the relevant parts of the organizations were involved. Although the number of answers was not the highest, but the deviation between different units was close to even, so it is fair to state that the results are in line with the current level inside each unit, so the results of the questionnaire are valid. With a higher response rate, the results would be more reliable.

4 Case study & case company

This chapter focuses on the case study and case company part of the research. Following sub chapters introduce the case company briefly and the current level of its procurement data-analytics based on the interviews, questionnaires and observations made by the researcher.

4.1 Description of the Case Company

The case company is a Finnish publicly listed manufacturing company. Its annual revenue is a bit over one billion euros and operating profit close to 240 million euros. It employs over 3000 thousand persons in over 20 different countries. Most of its employees are working in Finland. All its manufacturing sites are in Finland. The case-company manufactures products which can be found in almost every household in Finland and most of the products people use daily.

4.2 Current State of Procurement Data-analytics

Based on the interview and questionnaire the level of procurement analytics has developed during the past 5 to 10 years. Previously all the tasks have been handled manually and it has taken lot of time to complete the needed analysis. Relevant data has been collected from various sources into single Excel file. Analysis and visualizations have been performed in the Excel file. Few years back the Case Company implemented a data visualization platform which has direct link to the ERP system. That implementation has minimized the ad hoc tasks regarding the data analysis on and increased the visibility of some key performance indicators. Despite the good development in the procurement data-analytics, most of the operational analytics is still manual and time consuming.

The level of data-analytics utilized differs in each part of the procurement organization. Some teams may utilize the analytical tools and processes daily while other teams utilize them only when they are checking their key performance indicators. However, most of the teams utilize mainly historical data. Predictive analytics are minimal or totally missing. If there are some predictive analytics utilized, it is usually done manually and often just once.

The ownership of data is lacking based on the interview, questionnaire conducted, and observations made by the researcher. There is no clear strategy or governance model for how to take care of the data and analytical tools. The end goal of the analytical processes is often very clear, for example updating a KPI regarding the vendor evaluation. However, the start, and middle part of the process is often indeterminate and lowers the value of the processes and its end results.

Most of the data utilized is from internal sources, such as ERP-system and quality management system. Some data is extracted from outside sources, but it is limited. At the moment the organization does not utilize any data from outside sources in a consistent matter, for example extracting relevant data from market intelligence reports.

4.3 Analysis of current level

At the current level the data-analytics is responsive. Almost all the analytical activities are based on a historical data and are utilized to present the past performance. Case company's procurement organization does not incorporate data from outside sources to the decision making in continuous manner. There might be some individual cases when the data from the outside sources is utilized but not in a consistent manner.

Current level of the analytics dimension was seen to be close to average, analytics are not solely used to describe what has happened but also, not to achieve competitive advantage by automating manual process. Figure 5 shows how the different procurement organizations evaluated the level of analytics in their own organizations.

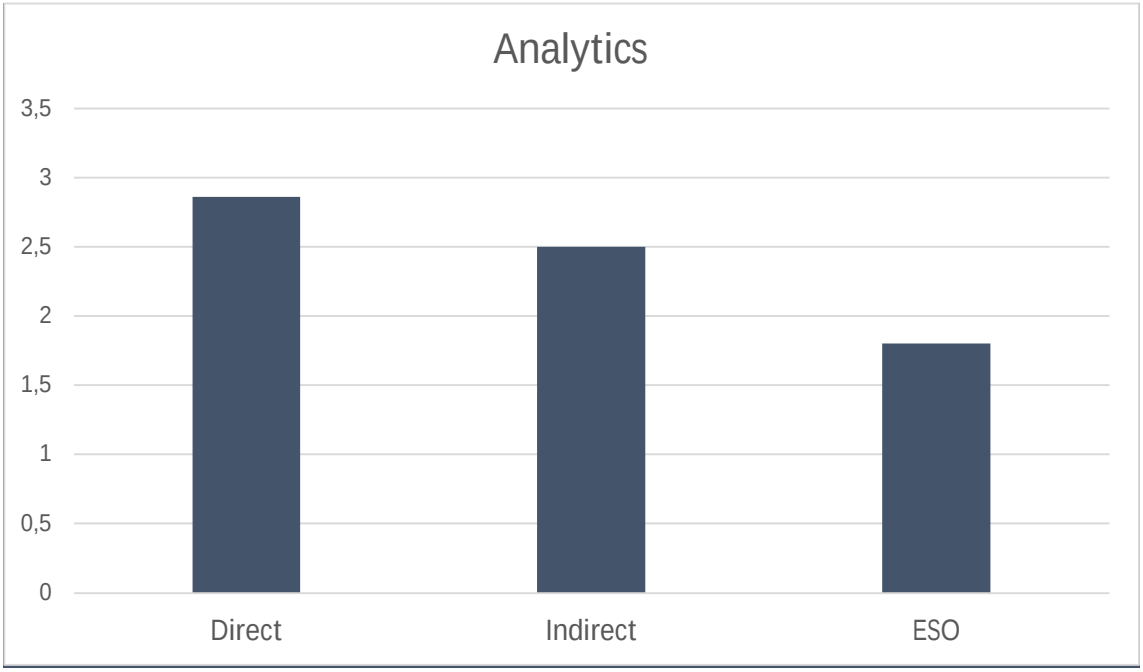

Figure 5. The level of analytics at the case company

Figure 6 below shows that, the culture & execution is seen to be on a middle part of the evaluation spectrum. On the highest level of the spectrum the organization's key stakeholders would be seen as dedicated users of data-analytics and data-driven decision making with the singular goal of maximizing business value.

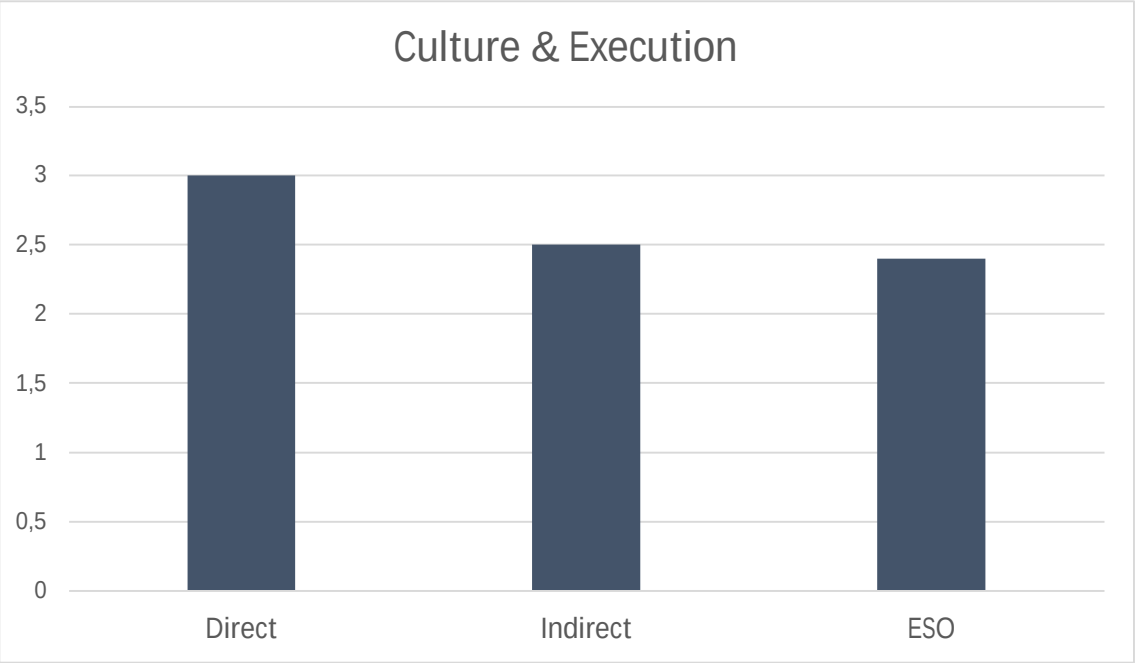

Figure 6. The level of Culture & Execution in each organization

On the governance and strategy spectrum the answers indicate that the current level is around middle of the spectrum, as can be seen from the figure 7. In the ESO organization, the results are below 2.5 in the evaluation spectrum. While evaluating ESO's results it is important to keep in mind that the number of responses compared to the reach was the lowest compared to the other organizations. Response rate being at 25 percentage. Strategy spectrum on the highest level would indicate that the organization is using data to drive innovation and to assume a leadership position in the marketplace. Governance dimension on the highest level would be in line with the strategy through out the entire information ecosystem in place.

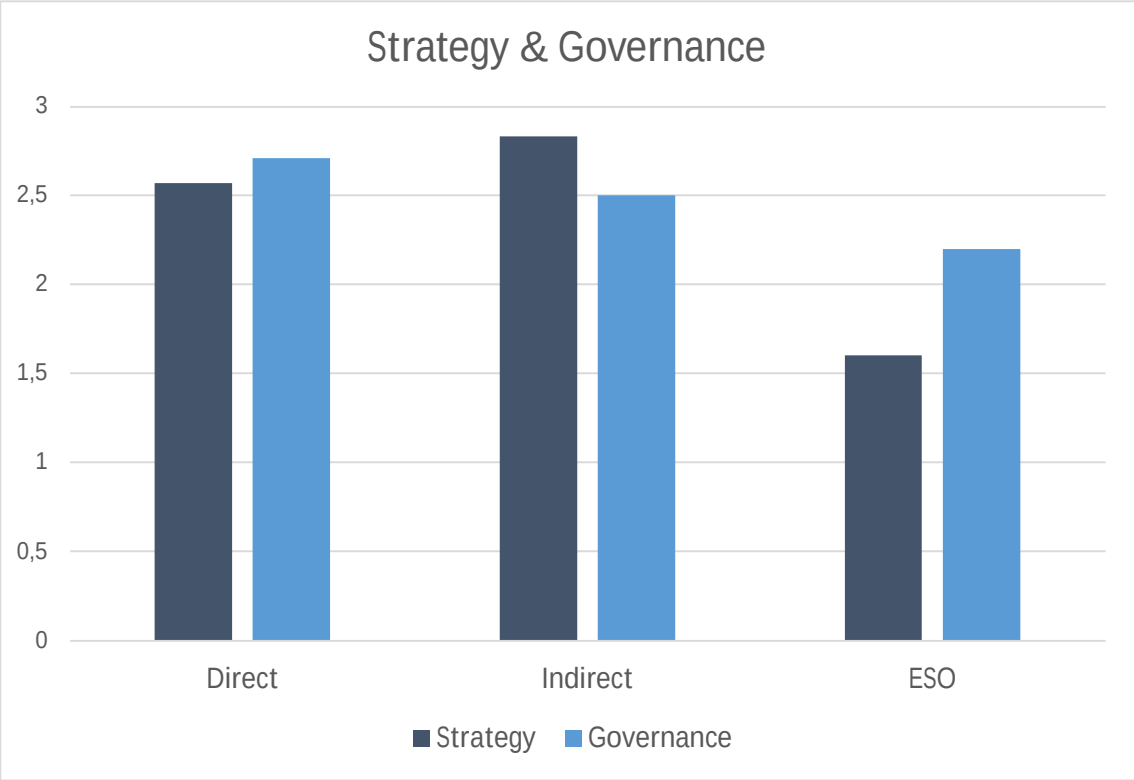

Figure 7. Level of Strategy & Governance

Information dimension is on the highest level based on the answers collected. Figure 8 shows that the Direct and Indirect organizations assess the level to be three or above, which indicates that the Information is used to “improve”. On the highest level, information would be seen as a “strategic asset” and a key aspect of all the decision making and daily operations. Currently the procurement organization is using information to improve their decision making and operations.

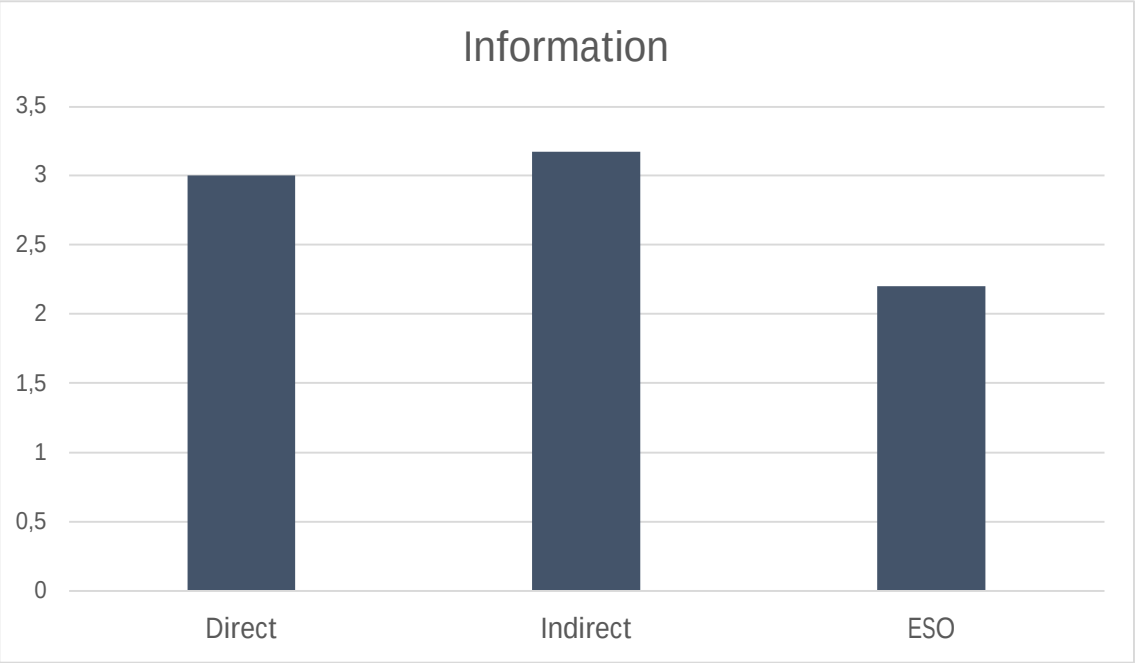

Figure 8. Level of Information

Scoring higher on the information dimension indicates that the organization has the desire to exploit the data-analytic capabilities in a more structured manner. Also, based on the interviews it is fair to say that the organization has a sound interest to develop its data-analytic capabilities to better serve the other service lines of the case company. Creating a more structured governance model and implementing the data strategy as a part of business strategy are key factors to reaching higher levels on each dimension evaluated for this study.

4.4 Summary of the outcomes from the case-study

The case company's procurement department has room to improve on all the measuring dimensions, as the scores are settling around 2.5 out of 5. Scoring on each dimension gives the case company's procurement leadership team some clear outlines on which way they could start developing the data-analytics aspect of the procurement. Future development endeavors can be based on the dimensions which were measured in this

case study. Basing the development on a set level, makes the future evaluation of the development easier as there is a clear starting level where the results can be compared.

5 Conclusions

The purpose of this thesis was to examine how to exploit data-analytics in procurement, what kind of added value data-analytics can enable and what is needed to utilize data-analytics effectively for procurement purposes. Based on the literature, the use of data-analytics in procurement has been discussed quite extensively and for various purposes, such as supplier selection, raw material sourcing, demand forecasting, risk management in procurement and automation of operational activities. Also, a case study was conducted for a manufacturing company to find out the current level of their procurement data-analytics and mapping out what should be their next steps to further develop the procurement data-analytics.

The study shows that data-analytics can bring significant benefits in areas such as supplier selection and risk management as the company is able to create consistent evaluation models for its suppliers and procured products and services. Consistent evaluation models based on relevant data will lead to more effective decision making which will eventually lead into more efficient company with better operating margin. Transactional data from suppliers, and internal and external company information, combined with risk management frameworks, can significantly reduce risk, and deliver significant cost savings if successful. Data-analytics also improve communication between the business and its stakeholders, allowing operational activities to be automated. Electronic data exchange improves tracking and automated ordering processes reduce the manual workload of the company.

Data-analytics makes it easier to forecast demand with the availability of rich data on customers and current levels of the market. Procurement can be transformed from reactive to active with the help of data-analytics. Data-analytics can be used to compare different types of customer feedback or to gain insights into regional differences in demand. For example, at the case company data-analytics was utilized to understand how the Covid-19 epidemic might affect the demand of their products. The same methods work for B2B and B2C commerce. In raw materials procurement, data-analytics can be

used, for example, to obtain different price data to conclude various supply contracts with suppliers or to hedge one's own business, for example through derivatives. The case company has utilized price data to model different scenarios on how the recession might affect the costs of raw materials and logistics.

The literature review and the case study showed that basing decisions on facts and figures made more sense than on experience or educated guesses. Each interviewee of the case study stated that basing the decisions on a concrete data has led to more effective decision making, which has enhanced case company's performance. However, decision-making based on experience cannot be completely ignored, as there is a great deal of variation in decision-making situations due to a wide range of variables. Decisions based on data analysis and facts were considered more meaningful from a managerial point of view, as they provide support to the decision-maker. At the case company the procurement leadership team has identified that it is crucial to have people with experience and skills to utilize data-analytics making decisions to really be effective.

Organizational culture, technical capabilities, resources, and professional skills also have a major impact on decision-making situations. Data-analytics applications require investment, skills, and technology to succeed in a way that benefits the business. Thus, depending on the industry, the size of the company and the number of resources available, there are many variations in the use of data-analytics among them. The many different sources, ownership and diversity of data also raise difficult questions about the use of data-analytics.

There are also challenges and issues in the use of data-analytics. Often data is fragmented and distributed across numerous systems in the enterprise and not all the data needed is necessarily in a digital format that allows it to be processed in a relevant way. The lack of skills and tools to handle data was also often identified as a problem in the literature, although this varied considerably between organizations. One problem is the

challenge of putting the results of data analysis into a visual and understandable format that allows it to be used to support decision making.

In addition to the general challenges mentioned above, the literature suggests that there are also problems with the use of data-analytics in the context of globalization, as many companies operate internationally, with data naturally being spread across different countries and continents. This creates problems of privacy, ownership, and centralized systems where data should be easily accessible. Integrating data into a company's strategy takes time and requires investments by the company. According to the literature, it would be advisable to change the company's culture, strategy, data exchange and hire skilled staff for data-analytics projects.

There may be a strong appetite for using data-analytics, but it may require a significant investment to implement. Companies may have a lot of data scattered across different digital and non-digital systems. The exploitation of such data is likely to require a lot of manual work, which will contribute to higher costs. Newer firms are likely to be much more agile in adopting an analytical culture and in reaping the benefits of data.

5.1 Limitations and future research

This study was conducted to map out the needs and expectations of procurement data-analytics. The focus of this study was placed on what is needed to effectively utilize data-analytics in the field of procurement. It is worthy to note that the interviewees are procurement professionals and are actively seeking ways to further develop the procurement operations of the case company. The number of interviewees was limited based on the request by the case company as the goal was to have the interview results from an executive and strategical point of view rather than from an operational point of view. Additionally, one should consider that data-analytics is an evolving concept and the value it can bring for an organization varies significantly. Challenges regarding data governance model and data strategy were identified. The absence of data governance

model and data strategy is most likely not limited solely to procurement organization, other parts of the supply chain most likely have same kind of challenges with the data governance and data strategy. However, the situation with other parts of the organization were not researched so it cannot be for certain.

This study was a qualitative single case-study trying to understand the needs of procurement organization to effectively utilize the data-analytics. Consequently, results of this study touch the surface of topic and give holistic view of the current level of procurement data-analytics in the case company's procurement organization. Therefore, investigating what really can be done with data-analytics in the field of procurement would be a great topic for further research. Companies are not fully aware what data-analytics can enable. Further research could also have a high-level plan for a company on how to implement and utilize the identified data-analytic capabilities that would add value to company's procurement operations.

The literature review is limited to high-level attributes and the case study is solely for the case company's purposes. Interviewing not just the procurement director but also the leads of different procurement functions proved to be useful since it provided various perspectives to analyze the current level and identifying the needs of each function. It was not possible to focus on a certain procurement function in the organization but focusing on smaller variety of procurement functions and identifying their specific needs would be excellent topic for future research. The case company in this research was a manufacturing company, therefore future research could include companies' other industry sectors as well.

5.2 Fulfillment of objectives and answering the research questions

The goal of the thesis was to conduct a thorough literature review of how the data-analytics could be effectively exploited in procurement and what would that effective exploitation require from the organization. Also, the purpose of the case study was to

map out the current level of the data-analytics in the procurement organization of the case company. Goal was to map out the current level and based on the analysis of current level and aspects identified in the literature review create a proposal for the case company where would be identified the smartest next steps regarding the procurement data-analytics.

According to the results of this study, data-analytics can be seen as a significant part of a company's operations and business. How companies utilize the information generated from the data is key for their potential success. Especially utilizing the analytics to create scenarios of the future environment and how the operations should be handled.

Data-analytics can enable all sorts of added value for a company, such as cutting costs, improving product quality or reducing the supply chain risk levels, when the needs of an organization are properly identified. Most common way to exploit data-analytics in the field of procurement is utilizing it e.g., supplier selection and demand forecasting. Succeeding in both areas can decrease the potential risks in quality defects and stock outs, which tend to lead into better efficiency and costs saved.

To utilize data-analytics effectively a company needs a clear commitment from the management with a clear governance model and data strategy. A governance model and data strategy are key components to really create additional value for the business through implementation of data-analytics. Because of the differences between companies, there are several components that can be crucial for one company, but they are not crucial for another company, it depends about the company and what is their area of business. Analyzing the current state of the company is imperative for successful development of data-analytics.

At the case company's procurement department, the current level of data-analytics is improving but still on a mediocre level based on the results introduced in the chapter 4.

The managerial implications and next steps on how the case company should improve its procurement data-analytics are introduced in the next chapter.

6 Managerial implications

Goal for any company should be to utilize the data-analytics in a manner where they can prevent some of the issues or problems which may arise in their operations. At the moment the case company's procurement department is utilizing the data-analytics to understand what has happened, sort of looking into to the rearview mirror. Key performance indicators are measuring the past events. Of course, procurement operations can be altered based on the results in some of the KPI's. In this case the corrective actions are often done afterwards and the risk for actions to be too extensive is potential.

Identifying the relevant data sources, internal or external, is key for a company to effectively utilize data-analytics for decision making. Currently the case company's procurement department utilizes only data from its own operations in a continuous manner. In some cases, external data is utilized for one-off reviews, for example creating scenario on how the covid pandemic influenced the supply chain and how it would affect the case company's procurement operations.

Utilization of data-analytics in procurement is still an up-and-coming trend. With a proper implementation procurement data-analytics can create significant additional value for companies. Clear step by step plan on how to improve utilization of data-analytics in the case company's procurement department is needed, as the improvement requires resources and clear commitment from the management. Case company must be ready to embrace the change and implementation of new tools and ways of working. It also must be ready to assess the process pain points and create plans for their improvement.

There are a great deal of research and examples of the efficiency gains that digitalization and analytics can bring. There is a wide range of tools available and the benefits of implementing data-analytics is not limited solely to cost savings, but also include areas as greater transparency, better communications, and effectivity of procurement.

It can therefore be said that for maximum benefit, the potential of data-analytics should be identified at the procurement strategy definition stage and strategic objectives should be better aligned with the opportunities offered by the implementation of data-analytics in order to create additional value for the procurement organization.

6.1.1 Development suggestions for the case company

The importance of effective data-analytics is growing all the time. Decision making based on relevant data and analysis is key for competitive advantage. In the field of procurement, effective data-analytics will benefit the whole supply chain, and in the process, it will make the whole company more profitable. Based on the research, data needs to be part of the strategy, in order for data-analytics to create added value and sustainable competitive advantage. Without effective implementation and governance model, the data-analytics cannot be utilized in a most effective way. Key is to recognize the level of data-analytics needed for an entity in question.

For the case company the priority should be, setting up a clear data governance model and making data one of the key components of the strategy. Governance model should be based on the same principles as in the other business units of the company. However, some parameters should be edited to meet the needs of the organization. That will help with the further implementation of other data sources and limit the potential data clean up needed for successful implementation. One of the key drivers for effective governance model is to create the model as transparent as possible.

Second priority should be, to create a sustainable way to conduct the scenario analysis. Implementing ways to utilize the outsource data and Big Data for more accurate analysis will enhance the decision-making process. Significant part of this sustainable scenario analysis process is to make the analytical tools accessible to all employees and arranging needed trainings accordingly. This will create the additional value through higher level and more efficient utilization of data-analytics in the procurement department.

Creating sustainable models/scenarios that can be updated without long manual process.
Utilizing outsource data or Big Data for more accurate scenario creation, which enhance the decision-making process. Using and trusting the created models and scenarios in decision making is key part for creating added value through data-analytics.

After all, the case company's procurement organization needs to have the support from the senior management of the company to start implementing the aspects mentioned earlier. Support from the management is crucial to successfully develop the data-analytic competencies in the procurement organization and tackle the potential resistance of change. Successful implementation will require time and resources. With higher level of data-analytics, the procurement department can lower their costs, reduce the potential risks regarding the supply chain and free employees' resources to tasks that generate more value for the company.

References

Akter, S. et al. (2016) “How to improve firm performance using big data-analytics capability and business strategy alignment?”, International Journal of Production Economics, Vol. 182, pp. 113–131. doi: 10.1016/j.ijpe.2016.08.018.

Alomar, M. A. & de Visscher, C. (2019). E-public procurement: Which factors determine its acceptance by small- to medium-sized enterprises and large companies in Belgium? International review of administrative sciences, 85(2), 356-376. https://doi.org/10.1177/0020852317703466

Al-Ruithe, M., Benkhelifa, E. & Hameed, K. (2018). A systematic literature review of data governance and cloud data governance. Personal and ubiquitous computing, 23(5-6), 839-859. https://doi.org/10.1007/s00779-017-1104-3

Aryal, A., Liao, Y., Nattuthurai, P. and Li, B. (2018), "The emerging big data-analytics and IoT in supply chain management: a systematic review." Supply Chain Management: An International Journal 25(2): 141-156.

Awan, U., Kanwal, N., Alawi, S., Huiskonen, J. & Dahanayake, A. (2021). *Artificial Intelligence for Supply Chain Success in the Era of Data-analytics*. https://doi.org/10.1007/978-3-030-62796-6_1

Bals, L., Schulze, H., Kelly, S., & Stek, K. (2019). Purchasing and supply management (PSM) competencies: Current and future requirements. Journal of purchasing and supply management, 25(5), 100572. https://doi.org/10.1016/j.pursup.2019.100572

Bizclick, A. (2022). Crisis proofing supply chains through procurement analytics. Retrieved 2022-04-11 from https://procurementmag.com/technology-and-ai/crisis-proofing-supply-chains-through-procurement-analytics

Bradley, R. (2021). 8 Procurement analytics use cases to meet the moment. Retrieved 2022-04-05 https://blogs.oracle.com/analytics/post/8-procurement-analytics-use-cases-to-meet-the-moment

Chopra, A. (2019). *AI in Supply & Procurement*. https://doi.org/10.1109/AICAI.2019.8701357

Cox, A. & Lamming, R. 1997. Managing supply chain in the firm of the future. European Journal of Purchasing and Supply Management 3(2). https://doi.org/10.1016/S0969-7012(97)00002-6

Connaughton, Patrick, and Christopher Sawchuk. 2014. "Procurement Analytics in the Era of Big Data: What CPOs Need to Know". The Hackett Group.

De Haes WVGS (2008) Practices in IT governance and business/ IT alignment. Inf Syst Control 2:1–6

Delen, D. & Demirkan, H. (2013). Data, information and analytics as services. Decision Support Systems, 55(1):359-363. https://doi.org/10.1016/j.dss.2012.05.044

Eriksson, P., & Kovalainen, A. (2008). *Qualitative Methods in Business Research*. https://doi.org/10.4135/9780857028044

Farzipoor Saen, R. (2010). Developing a new data envelopment analysis methodology for supplier selection in the presence of both undesirable outputs and imprecise data. *International journal of advanced manufacturing technology, 51*(9-12), 1243-1250. https://doi.org/10.1007/s00170-010-2694-3

Gottge, S., Menzel, T. & Forslund, H. (2020). Industry 4.0 technologies in the purchasing process. Industrial management + data systems, 120(4), 730-748. https://doi.org/10.1108/IMDS-05-2019-0304

Goyal, G., Samalia, H.V. and Verma, P. (2018), "Mediating role of process simplification in process integration and upstream supply chain flexibility", International Journal of Productivity & Performance Management, Vol. 67 No. 5, pp. 825-844.

Gupta, U. & Cannon, S. (2020). A Practitioner's Guide to Data Governance: A Case-Based Approach.

Hallikas, J., Immonen, M., & Brax, S. (2021). Digitalizing procurement: The impact of data-analytics on supply chain performance. *Supply chain management, 26*(5), 629-646. https://doi.org/10.1108/SCM-05-2020-0201

Handfield, R., Jeong, S. & Choi, T. (2019). Emerging procurement technology: Data-analytics and cognitive analytics. *International journal of physical distribution & logistics management, 49*(10), 972-1002. https://doi.org/10.1108/IJPDLM-11-2017-0348

Hofmann, E., & Rutschmann, E. (2018). Big data-analytics and demand forecasting in supply chains: A conceptual analysis. *The international journal of logistics management, 29*(2), 739-766. https://doi.org/10.1108/IJLM-04-2017-0088

Huuhka, T. 2019. Tehokkaan hankinnan työkalut. Books on Demand.

Iloranta, K. & Pajunen-Muhonen, H. (2008). Hankintojen johtaminen: Ostamisesta toimittajamarkkinoiden hallintaan. Tietosanoma.

Jones, S. (2020). 3 ways Data-analytics can empower your procurement team. Retrieved 2022-04-08 https://www.celonis.com/blog/three-ways-data-analytics-can-empower-your-procurement-team/

Lamba, K., & Singh, S. P. (2017). Big data in operations and supply chain management: Current trends and future perspectives. *Production planning & control, 28*(11-12), 877-890. https://doi.org/10.1080/09537287.2017.1336787

Lamba, K., & Singh, S. P. (2018). Modeling big data enablers for operations and supply chain management. *The international journal of logistics management, 29*(2), 629-658. https://doi.org/10.1108/IJLM-07-2017-0183

Lamming, R. 1993. Beyond Partnership, Strategies for Innovation and Lean Supply. Hampstead: Prentice Hall.

Lapan, S. D., Quartaroli, M. T., & Riemer, F. J. (2012). *Qualitative research: An introduction to methods and designs*. San Francisco: Jossey-Bass

Lyke-Ho-Gland, H. (2020). Three keys to data and analytics effectiveness. Retrieved 2022-04-19 https://www.industryweek.com/leadership/article/21120000/three-keys-to-data-and-analytics-effectiveness

Manello, A. and Calabrese, G. (2019), "The influence of reputation on supplier selection: an empirical study of the European automotive industry", Journal of Purchasing and Supply Management, Vol. 25 No. 1, pp. 69-77.

Monczka, R.M. 2016. Purchasing and Supply Chain Management 6th ed. Cengage Learning.

Morrow, M. K. (2021). Data Integrity vs Data Quality – Definitions & Differences Retrieved 2022-04-20 from https://zipreporting.com/data-integration/data-integrity-vs-data-quality.html

Nicoletti, B. (2020) Procurement 4.0 and the fourth industrial revolution: the opportunities and challenges of a digital world . 1st ed. 2020. Cham, Switzerland: Palgrave Macmillan.

O'Connor, A. (2020). Demystifying the difference between data integrity & data quality Retrieved 2022-04-20 from https://insidebigdata.com/2020/12/19/demystifying-the-difference-between-data-integrity-data-quality/

Panian Z (2010) Some practical experiences in data governance. World Acad Sci Eng Technol Manag (62):939–946

Pellengahr, K., Schulte, A. T., Richard, J., & Berg, M. (2016). Pilot Study on Procurement 4.0. *The Digitalization of Procurement*, Frankfurt, Germany.

Precisely Editor. (2022). Data Integrity vs. Data Quality: How are they different? Retrieved 2022-11-20 from https://www.precisely.com/blog/data-integrity/data-integrity-vs-data-quality-different

Prinzo BR, Group TP (2012) Developing a Strategy for your Data Governance Initiative, pp. 15–17

Reck, R. F. & Long, B. G. (1988). Purchasing: A Competitive Weapon. Journal of Purchasing and Materials Management, 24(3), 2-8. https://doi.org/10.1111/j.1745-493X.1988.tb00631.x

Rafati, L., & Poels, G. (2015). *Towards model-based strategic sourcing*. https://doi.org/10.1007/978-3-319-26739-5_2

Sanders, N.R., 2014. Big Data Driven Supply Chain Management: A Framework for Implementing Analytics and Turning Information into Intelligence. Pearson Education, pp.131- 147.

Saunders, M., Lewis, P., & Thornhill, A. (2007). *Research methods for business students: 4. ed*.

Sedkaoui, S. (2018). Data-analytics and Big Data. Wiley-ISTE.

Shamim, S., Zeng, J., Shariq, S. M., & Khan, Z. (2019). Role of big data management in enhancing big data decision-making capability and quality among Chinese firms: A dynamic capabilities view. *Information & management, 56*(6), 103135. https://doi.org/10.1016/j.im.2018.12.003

Su, T., & Lin, Y. (2015). Fuzzy multi-objective procurement/production planning decision problems for recoverable manufacturing systems. *Journal of manufacturing systems, 37*, 396-408. https://doi.org/10.1016/j.jmsy.2014.07.007

Wang, G., Gunasekaran, A., Ngai, E. W., & Papadopoulos, T. (2016). Big data-analytics in logistics and supply chain management: Certain investigations for research and applications. *International journal of production economics, 176*, 98-110. https://doi.org/10.1016/j.ijpe.2016.03.014

Weele, A. J. v. (2010). Purchasing & supply chain management: Analysis, strategy, planning and practice (5th ed.). Cengage Learning.

Wende K (2007) A Model for Data Governance – Organising Accountabilities for Data Quality Management. In Proceedings of the 18th Australasian Conference on Information Systems, Toowoomba (Australia), 2007–12-06, pp. 417–425 (2012).

Yin, R. K. (2010). Case study research: Design and methods. *Pedagogická orientace, 22*(4), .

Appendix

Attachment 1. Current level questionnaire

Questionnaire to map out the current level of data-analytics in the case company's procurement department.

Background information:
Are you working in Indirect, Direct procurement or ESO?

1. Strategy: Please evaluate the strategic level of procurement data-analytics at the case company. Scale ranging from 1 to 5.
2. Information: This assessment dimension examines the role and contribution of information to organizational success. Is the information being used to (1) observe, (2) manage, (3) improve, (4) differentiate or (5) as a strategic asset.
3. Analytics: This assessment dimensions explores the level of usage and the strategic nature of analytics in decision making. From scale 1-5. At the lowest level (1) the analytics is used simply to describe what has already occurred and at the highest level (5) it is used to achieve competitive advantage by automating critical business processes for strategical advantage.
4. Culture and Execution: How is the culture and execution regarding data-analytics? At the lowest level (1) organization is led by the preferences of an individual and at the highest level (5), key stakeholders are dedicated users of data-analytics and data-driven decision making with the singular goal of maximizing business value.
5. Architecture: This phase of assessment focuses on preserving and protecting the consistency and appropriateness of data usage, its quality and integrity. Data exists to satisfy business requirements.
6. Governance: This dimension focuses on the extent to which data governance policies, procedures, processes, and systems have become embedded in the organization. At the lowest level (1) it is just arbitrary and ad hoc policies, at the highest level it is clearly articulated and communicated rules and regulations, systems

and processes that are grounded in a strategic, systematic, and structured approach to govern the entire information ecosystem.

7. Open comments regarding the current level of data-analytics in the procurement organization.

Attachment 2. Interview template for procurement management team

Interview of current level of data-analytics in the procurement organization and what are the needs of each procurement category, identified by the category leader.

Background information:
Tell a bit about your background and what does your unit do?

1. How does your unit utilize data-analytics at the moment?
2. What is the added value sought-after through data-analytics?
3. What are the needs your unit has to effectively exploit data-analytics?
    a. Tools?
    b. Competencies?
4. What kind of analytical tools would bring added value to your organization?
5. What kind of functionalities the analytical tools should have?
6. What are the characteristics that should be found in the data, so it could be exploited to achieve the added value mentioned in question two?
7. Does your unit have an effective data strategy/governance model? Who oversees the most important data sources?
    a. Do you think this kind of model/strategy is needed?
    b. What would be the suitable level for it to be effective? (Company, supply chain or procurement organization)