MASTER THESIS

DATA-DRIVEN DECISION MAKING (DDD) BY SME ONLINE RETAILERS

EXPLORING CRITICAL DETERMINANTS INFLUENCING THE ADOPTION OF DDD BY SME ONLINE RETAILERS

Author: Daniël Bojoga
1st Supervisor: dr. Robin Effing
2nd Supervisor: dr.ir. A.A.M. Spil
Academic Institution: University of Twente
Faculty: Behavioural, Management and Social Sciences (BMS)
Programme: MSc in Business Administration – Digital Business

Acknowledgement

This document is part of my master thesis to complete my study Master of Science in Business Administration – Digital business. First of all, I would like to thank my first supervisor dr. R. Effing as well as my second supervisor dr.ir. A.A.M. Spil for guiding me throughout this research project.

Furthermore, I would like to thank the experts who participated in the interviews. Their time, expertise and passionate input were highly appreciated during the holiday period. This research project would not have been successfully conducted without these experts.

Finally, I must express my profound gratitude to my family, friends, and girlfriend for their massive support, trust and continuous encouragement throughout my years of studying. My graduation would not have been possible without their help. Thank you.

Daniël Bojoga

Abstract
Data has become one of the company's most valuable assets in today's business world. Research shows that companies that can adequately harness their data effectively can make better and faster decisions in their business operations. This decision-making practice is also known as Data-Driven Decision Making (DDD). In particular, companies who operate in highly competitive industries, such as the retail sector, can gain a competitive advantage from this DDD practice as these companies rely on efficiency and effectiveness to remain competitive. Mainly large retailers are increasingly adopting this way of decision-making. However, small and medium-sized retailers still struggle to implement DDD successfully as these SMEs face challenges and barriers. Therefore, this study aimed to explore critical determinants that influence the adoption of DDD by SME online retailers operating in the Netherlands. This research used the TOE (Technology, Organisation, Environment) framework to explore the critical determinants of DDD adoption. A literature review was conducted on prior TOE-based research concerning big data analytics adoption to explore potential factors influencing DDD adoption. Thereafter, semi-structured interviews were conducted with experts who assist SME online retailers with DDD to discuss these potential adoption factors and identify the critical determinants influencing the adoption of DDD by SME online retailers. The results show that the critical determinants are positioned in the technological and organisational context. In the technological context, it is presumed that the Relative Advantage, Complexity, Compatibility, Data Management and Process Management can be considered critical determinants that influence the adoption of DDD. In the organisational context, it is suggested that Top Management Support, Human Resources and a Data-Driven Culture can be considered critical determinants that influence the adoption of DDD. Furthermore, this study suggests practical implications that support SME online retailers in adopting DDD successfully and provides future research implications regarding the factors influencing the adoption of DDD by SME online retailers.

Table of contents

1. Introduction

In today's business world, innovative companies are always searching for new technologies that allow them to develop and stay competitive in their industries. Over the last decade, both academics and companies have gained interest in the field of data science and explored the numerous advantages and opportunities that (big) data can provide (Günther, Rezazade Mehrizi, Huysman, & Feldberg, 2017; Mikalef, Pappas, Krogstie, & Giannakos, 2017). Collecting data and using (sophisticated) analytical programs have proven to support organisations in their decision-making process to create business value (McAfee & Brynjolsson, 2012; Ohlhorst, 2012; Troisi, Maione, Grimaldi, & Loia, 2019). Analytical technology development for decision-making has been rapid and broad over the years (Davenpoort, 2018). These analytical methods have been developed from simple descriptive analytics to advanced analytics with integrated Artificial Intelligence (AI) capabilities to drive automation of knowledge work practices (e.g. creative thinking and non-repetitive problem solving) (Davenpoort, 2018; PricewaterhouseCoopers, 2021).

Nowadays, data is considered one of the organisations' most valuable assets (Morabito, 2015). Research shows that the global big data and business analytics market had an estimated market capitalisation of 169 billion U.S. dollars in 2018 and expects to reach 274 billion U.S. dollars by 2022 (Mlitz, 2021). In the past, business leaders made decisions primarily based on intuition. However, present studies show that the best decisions taken today are backed by data and analytical tools (Dutta & Bose, 2015; LaValle, Lesser, Shockley, Hopkins, & Kruschwitz, 2011). This phenomenon is also known as Data-Driven Decision Making (DDD). Provost and Fawcett (2013) define DDD as "the practice of basing decisions on the analysis of data rather than purely on intuition" (p. 3). With the aid of DDD, organisations can realise improvements in operational and financial metrics (McAfee & Brynjolfsson, 2012; Provost & Fawcett, 2013; Reinhold & Reinhold, 2014). For instance, McAfee and Brynjolfsson (2012) found that the effects of using DDD can result in improvements in the organisation's return on assets, return on equity, asset utilisation and market value. Researchers and institutions believe that the benefits of DDD can be realised within all organisational sizes and across several industries (Bianchini & Michalkova, 2019; Provost & Fawcett, 2013). Hence, data-driven decision making is a crucial consideration for every organisation if it desires to make improved decisions leading to business growth.

However, while most large companies are increasingly adopting this new way of decision-making, smaller and medium-sized enterprises (SMEs) are still struggling to implement DDD successfully as these companies face challenges and barriers when adopting IT innovations (Bianchini & Michalkova, 2019). The present research suggests that this is mainly due to the fact that SMEs are limited in their resources (Del Vecchio, Di Minin, Petruzzelli, Panniello, & Pirri, 2017; Reinhold & Reinhold, 2014, Sen, Ozturk, & Vayvay, 2016). SMEs are primarily struggling with the expertise of personnel, financial resources and cultural changes in order to realise digital transformations (OECD 2021, Reinhold & Reinhold, 2014). Important to note is that SMEs play a crucial role in all economies worldwide. Considering only European counties, small and medium firms account for 99% of all businesses (European Commission, 2020). If SMEs do not adopt DDD, this could potentially mean that the competitive position of SMEs becomes weaker because a substantial part of large corporations has already implemented DDD successfully.

Furthermore, one must also evaluate the degree of applicability of DDD in terms of industries. According to research from 2018, European organisations are primarily applying DDD in industries such as ICT, utilities, transportation, storage, manufacturing, real estate, construction, and retail (Bianchini & Michalkova, 2019). SMEs are highly active in the retail sector. Nearly 1 out of 4 European SMEs operate in the retail or wholesale industry (EuroCommerce, 2017). In 2020, figures from the Netherlands showed that approximately 62%

of the large retail organisations utilised big data analytics (CBS, 2022). Comparing this utilisation percentage to SME retailers, 24% of small retailers (10 – 49 employees) and 39% of medium-sized retailers (50 – 250 employees) utilised big data analyses for their operations (CBS, 2022). To assist a substantial part of the SMEs with adopting DDD, the retail sector might be a promising sector to implement DDD as a substantial part of SMEs operate in this industry (OECD, 2019). SME retailers are a major social and economic contributor to the European economy. Besides their contributing revenue to the economy, the retail and wholesale sector is the second largest employer in Europe. Almost two-thirds of the employees from the retail and wholesale sector are employed at SMEs (EuroCommerce, 2017). Additionally, the retail industry is highly competitive (Hossain, Akter, & Yanamandram, 202). Efficiency and growth within organisations do not only require reliable business operations, but also innovation practices to remain competitive (Caro & Sadr, 2019; Hossain et al., 2020). DDD is a proven practice that could positively contribute to an SME's business operations while enhancing its competitive position in the retail market (McAfee & Brynjolsson, 2012; Ohlhorst, 2012; Troisi, Maione, Grimaldi, & Loia, 2019). Hence, guiding SME retailers is essential to overcome the barriers to adopting DDD and thereby a way to achieve more equal competition within the retail market.

However, limited literature is available regarding frameworks for SME retailers adopting DDD. The Dutch Retail Innovation Platform suggests future research in translating existing theories and frameworks related to the conversion of data into business value specified for the retail industry (Weltevreden, Effing & Ectors, 2020). To contribute to this research gap, this study used the TOE framework to explore the critical factors influencing the adoption of DDD by SME online retailers. It was decided to focus on SME online retailers which include click-and-mortar retailers (retailers who have both physical and virtual e-commerce channels) and e-commerce retailers (retailers who only sell their products via e-commerce channels).

Specifically, the primary objective of this study was to explore the critical determinants influencing the adoption of DDD by Dutch SME online retailers. In addition, this study aimed to generate practical implications that SME online retailers can use to evaluate the critical determinants for their organisation. Hence, the central research question has been formulated as follows: *"What are the critical determinants influencing the adoption of DDD by SME online retailers?"*

Further, this study used a qualitative research approach. Semi-structured interviews were conducted with Dutch experts whom assist SME retailers with adopting DDD. With the aid of these interviews, a TOE framework containing the important factors influencing the adoption of DDD by SME online retailers was developed. Prior literature on (big) data analytics adoption using the TOE framework has been used and adjusted accordingly to explore the critical determinants influencing the adoption of DDD by SME online retailers.

Moreover, this study provides both theoretical and practical contributions. This research contributed by extending current literature with the exploration of (critical) factors for the adoption of DDD by (Dutch) SME online retailers. In particular, it complements the literature focusing on the challenges and barriers that SMEs face with technology adoption. In terms of practical contributions, SME online retailers can utilise the practical implications as a guideline to start adopting DDD.

Finally, this thesis is structured as follows. Firstly, the theoretical framework of this study will be provided. Secondly, the methodology to conduct this research will be discussed. Thirdly, the results of this study will be presented. Fourthly, a comparison will be given between the results from this study and prior TOE-based literature on (big) data analytics adoption. Lastly, a discussion and conclusion will be given that encompasses the theoretical and practical implications of this study as well as the limitations and future research suggestions.

2. Theoretical Framework

This chapter presents the theoretical background of this research. The first section of this chapter describes the concept Data-Driven Decision Making and the effects on company performance. The second section of the chapter explains the concept Big Data Analytics which is a technological tool that enables DDD. The third section elaborates on techniques to analyse and interpret forms of data. The fourth section describes the current status of SMEs performing DDD through the use of (big) data analytics. The fifth section explains the Technology-Organisation-Environment (TOE) Framework for technology adoption which was used to explore the critical determinants influencing DDD adoption by SME online retailers. Finally, the sixth section includes an overview and a discussion of prior studies on adopting (big) data analytics using the TOE framework.

2.1 Data-Driven Decision Making (DDD)

With the advent of new technologies and the increase of internal and external data, companies and academics are exploring new ways to create business value for their organisation. Technologies such as data analytics allow organisations to transform their collected data into information that can be of significant value to the organisation. Studies have proven that companies that use Data-Driven Decision Making (DDD) realise better performance in terms of operational and financial metrics (McAfee & Brynjolfsson, 2012; Provost & Fawcett, 2013). Provost and Fawcett (2013) define Data-Driven Decision Making (DDD) as *"the practice of basing decisions on the analysis of data rather than purely on intuition"* (p. 3). Before the advent of data technologies, managers made decisions that were primarily based on incomplete information, experience and intuition (Dutta & Bose, 2015; LaValle et al., 2011; Provost & Fawcett, 2013). DDD allows managers to assist their decisions with data as statistical applications provide insights into the current stage of operations and what might happen in the future. The primary fundamentals of Data-Driven Decision Making were developed more than 50 years ago (Delen & Zolbanin, 2018). Delen and Zolbanin (2018) highlight that already in the late 1960s and 1970s, researchers in the field of information systems have spent a tremendous amount of time developing decision-support systems allowing users to generate solutions that can be applied to complex decision-making and problem-solving. Ever since, the analytics of these decision-support systems matured to the integration of operational research, machine learning and information systems. DDD can now be utilised at different organisational levels and across different industries (McAfee & Brynjolfsson, 2012; Provost & Fawcett, 2013). In particular, highly competitive industries can benefit from this DDD practice as these industries rely on efficiency and effectiveness to remain competitive (Chen, Chiang, & Storey, 2012; Rejikumar, Asokan, & Sreedharan, 2020). Nearly a decade ago, a study by McAfee and Brynjolfsson (2012) had proven that industry-leading companies who embrace DDD are able to realise 5 per cent more productivity and 6 per cent more profit (on average) compared to their industry rivals. These marginal differences remained robust after considering labour, capital, purchased services and IT investment costs.

In terms of value creation, DDD provides various ways to create value. The fundamentals of DDD assist in faster decision-making in most business practices by using an intense application of data science and data mining (Provost & Fawcett, 2013). Examples are marketing practices (direct marketing, online advertising, product recommendations), financial practices (credit scoring, financial trading), customer support (help-desk management), and security (fraud detection) (Grewal, Roggeveen, & Nordfält, 2017; Provost & Fawcett, 2013). In particular, Nuortimo and Harkonen (2019) conclude that data-driven technologies mainly assist in addressing challenges in the field of marketing and market structure analyses. The authors state that companies are now able to make better decisions in terms of pricing, campaign management, brand positioning and product development.

Considering the retail industry, DDD is rapidly transforming modern operations (Kesavan & Kushwaha, 2020). Grewal et al. (2017) state that the retail sector has always been a front leader in the collection of data. Due to the improved access to computing power and the availability of analytical systems, retailers have increasingly started to take advantage of the opportunities to leverage their collected data to solve problems. The collection and use of data have primarily made it possible for both retailers and researchers to understand and act upon the dynamics of customer behaviour. For example, researchers made a prediction model for consumers' variety seeking in their purchases by using public weather data and a groceries panel for a selection of 5 products (Tian, Zhang, & Zhang, 2018). The authors developed a model to exploit weather data for analytics and implications for weather targeting strategies to reduce promotional expenses and increase profits. Grandhi, Patwa, and Saleem (2017) conclude that retailers are using data to understand what and why customers are buying, exploring consumption patterns and evaluating customer satisfaction. The authors argue that the retail industry is a customer-focused industry, and therefore different sources of data are used to understand customers better and enhance customer service. Bradlow, Gangwar, Kopalle, and Voleti (2017) categorise a variety of specific data sources for retailers into five dimensions. Specifically, the researchers highlight how customer, product, location, time and channel data sources can be used to strategically optimise prices and maximise sales.

2.2 Big Data Analytics

In order to execute DDD, analytical tools have to be applied to transform the collected data from internal and external sources into valuable information that can be used by the company. Particularly, large organisations operating in data-intensive industries (e.g. banking, insurance, energy, automotive, and retail) have access to a massive volume of both structured and unstructured data (Coleman et al., 2016). Applying analytical tools to these massive data collections is also known as Big Data Analytics (Troisi, Maione, Grimaldi, & Loia, 2019). In simple terms, big data refers to a massive collection of data, and analytics refers to sophisticated tools that can generate valuable insights from big data.

Big data is mainly characterised by three dimensions within the literature (Delen & Zolbanin, 2018; He, Wang, & Akula, 2017; McAfee & Brynjolfsson, 2012; Santoro, Fiano, Bertoldi, & Ciampi, 2019; Troisi et al., 2019). These are Volume, Variety, and Velocity. Volume refers to the amount of data that is being collected. This can be expressed by the amount of capacity that is needed to store the data. Variety refers to the type of different data formats which are structured data and unstructured data. Structured data is extracted chiefly from traditional relational databases where data is correlated to each other. On the other hand, unstructured data encapsulates data that has no distinct correlations. Examples are random data from media and entertainment, emails, log files and sensors. Velocity refers to the speed in terms of generating and processing the data. Some other dimensions are also acknowledged and used within the literature to describe big data (Santoro et al., 2019; Troisi et al., 2019; Wamba, Akter, Edwards, Chopin, & Gnanzou, 2015). These dimensions are veracity and value. Veracity refers to the quality, reliability and uncertainty of the collected data (Santoro et al., 2019; Wamba et al., 2015). The value dimension includes the benefits that are extracted from the data (Santoro et al., 2019; Wamba et al., 2015).

2.3 Techniques to analyse and interpret forms of data

Moreover, once the data is generated and ready to be processed, the analytical tools can be applied to create value from the data. Delen & Zolbanin (2018) define analytics as "a process that employs various techniques to analyse and interpret different forms of data to enable better decisions and improve firm performance" (p.188). Generally, three main subcategories of

analytics can be distinguished (Coleman et al., 2016; Delen & Zolbanin, 2018). These categories are descriptive analytics, predictive analytics and prescriptive analytics.

Descriptive analytics can be used to provide insights into current or past practices (Coleman et al., 2016; Delen & Zolbanin, 2018). It mainly includes traditional business intelligence and visualisation techniques. The statistics and models are used to elaborate on the differences within data or to illustrate and prove relationships between variables (Delen & Zolbanin, 2018).

Predictive analytics provide insights into probabilities of possible events in the future based on historical data (Coleman et al., 2016; Delen & Zolbanin, 2018). For example, it uses algorithmic models that focus on making empirical predictions rather than relying on theory. Statistics, (advanced) mathematical models, data mining and machine learning methods can be used to generate a predictive analysis (Delen & Zolbanin, 2018).

Prescriptive analytics generate possible actions and their likely consequences under certain conditions. Coleman et., al (2016) state that this method mainly converts the results of descriptive and predictive analytics into business decisions. Delen and Zolbanin (2018) state that prescriptive analytics uses a set of mathematical techniques that computationally determine the optimal action or decision given a complex set of objectives, requirements, and constraints to enhance organisational performance.

2.4 SMEs and DDD

Although research shows that the adoption rate of DDD by SMEs remains relatively low compared to larger organisations, researchers do believe that SMEs can benefit from utilising data (Coleman et al., 2016; Ohlhorst, 2012; Troisi et al., 2019). Thanks to the developments and the increasing pace of technology developments, SMEs can now also benefit from big data analytics (Goswami, Han, Wang, & Jiang, 2015). All businesses can have access to a tremendous amount of data and recent technological developments in software and hardware provide affordable solutions for SMEs (Coleman et al., 2016; Lu, Cairns, & Smith, 2020). Wang and Wang (2020) state that utilising big data can be considered as an organisational venture for SMEs on the condition that a SME aligns its business strategy with the strategic use of big data and maintain a long-term strategy of using business intelligence. The authors add that the motivation of SMEs to use data analytics is to reduce costs, improve customer service, enhance marketing strategies, and achieve sustainability. Another study by Bertello, Ferraris, Bresciani and De Bernardi (2020) illustrates that big data can also support SMEs in making well-informed and effective decisions on whether or not the firm should consider the internationalisation of the business.

Furthermore, researchers have investigated the benefits of DDD for SMEs in specific industries. With the use of big data in combination with DDD practices, small and medium manufacturers can make better decisions in the production process resulting in better production efficiency and a reduction in the costs of materials (Chen, Han, Cao, Zheng, & Xu, 2020). Saleem et al. (2020) state that small and medium manufacturers can enhance product and process innovation, improve supply chain management and the overall performance of the company. Another study found that SMEs operating in the agriculture sector can benefit from big data as it supports the decision-making process and strengthen the management control systems (Vitale, Cupertino, & Riccaboni, 2020). Marcinkowski and Gawin (2020) conclude that SMEs operating in the facility management sector can leverage data to make data-driven decisions to decrease property utilisation costs and create opportunities for new revenue streams.

Some authors concluded the benefits of DDD for SMEs in the retail sector. Liu, Soroka, Han, Jian and Tang (2020) conducted cloud-based big data analytics for SMEs to generate customer insights that can result in innovations for the company. The authors state that SMEs

operating in the retail business can benefit from several business values. Examples are in-store behaviour analysis, variety and price optimisation, product placement design, labour inputs optimisation, logistics optimisation, and web-based markets. Moreover, Lu, Cairns and Smith (2020) developed a process model for DDD including descriptive analytics, diagnostic analytics, predictive analytics and prescriptive analytics. The model was applied to small retail businesses to create a customer sales strategy.

As with every IT innovation, there are also challenges and barriers associated with the adoption of DDD. Whereas a substantial part of larger firms has already successfully implemented analytical technologies for better decision-making, researchers identified that SMEs are slow adopters of DDD (Coleman et al., 2016). Many researchers agree upon the fact that the relatively slow adoption rate is caused by the limited resources of SMEs (Coleman et al., 2016; Dittert, Härting, Reichstein, & Bayer, 2017; Kugler, 2020; O'Connor & Kelly, 2017; Vitale et al., 2020; Wang & Wang, 2020). Wang and Wang (2020) clarify that the low adoption rate is a result of SMEs having insufficient IT resources and misalignment with the strategic use of big data and the business strategy. Dittert et al. (2017) conclude that most barriers can be classified into four categories: security considerations; limited financial resources; lack of knowledge; and lack of prioritisation addressing business issues. The authors argue that a lack of knowledge and financial restrictions are closely interrelated as most SMEs are a sheer domain specialist and will therefore not be aware of the big data opportunities for their business. Some researchers highlight that the organisational culture can also hinder the adoption if this is not properly aligned with a DDD practice (Coleman et al., 2016; Kugler, 2020; Vitale et al., 2020). Coleman et al. (2016) conducted an extensive review on the challenges SMEs face in effectively using their data resources. In addition to the beforementioned challenges, the authors add the following challenges: intrinsic conservatism; shortage of in-house data analytic expertise; bottlenecks in the labour market; lack of exemplary business cases; shortage of useful and affordable consulting and business analytics service; non-transparent software market; lack of intuitive software; and lack of management and organisational models.

To conclude, the low adoption rate of DDD by SMEs can be explained by the challenges and barriers that SMEs encounter. Considering the position of SMEs in the economy and the rapid growth of larger enterprises implementing DDD, SMEs are in danger of losing their competitive position in the market. Therefore, there is a strong urgency to provide support and guidance for the adoption of DDD by SMEs.

2.5 Technology-Organisation-Environment (TOE) Framework for Technology Adoption

A technology adoption model can be used to explore the critical factors for the adoption of a particular technology. Tornatzky and Fleischer (1990) created an analytical framework that encapsulates a generic set of factors that explain and predict the likelihood of an organisation adopting a particular innovation or technology. These are technological, organisational, and environmental factors influencing technology adoption by an organisation. The technological dimension explains the internal and external technologies that are relevant to an organisation (Verma & Bhattacharyya, 2017). Thus, the technological context refers to the characteristics of the technology being used (Park & Kim, 2019). This dimension is considered separately from the environment to emphasise how technological issues could influence technology adoption (Verma & Bhattacharyya, 2017). In particular, the organisational dimension of the TOE framework refers to the resources, organisational structure and other characteristics of the firm (Park & Kim, 2019). The environmental dimension encompasses industry characteristics and government regulations. In this context, this mainly refers to the SME's partners and competitors, the macroeconomic environmental factors and the regulatory environment (Park & Kim, 2019).

Moreover, the TOE framework has both advantages and disadvantages. In general, the main advantage of the TOE framework is that the model is considered as a solid basis for evaluating the adoption of various IT innovations among different types of organisations (Park & Kim, 2019; Verma & Bhattacharyya, 2017) and several studies within the literature illustrate reliable empirical support of the framework (Chen, Preston, & Swink, 2015; Lai, Sun, & Ren, 2018). The main disadvantage mentioned in the literature is that the TOE framework is in danger of providing potential biases due to selected characteristics of the three dimensions that are empirically tested on other IT innovations (Ramdani & Kawalek, 2007; Verma & Bhattacharyya, 2017). However, a qualitative research approach could prevent such biases by explicitly asking the interviewees about those factors which the interviewee believes are important, rather than solely structuring the interview around the TOE attributes mentioned in the literature (Verma & Bhattacharyya, 2017). With this in mind, the researcher believes that the TOE framework is an adequate tool to explore the critical success factors for adopting DDD by SMEs online retailers.

2.6 Prior studies on the adoption of (big) data analytics using the TOE framework

Prior studies on IT adoption using the TOE framework could help to understand and guide this research to explore the critical determinants influencing the adoption of DDD by SME online retailers. Since DDD is closely related to extracting value from data analyses, a systematic literature review of studies on adopting (big) data analytics by companies using the TOE framework was conducted. Ten studies have been reviewed in total. Because the research context of each study is important, this section will provide a brief discussion of the reviewed studies. The order of the studies described is ranked by the year of publication and whether these studies were quantitative or qualitative. Table 1 and Table 2 show an overview of the systematic literature review conducted. Each column of the TOE dimensions describes what factors were examined that directly or indirectly influence the firm's adoption of (big) data analytics. These factors were either found to be positively or negatively influencing the adoption of (big) data analytics. In table 1, the asterisk illustrates that the factor was found to be significantly influencing the adoption of the IT innovation.

Table 1 Prior TOE-based research for the adoption of (big) data analytics - Quantitative studies

#	Authors	Technology	Organisation	Environment	IT Innovation
1	(Chen, Preston, & Swink, 2015)	- Expected Benefits * - Technology Compatibility *	- Top Management Support * - Organisational Readiness *	- Competitive Pressure *	Big Data Analytics (usage)
2	(Lautenbach, Johnston, & Adeniran-Ogundipe, 2017)	- Data-related Infrastructure Capabilities * - Data Management Challenges	- Top Management Support * - Talent Management Challenges	- External Market Influence * - Regulatory Compliance	Business Intelligence and Analytics (Usage extent)
3	(Lai, Sun, & Ren, 2018)	- Perceived Benefits * - Technology Complexity - Data Quality	- Top Management Support * - IT Infrastructure and Capabilities - Financial Readiness - Firm Size *	- BDA Adoption of Competitors * - Governmental Policy and Regulations * - Supply Chain Connectivity *	Big Data Analytics
4	(Li, Dai, Gershberg, & Vasarhelyi, 2018)	- IT Complexity - Technological Competence *	- Management Support * - Size	- Professional Help * - Standards *	Audit Analytics

Table 1 (Continued)

#	Authors	Technology	Organisation	Environment	IT Innovation
5	(Park & Kim, 2019)	- Perceived Benefits from Big Data * - Simplicity of System Usage - Compatibility with Existing Systems - Security and Privacy * - Data Quality and Integration *	- Management Support for Big Data * - Technological Capabilities * - Financial Investment Competence *	- Competitor Adoption - Partner Adoption - Government Support and Policy *	Big Data Adoption
6	(Sun, Hall, & Cegielski, 2019)	- Relative Advantage * - Technology Competence * - Technology Resources *	- Top Management Support * - Firm Size	- Competitive Pressure * - Trading Partner Readiness - Regulatory Environment *	Big Data Adoption
7	(Chaurasia & Verma, 2020)	- Big Data Quality * - Complexity * - Compatibility - Technology Readiness *	- Firm Size * - Top Management Support *	- Competitive Pressure * - Regulatory Support	Big Data Analytics
8	(Maroufkhani, Wan Ismail, & Ghobakhloo, 2020)	- Relative Advantage* - Compatibility* - Complexity * - Risk and Insecurity * - Trialability * - Observability *	- Top Management Support * - Organisational Readiness *	- Competitive Pressure * - External Support * - Government Regulations *	Big Data Analytics

Table 2 Prior TOE-based research for the adoption of (big) data analytics – Qualitative studies

#	Authors	Technology	Organisation	Environment	IT Innovation
9	(Sun, Cegielski, Jia, & Hall, 2016)	- Relative Advantage - Cost of Adoption - Complexity - Compatibility - Trialability - Observability	- Human Resources - Management Support - Technology Resources - Technology Readiness - Decision-Making Culture - Change Efficiency - Intention to Adopt Big Data - Organisation Characteristics - Business Strategy Orientation - IT Organisation Structure - Business Resources - IS Strategy Orientation - Firm Size - Appropriateness	- Privacy and Ethical Concerns in Collecting Data - Trading Partner Readiness - Regulatory Environment IS Fashion - Market Turbulence - Institutional Based Trust	Big Data Adoption
10	(Verma & Bhattacharyya, 2017)	- Complexity - Compatibility - IT Assets	- Top Management Support - Organisational Data Environment - Perceived Costs	- External Pressure (Trading Partners & Competitors) - Industry Type	Big Data Analytics

As can be seen in tables 1 and 2, mainly quantitative studies have been performed to examine significant factors influencing the adoption of (big) data analytics. For example, (1) Chen, Preston and Swink (2015) conducted a quantitative study on the adoption of big data analytics resulting in supply chain value. The authors found that expected benefits and technological compatibility are direct factors influencing the adoption of big data analytics, and organisational readiness and competitive pressure are indirect factors influencing the adoption of big data analytics through top management support.

(2) Lautenbach, Johnston and Adeniran-Ogundipe (2017) studied the factors influencing business intelligence and analytics adoption in South African organisations. Their study examined six factors of which data-related infrastructure capabilities, top management support and external market influence were found to be positively contributing to the adoption of business intelligence and analytics by the organisation.

(3) Lai, Sun and Ren (2018) examined nine factors influencing the firm's adoption intention of Big Data Analytics in logistics and supply chain management. Firm size was used as a control variable. Their research showed that perceived benefits and top management support are the main key factors that showed a significant positive influence on the adoption intention of big data analytics. Competitive pressure and governmental policy and regulations and supply chain connectivity were considered environmental factors. The results of their study showed that all three environmental factors can positively moderate the direct relationship between top management support and intention to adopt big data analytics.

(4) Li, Dai, Gershberg, & Vasarhelyi (2018) examined factors that influence post-adoption usage of audit analytics at the organisational level and whether using audit analytics can improve the performance of the internal audit process. Post-adoption level usage was measured in adoption-level usage and feature-level usage. The authors found that management support, technological competence, and standards influence application-level usage. Professional help, technological competence, and application-level usage drive feature-level usage. Encouragement by top management and regulators were found to be the most critical factors that shape how internal auditors use audit analytics.

(5) Park & Kim (2019) examined the factors activating big data adoption in Korean firms. With the aid of an analytic hierarchy process and regression analysis, the authors concluded that the perceived benefits from big data, technological capabilities, financial investment competence, and data quality integration were the most critical determinants influencing the adoption of big data by Korean firms. Management support for big data, security and privacy, and government support and policy were also suggested as important factors influencing big data adoption but showed weaker significance in the regression analysis compared to the critical determinants.

(6) Another study by Sun, Hall and Cegielski (2019) explored the factors for adopting big data in a business-to-business context across different Chinese industries. The factors were tested using structural equation modelling and Fuzzy-set Qualitative Comparative Analysis (fsQCA). The results illustrate that the relative advantage, technological competence, technology resources, top management support, competitive pressure and regulatory environment all have a significant impact on big data adoption by the firm.

(7) Chaurasia & Verma (2020) combined the perceived strategic value model of big data application (BDA) and the TOE framework to understand the factors influencing the adoption of big data by firms operating in the Architecture, Engineering and Construction industries. The authors argue that big data adoption can be explained by the perceived strategic value of big data application by the firm. The results illustrate that factors significantly influencing the adoption of big data are big data quality, complexity, technology readiness, top management support, firm size, and competitive pressure.

(8) Maroufkhani, Wan Ismail, & Ghobakhloo (2020) examined the direct relationship between the TOE factors and big data analytics adoption among Iranian SME manufacturers. The direct relationship between big data analytics adoption and firm performance was also investigated. By applying partial least squares-structural equation modelling, the authors concluded that all the factors examined in their study (relative advantage, compatibility, complexity, risk and insecurity, trialability, observability, top management support, organisational readiness, competitive pressure, external support and government regulation) must be emphasised in the manufacturing sector of SMEs to successfully adopt big data analytics within the firm. Noteworthy is that this study included risk and insecurity, trialability, and observability for the technological context which is not frequently examined within other prior big data analytics adoption studies. Additionally, the study found that business value generated from big data adoption improves the firm performance of SME manufacturers in Iran.

Also, qualitative studies have been performed to assess the IT adoption by firms using the TOE framework. For example, (9) Sun, Cegielski, Jia, and Hall (2016) conducted an extensive literature review on the factors influencing the adoption of big data in an organisation by combining the Diffusion of Innovation theory, institutional theory and the TOE framework. In total, 26 factors were identified that influence organisational big data adoption.

(10) Verma & Bhattacharyya (2017) combined a Perceived Strategic Value adoption model and the TOE framework to qualitatively explore the factors influencing the adoption of big data analytics in Indian firms. Eight factors were examined of which complexity and perceived costs were found to be inhibitors of big data analytics. The remaining factors (i.e. compatibility, IT assets, top management support, organisational data environment, external pressure, and industry type) were considered facilitators of adopting big data analytics. Compared to other studies, this study found IT assets and organisational data environment to be facilitators of big data analytics adoption.

3. Methodology

This chapter will discuss the methodology used for this research. The first section of this report elaborates briefly on the research methods and the theoretical framework used in this research. The second section of this chapter elaborates thoroughly on the TOE framework which functions as the theoretical model of this research to explore the critical determinants affecting the adoption of DDD by SME online retailers. The third section explains the selection of the interviewees who participated in this research. The fourth part describes the data collection method used for this research. The fifth section of this chapter elaborates on the data analysis method that assisted in summarising the results of the research. And finally, the last section of this chapter elaborates on the validity and reliability of the summarised findings from this study.

3.1 Research Design

To accomplish the research objective, semi-structured interviews were conducted over a period of 1 month (Medio July 2021 – Medio August 2021). These interviewees were conducted with experts from consultancy companies that assist SME online retailers with DDD adoption. The literature showed that primarily large organisations are increasingly adopting DDD, while SMEs are still struggling to successfully implement DDD as these firms face multiple challenges and barriers (Coleman et al., 2016; Dittert et al., 2017; Maroufkhani et al., 2020). As a result, the current literature primarily contains studies about the determinants affecting the successful adoption of (big) data analytics in larger organisations.

However, one cannot conclude that the determinants for larger organisations also apply to smaller and medium organisations since SMEs are typically different in their characteristics (Ghobadian & Gallear, 1997). Examples of such characteristics are organisational structure, procedures, processes and people. The determinants for adopting DDD by SMEs could be explored if such studies were replicated for SMEs who did succeed in adopting DDD. Despite that, present literature is still rather limited in identifying the critical determinants influencing the adoption of DDD for SMEs. Research shows that European companies primarily apply DDD in data-intensive industries such as the retail sector (Bianchini & Michalkova, 2019). A substantial percentage of the total SMEs are active within the retail industry (EuroCommerce, 2017). The Dutch Central Bureau of Statistics (2022) illustrates that Dutch SME retailers are lagging behind compared to large retailers in terms of utilising big data analytics. Consequently, this gives larger retailers a significant competitive advantage in the retail market. SME retailers are a major social and economic contributor to the European economy (Coleman et al., 2016; EuroCommerce, 2017). This raises the urgency of addressing SME retailers' challenges and barriers by providing guidelines to adopt DDD.

Therefore, this study tried to fill this research gap. It was decided to emphasise DDD adoption by SME online retailers (click-and-mortar retailers & e-commerce retailers). As a result, this study provides insights into the determinants influencing the adoption of DDD which are relevant for a substantial portion of the total SMEs active in the Netherlands. It was believed that experts from the practical business field could provide such insights as they have assisted SMEs in adopting DDD successfully. Qualitative research allowed the researcher to explore a profound understanding of the factors influencing the adoption of DDD by SME online retailers.

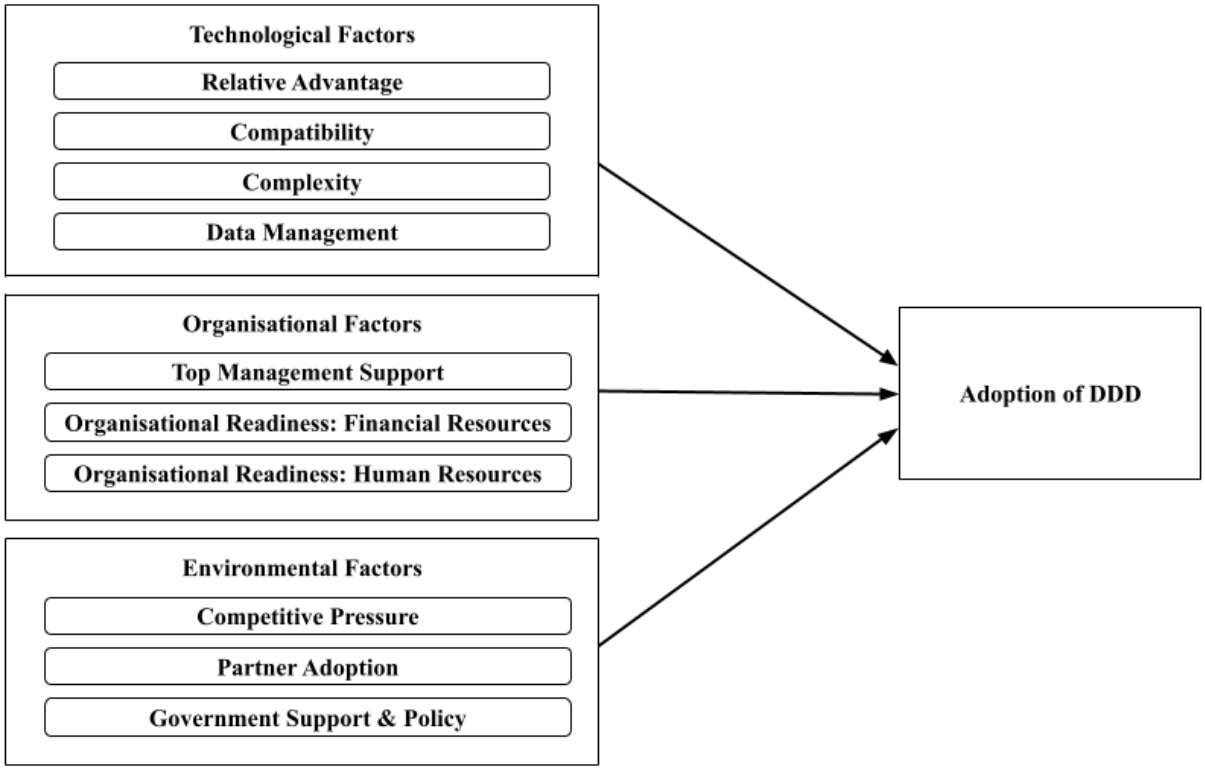
Moreover, a commonly used adoption model for IT adoption has been used to develop a theoretical framework for this research. The TOE framework created by Tornazky and Fleisher (1990) assisted in developing questions of the semi-structured interviews and in structuring the results of this research to describe in-depth details about the critical determinants for adopting DDD. In order to execute DDD, companies need to use a system or tool that allows data to be analysed. An example of such a tool is (big) data analytics. Therefore, a systematic literature review was conducted to provide insights into prior studies using the TOE framework

to explore and validate critical factors influencing the adoption of (big) data analytics. Based on these prior adoption studies, the most frequently mentioned factors were selected and placed in an initial theoretical framework for this research. This initial theoretical framework was used to design questions for the semi-structured interviews. After discussing the factors with the interviewees, the results were analysed and a final theoretical framework for the adoption of DDD by SMEs was developed. More importantly, an analysis was made to distinguish the critical determinants from all the factors that influence the adoption of DDD by SME online retailers.

3.2 The proposed theoretical framework for DDD adoption by SME online retailers

To achieve the objective of this study, a conceptual framework was built to explore the determinants influencing the adoption of DDD by SME online retailers. The TOE framework by Tornazky and Fleisher (1990) was chosen to construct this theoretical framework. Based on the literature review conducted, the researcher made the decision to select the most commonly used factors from prior studies on (big) data analytics adoption. These frequently mentioned factors were considered potential factors influencing DDD adoption by SME online retailers. In the technological dimension, the relative advantage, compatibility, complexity and data management were considered potential factors affecting the adoption of DDD. Within the organisational context, the potential factors influencing DDD adoption were top management support and organisational readiness in terms of financial resources and human resources. From the environmental perspective, competitive pressure, partner readiness and the regulatory environment were considered potential factors influencing the adoption of DDD. After evaluating the TOE framework's applicability and deriving potential key determinants from the literature, a research framework was created. Figure 1 illustrates the initial proposed theoretical framework of this study which was discussed with the experts during the interviews.

Figure 1 The initial theoretical framework for adopting DDD by SME online retailers



The construct Data-Driven Decision Making (DDD) refers to the definition defined by Provost and Fawcett (2013). Provost and Fawcett (2013) define DDD as "the practice of basing decisions on the analysis of data rather than purely on intuition" (p. 3). The IT tools used to execute DDD are data analytical applications.

Furthermore, several methods exist to categorise adoption levels. This study used an adopted version of the criteria from Verma & Bhattacharyya (2017) who developed categories for adoption levels in firms based on Rogers' (2003) adopter categories. The authors categorise companies into adopters (organisations that have already adopted the technology), prospectors (organisations that seek adoption of the technology in the forthcoming years) and non-adopters (organisations that do not have the intention to adopt the technology). One of the contributions of this study was to assist SME online retailers in starting with the adoption of DDD. Therefore, this means that the determinants considered in this research primarily apply to SME online retailers which can be categorised as non-adopters and prospectors of DDD.

Moreover, there are more methods to categorise companies into different enterprise levels in terms of size. For consistency purposes in terms of academic literature, this study aligns with previous study measurements to define the SMEs which are in accordance with the European parameters for defining organisational levels in terms of size (Dittert, 2017; O'Connor & Kelly, 2017, Vitale et al., 2020). Based on these parameters, this study considers an SME as an organisation that has less than 250 employees and an annual turnover that does not exceed 50 million euros.

Further, there are more ways to define retailers. According to Singh (2013), retail refers to "the set of activities that markets products or services to final consumers for their own personal or household use" (p. 472). As of today, these set of activities can be both online and offline. However, this research focuses only on SME online retailers that encompasses click-and-mortar retailers (retailers who have both physical and virtual e-commerce channels) and e-commerce retailers (retailers who only sell their products via e-commerce channels) (Steinfield, Bouwman, & Adelaar, 2002). This type of retailer has been selected because these retailers usually have more access to data resources (e.g. consumer data generated from the company's web shop) compared to SME retailers that only have a physical location where products are offered to consumers. It is assumed that these (Dutch) SME online retailers have a much better opportunity to adopt DDD because of data accessibility as well as a certain data volume that is required for a valuable data analysis.

3.2.1 Explanation of proposed TOE - factors influencing DDD adoption

Technology Context

Within the technological context, four factors have been included based on the literature review on prior TOE-based studies concerning the adoption of (big) data analytics. These are the Relative Advantage, Compatibility, Complexity and Data Management. Three of these factors are frequently used within IT adoption research and are derived from the Diffusion of Innovation (DOI) Theory by Rogers (1983). The DOI theory classifies five critical factors that influence the adoption of theory an IT innovation. These are the relative advantage, compatibility, complexity, trialability and observability. Among these five factors, research indicates that the relative advantage, compatibility and complexity are the most consistent with showing significant relationships to innovation adoption (Tornazky & Klein, 1982). Based on this research suggestion, this study solely included these three factors from the DOI theory for the adoption of DDD by SME online retailers.

Relative Advantage: The relative advantage is a frequently mentioned factor within IT adoption studies that shows a strong significant positive relation with the adoption of the IT innovation (Tornazky & Klein, 1982). Rogers (1983) defines the relative advantage as "the

degree to which an innovation is perceived as being better than the idea it supersedes". Maroufkhani et al. (2020) state that the primary decision-makers within the company evaluate the consequences or advantages of adopting the technology to make sure that this technology has a relative advantage over the current system used within the company. Within the literature, the relative advantage is generally evaluated by the degree of the perceived benefits that the IT adoption can provide to the organisation. Therefore, the relative advantage and perceived benefits/expected benefits are used interchangeably in Big Data analytics adoption studies employing the TOE model (Chen, Preston, & Swink, 2015; Lai, Sun, & Ren, 2018; Park & Kim, 2019; Tornazky & Klein, 1982). Maroufkhani et al. (2020) and Sun et al. (2019) found that the relative advantage is a significant factor promoting the adoption of big data utilisation. Other studies formulate this factor as expected or perceived benefits from data analytics (Chen, Preston, & Swink, 2015; Lai, Sun, & Ren, 2018; Park & Kim, 2019). According to Park & Kim (2019), it is the main determinant of adoption as there would be no reason to implement and utilise the technology without evaluating its benefits. Hence, the more significant benefits the organisation expects from DDD to gain a relative advantage compared to the current system used in the organisation, the more likely the SME online retailer will adopt DDD in their organisation.

Compatibility: Compatibility has been frequently suggested as an important factor within prior TOE-based studies concerning the adoption of big data analytics (Chaurasia & Verma, 2020; Chen et al., 2015; Lai et al.,2018; Maroufkhani et al., 2020; Park & Kim, 2019; Sun et al., 2016; Verma & Bhattacharyya, 2017). Many of these prior studies refer to Rogers' (1983) definition who defines compatibility as "the degree to which the innovation is perceived as consistent with the existing values, past experiences, and needs of the potential adopter" (p.223). Some authors elaborate on this by stating that the compatibility of adopting the technology potentially reflects the congruity with the culture and at the same time the business practices of the company (Chen et al., 2015; Maroufkhani et al., 2020). Park and Kim (2019) describe compatibility as the degree to which big data is compatible with existing information systems within the company. Tornatzky and Klein (1983) identified that compatibly within prior IT adoption studies have been operationalised as two types of compatibility which are operational (compatibility with what people do) or cognitive (compatibility with what people feel or think about a technology). The authors add that these forms of compatibility are sometimes difficult to distinguish within the literature but theoretically are both forms positively related to IT adoption. In this research compatibility of DDD refers to its congruence with the business practices of the SME online retailer. In order to take full advantage of the technology, DDD needs to be compatible with the current IT systems to maximise the potential usage of DDD. Therefore, this would suggest that the higher the degree of compatibility with current IT systems, the more likely the adoption of DDD by SME online retailers.

Complexity: In terms of the technological context, complexity is a frequently mentioned critical factor within the literature that influences IT adoption (Chaurasia & Verma, 2020; Lai et al.,2018; Park & Kim, 2019; Sun et al., 2016; Verma & Bhattacharyya, 2017). It refers to the degree of which the IT innovation is perceived as challenging to understand and use (Maroufkhani et al., 2020; Verma & Bhattacharyya, 2017). It is believed that the greater the complexity of a particular IT innovation, the less likely the IT innovation will be implemented by the organisation (Maroufkhani et al., 2020). Park and Kim (2019) refer to this factor as the simplicity of the system usage. Because in contrary to complexity, the greater the simplicity of the system usage, the more likely that the company will successfully adopt the innovation. To conclude, this would suggest that a greater degree of complexity has a negative effect on the adoption of DDD by SME online retailers. On the other hand, the greater the simplicity of the system usage, the more likely the adoption of DDD by SME online retailers.

Data Management: Research indicates that data quality is a significant factor contributing to the adoption of an IT innovation. These studies highlight the importance that data should be reliable, complete, timely, consistent and accurate (Chaurasia & Verma, 2020; Lautenbach et al., 2017; Park & Kim, 2019). Lautenbach et al. (2017) state that without careful data management, there is a potential increase of errors. This means that decisions based on the data may become limited and unreliable if the organisation is not well-executing data management. Hence, this would imply that the better the data management by SME online retailers, the higher the likelihood of adopting DDD.

Organisational Context

Top management support: Top management support refers to the degree top managers are willing to understand, encourage and implement the IT innovation within their organisation. In most of the reviewed studies, top management support is considered a key determinant in driving the implementation of the IT innovation (Chen et al., 2015; Lautenbach et al., 2017; Lai et al., 2018; Li et al., 2018; Maroufkhani et al., 2020; Park & Kim, 2019). Maroufkhani et al. (2020) state that top management can play a facilitating role in arranging the process of change in terms of organisational norms, values and company culture. Ultimately, this should help enable the entire organisation as a whole to accept and adopt the IT innovation. Therefore, this would suggest that the more support from top management for DDD, the higher the likelihood of successfully implementing DDD by SME online retailers.

Organisational Readiness*:* Organisational readiness refers to the extent to which the company has adequate organisational resources available to implement and use a technology. Chen et al. (2015) and Maroufkhani et al. (2020) show that organisational readiness is a significant factor in the adoption of big data analytics. Moreover, some studies narrow down to specific organisational resources in their TOE model which include elements of human resources and financial capabilities (Lai et al., 2018; Lautenbach et al., 2017; Park & Kim, 2019; Sun et al., 2016). Thus, this would suggest that the more adequate organisational resources the SME has, the more likely the SME would adopt DDD.

Environmental context

Competitive Pressure*:* Competitive pressure refers to the degree to which the competition also adopts a particular IT innovation (Chen et al., 2015; Park & Kim, 2019). As more and more competitors are adopting the IT innovation, the organisation may feel pressured and acknowledge the urgency to adopt the IT innovation to remain relevant and competitive within its industry (Lautenbach et al., 2017; Sun et al., 2019; Verma et al., 2017). Therefore, competitive pressure would promote the likelihood of SMEs adopting DDD.

Partner Adoption: Some studies illustrate that partner adoption is an important factor contributing to the adoption of (big) data analytics by the organisation. Partner adoption refers to "the potential power and the chosen influence strategies of a business partner to seek IT adoption" (Verma & Bhattacharyya, 2017, p.8). Researchers argue that organisations might feel pressure from their partners to adopt a technology if their respective partners request or recommend implementing the IT innovation (Park & Kim, 2019; Sun et al., 2016; Sun et al., 2019; Verma & Bhattacharyya, 2017). Therefore, it is believed that the higher the level of partner adoption regarding DDD, the more likely the SME will also adopt DDD.

Government Support & Policy*:* Government support and policy refer to the degree to which organisations are influenced by the government's plan for support and regulatory policy to use the considered IT innovation (Sun et al., 2019). The literature indicates that government support is an important significant factor that can play a contributing role in the adoption of (big) data analytics (Lautenbach et al., 2017; Maroufkhani et al., 2020; Park & Kim, 2019; Sun et al., 2016). For example, Park & Kim (2019) argue that support from governmental

institutions regarding open public data and regulatory policy may stimulate the adoption of Big Data. On the other hand, Maroufkhani et al. (2020) note that government regulations can either stimulate or restrict organisations from using a certain IT innovation (i.e. beneficial firm development policies versus complex preconditions that must be met by the company to utilise the technology). Hence, favourable governmental support and policies would positively contribute to the adoption of DDD by the SME.

3.3 Selection of participants

A total of six interviewees participated in this research. Each interview was conducted individually. To explore the critical determinants, the author believed that this information could be adequately retrieved from experts who have dealt with the implementation of DDD by SME online retailers. It was assumed that these experts have the experience and knowledge to identify and explain the critical factors as these professionals have already assisted several SMEs with the implementation of DDD. A revised version of the expert criteria set by Park & Kim (2019) was used to select the interview participants. These criteria included that the expert has at least five years of experience in research or work practices in interdisciplinary fields of IT technology enabling DDD for SMEs. These experts could come from (IT) consultancy companies that assist SME online retailers with making data-driven decisions. The final criteria included that the expert has at least a bachelor's degree from a University of Applied Sciences in a business or technology-related program.

In terms of sampling, the data has been collected through non-probabilistic sampling as qualitative research studies are about discovering and explaining the perception of someone rather than illustrating statistical generalisation (Anderson, 2010) The researcher used desk research to get in contact with companies assisting SME online retailers with implementing DDD. The potential participants were invited by email or phone and the researcher verified whether the potential participant met the expert criteria. An overview of the participants can be found in table 3, which illustrates the number of the participant, the expert's position within the organisation and the type of business.

Table 3 Overview of interviewees

Interviewee's number	Position in the company	Type of business
1	Head of Data & Analytics	Full service digital agency
2	Co-founder and digital marketing consultant	Consultancy company in online marketing
3	Managing consultant	Consultancy company in conversion rate optimisation (CRO)
4	Data analyst / Consultant	Full service digital agency
5	Digital strategist	Full service digital agency
6	CEO and Founder	Consultancy in developing dashboards

3.4 Data collection

Six semi-structed interviews were used to collect the primary data of this research. Each interview lasted between thirty and sixty minutes. Questions about the factors influencing the adoption of DDD had to be incorporated to construct the main part of the interviews. As mentioned, the TOE framework functioned as the theoretical framework of this research to explore the critical determinants influencing the adoption of DDD by SME online retailers. The

TOE framework has therefore been used to create the questions for the semi-structured interviews. These questions were based on the factors positioned in the proposed theoretical model illustrated in figure 1. The researcher chose to use open-ended questions as this facilitates an open discussion regarding the factors influencing the DDD adoption. The entire list of questions can be found in appendix 2.

All the semi-structured interviews were conducted online with the aid of Microsoft Teams. Face-to-face interviews were not preferred due to the covid-19 situation. Nevertheless, the video calls allowed the researcher to perceive both the verbal and non-verbal cues from the interviewees. Budget and time for travelling to the destinations of the interviewees were also components for consideration which made the researcher decide to conduct the interviews online (Opdenakker, 2006). Microsoft Teams allowed the interviews to be recorded which could then be transferred into transcripts. Permission was given by all the interviewees to record the interviews.

Before the interview started, the researcher introduced himself and explained briefly the purpose of the research. The researcher explained that all the answers given by the interviewees will remain anonymous and quitting the participation of the interview was possible at any time. This should have ensured that the interviewees could speak freely to share their perspectives and experiences during the interviews. In advance of the interview being recorded, the participants had to consent with the terms and conditions which were created for this research. All the interviewees agreed with the terms and conditions of this research. These terms and conditions can be found in appendix 2.

In the first part of the interview, the researcher asked questions that addressed the background information of the participant. Each participant was asked about their current position in the company and how their working activities are related to DDD practices. Furthermore, questions were asked about the interviewee's prior experience assisting retail companies with implementing DDD. The purpose of these questions was to manage a good overview of the interviewees' background and to double verify whether or not the interviewee was appropriate for participation in this research. All of the invited participants were evaluated as suitable by the researcher during the interview.

After the introduction of the interviewee's background, the second part of the interview started. The interview proceeded with in-depth questions regarding the theoretical concepts used in this research. The primary theoretical concept included a conversation about the definition of DDD. Each interviewee was asked to provide a definition of DDD. After that, the researcher showed the definition of DDD used in this research. A discussion followed about potential similarities and differences between the definition of DDD by the participant and the definition of DDD used in this research. The purpose of this discussion was to create a mutual understanding of what DDD means in this research context.

When the mutual understanding of DDD was accomplished, the third part of the interview started. This part encompassed an explanation of the TOE framework by the researcher to explore the determinants of DDD adoption by SME online retailers (Tornatzky & Fleischer, 1990). The original TOE framework created by Tornatzky and Fleischer (1990) was shown to the participant and the researcher explained the adoption model. Each dimension of the TOE framework was explained and exemplary factors were shown that could influence the adoption of an IT innovation. The researcher provided an opportunity to ask questions about the TOE framework if some aspects of the model were not clearly understood by the interviewee. When the interviewee clearly understood the framework, the researcher explained that this model would be used to identify the determinants that influence the adoption of DDD by SME online retailers.

After the explanation of the model, the fourth part of the interview started. This part included the discovery of the determinants that influence the adoption of DDD in (Dutch) SME

online retailers. In this part of the interview, the researcher and interviewee mainly discussed the factors from the proposed theoretical model (figure 1). However, to avoid the bias of only structuring the interview regarding the factors fitting in the TOE framework, an opportunity was provided in which the interviewee could elaborate on the vital determinants that influence the adoption of DDD by SME online retailers. The researcher made clear that these factors did not have to fit in the dimensions of the TOE framework (Technology; Organisation and Environment).

After this conversation, the researcher moved over to discussing the factors from the theoretical framework using a fixed procedure of questions for each dimension. The discussion started with the technological dimension. The researcher showed the interviewee the technological factors while not displaying the other factors from the other respective dimensions. The interviewee was asked to select the technological factors which can be considered vital determinants for the adoption of DDD by SME online retailers and to elaborate on this selection. Furthermore, the interviewee was asked if there were any missing determinants in the technological dimension displayed that influence the adoption of DDD by SME online retailers. In case the interviewee suggested that there were certain factors missing in the model, an elaboration was requested by the researcher. Moreover, the researcher also asked how SME online retailers could evaluate the selected determinants by the interviewee for their organisation to generate practical implications for this research. After discussing these latter questions about the technological dimension, the interview proceeded with the organisational and environmental context which followed the same structure of questions as the technological dimension.

3.5 Data analysis

A qualitative content analysis has been used as a research method to describe the results of this research. Because there is a wide variety of approaches to conduct a content analysis, a research paper by Hsieh and Shannon (2005) assisted in selecting an adequate research approach to conduct a qualitative content analysis. The authors classify 3 research approaches which are commonly used within qualitive research. These content analysis approaches are conventional content analysis, directed content analysis and summative content analysis. The conventional approach is a content research method which applies to research where existing theory or research literature on the phenomena is rather limited. Directed content analysis is an appropriate qualitative research method when existing theory or prior research about a phenomenon is already present but still incomplete or would benefit from further development. Summative content analysis puts the emphasis on discovering underlying means of words or content using a word frequency counter. Since the objective of this study was to use the TOE framework by Tornatzky and Fleisher (1990) to explore and understand the determinants influencing the adoption DDD in Dutch SME retailers, direct content analysis was evaluated as an adequate data analysis approach. The directed content analysis also matches the list of interview questions of this research. Hsieh and Shannon (2015) mention that directed content analysis can be used in the event of data being collected primarily through interviews using open-ended questions followed by targeted questions about the predetermined categories.

As mentioned before, the interviews were recorded which allowed the researcher to make transcriptions of all the interviews. The transcriptions were made with Amberscript which allowed the audio data to be extracted where after it was transferred into text files. Incorrect audio transcriptions were adjusted if necessary. Each interviewee received the transcription of their interview via email after the completion of the entire transcription process. Every interviewee confirmed their interview transcription as correct. The coding process was initially performed through manual coding. However, the coding process was redone with the

ATLAS.TI application which allowed a better overview of the codes and the substantial amount of transcription pages from the interviews.

Moreover, based on the directed content analysis, each transcript was first being read by the researcher to derive codes and get immersed with the data at the same time. Then an initial coding scheme was developed to start the first coding process. This initial coding scheme was based on the factors from the initial theoretical framework for the adoption of DDD by SME online retailers. As the content analysis continued, new codes were developed and the initial coding scheme was revised. Data that could not be coded were analysed later to determine if they represented a new category or a subcategory which belonged to an existing code. The coding process was initially performed by the researcher individually. After that, a second reviewer was invited to code the transcript individually. These two coding schemes were then cross compared and one final coding scheme was developed accordingly. The final codebook can be found in appendix 3.

Ultimately, the theory and prior research on factors influencing the adoption of IT innovations using the TOE framework was used as a guide to describe the results of this research. The newly identified factors were also being analysed and discussed. By doing so, the researcher further refined and enriched the theoretical framework using the TOE model for identifying critical determinants influencing the adoption of DDD by SME online retailers.

3.6 Validity and Reliability

This study also needed to consider the validity and reliability to ensure the credibility of the research outcomes. According to Noble and Smith (2015), this is an essential part of qualitative research because the findings may be utilised in practice and future research. The validity of this research encompasses the degree of precision in which the findings are in line with the collected data from the interview. Reliability refers to the consistency of the researcher performing the analytical method to analyse the data. Although reliability and validity are frequently used in the literature, Noble and Smith (2015) created alternative terminologies that are more appropriate for qualitative research approaches. These criteria encompass the truth value, consistency and applicability. In the following paragraphs, each criterion will be discussed and the research strategy used to ensure the credibility of this study will be explained. Some research strategies have been chosen to enhance the credibility of the qualitative research outcomes.

The truth value resembles an alternative for validity (Noble and Smith, 2015). The following strategies were implemented to enhance the truth value of this study. The first measurement was that each participant followed the same interview protocol. Also, the researcher verified whether or not the interviewee understood the adoption framework before continuing with the questions to explore the key determinants influencing the adoption of DDD by SME online retailers. The second measurement was that the interviews were video recorded, which allowed the researcher to re-visit the data multiple times to avoid misunderstanding. The third measurement addressed respondent validation. Each interviewee had the opportunity to comment on the interview transcripts to ensure that transcripts reflect the actual interview. The fourth measurement included that a second reviewer was invited to code the transcripts in order to reduce the probability of researcher bias.

Consistency represents an alternative for reliability (Noble and Smith, 2015). The consistency of this research was enhanced by a clear and argued documentation of the methodology used for this research. This compromises the systematic literature review, interview protocol, data collection method and data analysis.

The applicability is the alternative terminology for the generalisability of the findings of this research (Noble and Smith, 2015). To ensure this applicability, a detailed description has been provided to what extent the results of this research can also be applicable to other

research contexts. In the methodological section, an explanation has been provided about what type of companies are used and to which industry these findings are representative.

Finally, the TOE framework has been criticised within the literature for a potential bias of only accounting for those factors that fit in the technological, organisational and environmental context. To minimise this bias, an opportunity was given to the interviewees to discuss factors of which they believed that these factors could be considered critical determinants to succeed in DDD adoption. This opportunity was placed before the researcher introduced the factors from the TOE framework (figure 1) that potentially influence the adoption of DDD.

4. Results

This chapter discusses the findings from the interviews conducted with the experts. The first part of the result chapter encompasses the interviewees' perspectives on the definition of DDD. The second part includes the interviewees' perspectives on the factors that influence the adoption of DDD. This second part also reveals the final theoretical framework (a refined version of the initial theoretical framework based on literature studies only) that explains the factors influencing the adoption of DDD by SME online retailers. More importantly, it discusses whether or not the factors could be considered critical determinants for adopting DDD by SME online retailers.

4.1 Understanding Data-Driven Decision Making (DDD)

In each interview, the definition of Data-Driven Decision Making was discussed to ensure that the researcher and the interviewee had a similar perception of the definition of DDD. Each interviewee was asked to provide their definition of DDD and elaborate on what it means to them. The results of the definitions given by the interviewees are illustrated in table 4.

Table 4 Understanding Data-Driven Decision Making

Interviewee's number	Defines Data-Driven Decision Making as
1	*"That you make a decision, not based on a feeling or gut feeling but just purely based on the numbers, the information that you have. Yes, very rational actually. Rational decision-making based on information you have"* (Interviewee 1).
2	*"You make decisions based on facts. And those facts, they are often more easily expressed in the form of numbers, figures"* (Interviewee 2).
3	*"It is basically all the decisions you make, day-to-day, and there are a lot of them. And that you strive to make as many of those decisions as possible based on data. You do not just have to consider the data only for the decisions you make, but you should at least make sure that there is a data component in every decision you make. I think that might be a slightly more nuanced definition"* (Interviewee 3).
4	*"Collecting data and processing that data into information so that you gain insights that provide your company guidance to make the right decisions"* (Interviewee 4).
5	*"Making decisions for the survival and daily ins and outs of a company, in which data is a very strong advisor. I think data is a kind of objective advisor. I personally prefer to talk about data-informed decisions, because in many cases you cannot necessarily say only data-driven. What data cannot yet do is add context and circumstances. The whole picture still needs to be done by humans"* (Interviewee 5).

Table 4 (Continued)

Interviewee's number	Defines Data-Driven Decision Making as
6	*"We describe data-driven working as: you have an organisation, that organisation that collects data, and the moment you give meaning to that data, it becomes information. A person can then view this information and convert it into insights. And based on these insights you can take actions. And when I look at Data-driven Decision Making, I see it as the decisions you make with the insights you gained from the information"* (Interviewee 6).

As illustrated in table 4, there is a notable difference in the interviewees' definitions in which intuition still plays a role in decision-making. On the one hand, there is a group of interviewees (Interviewees 3 - 6) who elaborate on their DDD definition in which intuitions are still a component of support for decision-making. For example, interviewee 5 argued: "*I think data is a kind of objective advisor. I personally prefer to talk about data-informed decisions, because in many cases, you cannot necessarily say only data-driven. What data cannot yet do is add context and circumstances. The whole picture still needs to be done by humans"* (Interviewee 5). Based on this definition, interviewee 5 argues that intuition is still important in decision-making as data cannot yet wholly evaluate the context and circumstances in many cases. A final review by humans is still needed to make the decision.

On the other hand, there is a group of interviewees (Interviewees 1 and 2) who explicitly exclude the influence of intuition in DDD. For instance, interviewee 1 defined DDD as: *"That you make a decision, not based on a feeling or gut feeling but just purely based on the numbers, the information that you have. Yes, very rational actually. Rational decision making based on information you have"* (Interviewee 1). Based on this quote, interviewee 1 defines DDD as a way of decision-making which is completely rational and does not include one's (gut) feelings.

After the interviewees provided their definition of DDD, the definition of DDD by Provost and Fawcett (2013) used in this research was discussed to ensure a mutual understanding of DDD. In all interview cases, a mutual understanding and agreement were made about the role of intuition in DDD. This mutual definition included that intuition is still being used in DDD on the condition that the decisions are primarily based on the analysis of data.

4.2 Explored factors in Technological, Organisational and Environmental context

With the aid of the TOE framework the critical determinants influencing the adoption of DDD by SME online retailers were explored. In the up-following sections of this chapter, a rich description of the findings has been documented as a result of the interviews conducted. The sections are categorised as technological context, organisational context and environmental context. Figure 2 shows a quick overview of the final theoretical framework for DDD adoption by SME online retailers. This framework contains all the discussed factors which influence the adoption of DDD by SME online retailers according to the interviews conducted. The factors that are added to the initial theoretical framework are process management, data-driven culture and non-governmental policies.

Furthermore, during the content analysis, the primary objective was to identify the critical determinants influencing the adoption of DDD by SME online retailers. Table 5 shows which of these factors were suggested as critical determinants influencing the adoption of DDD by SME online retailers. As illustrated in table 5, not all factors discussed with the interviewees were considered critical determinants influencing the adoption of DDD. Therefore, factors have

been distinguished and labelled as critical determinants, inhibitors, and drivers that influence the adoption of DDD by SME online retailers. In this research, a critical determinant refers to a factor of which the interviewees suggested that the respective factor has a highly critical influence on the successful adoption of DDD by the SME online retailer. A driver refers to a factor of which the interviewees believed that it motivates the SME online retailer to adopt DDD. Finally, an inhibitor refers to a factor of which the interviewees believed that it hampers the SME online retailer in adopting DDD.

Figure 2 Final theoretical framework for adopting DDD by SME online retailers

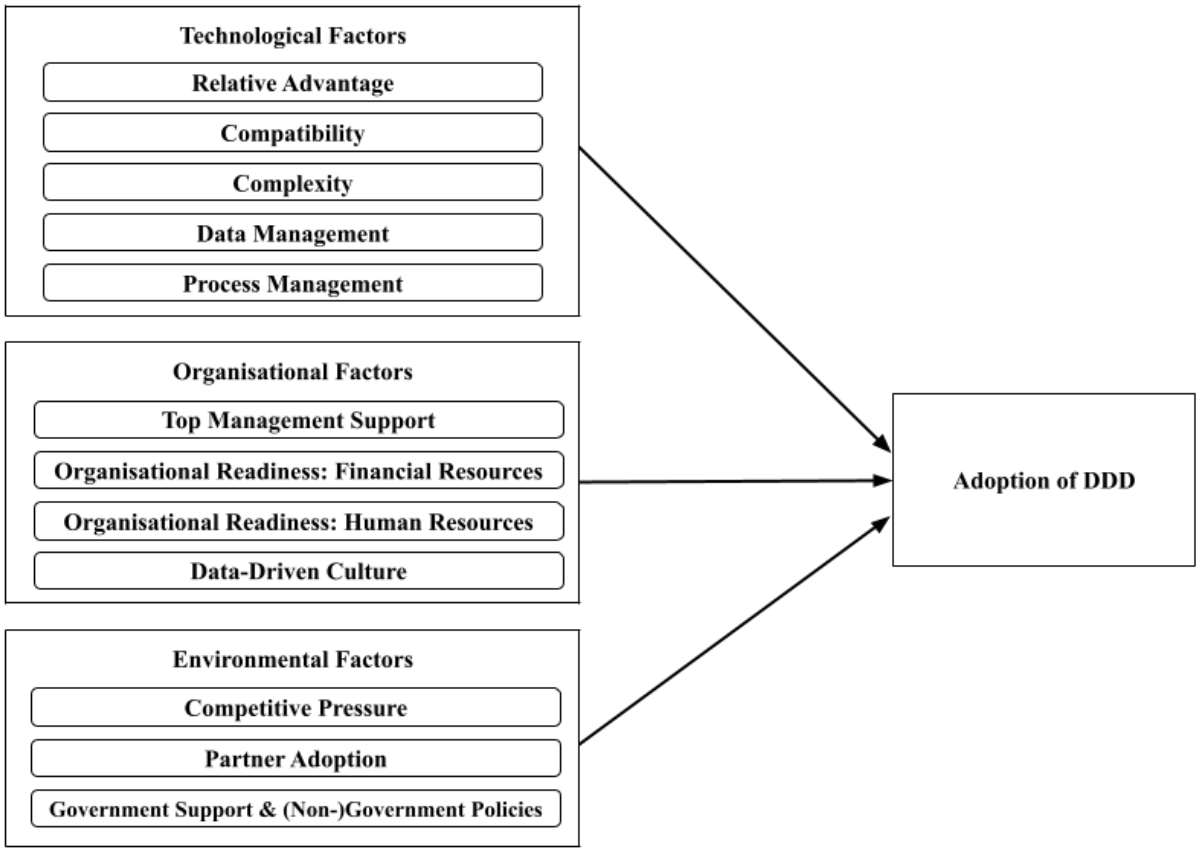


Table 5 Critical factors influencing the adoption of DDD by SME online retailers

Factors identified from study	Evidence provided by Interviewee	Factor described as
Relative Advantage	Interviewees: 1 - 6	Critical determinant
Compatibility	Interviewees: 1 - 6	Critical determinant
Complexity	Interviewees: 1 - 6	Critical determinant
Data Management	Interviewees: 1 - 6	Critical determinant
Process Management	Interviewee: 2	Critical determinant
Top Management Support	Interviewees: 1 - 6	Critical determinant
Organisational Readiness: Financial Resources	Interviewees: 1 - 6	Driver
Organisational Readiness: Human Resources	Interviewees: 1 - 6	Critical determinant
Data-Driven Culture	Interviewees: 3, 5 & 6	Critical determinant
Competitive Pressure	Interviewees: 1 - 6	Driver
Partner Adoption	Interviewees: 1 - 6	Driver
(Non)-Government Support & Policy	Interviewees: 1 - 5	Driver & Inhibitor

4.2.1 Technological context

This section will describe the technological factors influencing the adoption of DDD by SME online retailers. In the technological context, it was suggested that the Relative Advantage, Compatibility, Complexity, Data Management, Process Management can all be considered critical determinants influencing the adoption of DDD by SME online retailers. Process Management was added as a factor by one of the interviewees.

Relative Advantage

In this study, the relative advantage refers to the degree to which DDD is superior compared to the current way of decision making within the SME online retailer. Based on the interviews, it became clear that it was suggested that the relative advantage is one of the most critical determinants for the adoption of DDD by SME online retailers (Interviewees 1 - 6). A frequently mentioned statement among the interviewees was that the relative advantage is the main reason why the company wants to adopt DDD.

For example, when asking about what factors could be considered the most critical regarding the technological context, interviewee 1 mentioned the following: *"Then I would say the relative advantage. Why? Because the rest often follows. If a company understands very well why they have to work with data, and knows what is the real advantage of this, then a way will be found to make it a success. If that reason is not completely clear and they are not going to be a hundred per cent supportive of that. Like: Yes, we have heard it before, but we do not truly understand the value. Then you will not find a way to deal with those other steps because there are simply too many options"* (Interviewee 1). As can be interpreted from these quotes, Interviewee 1 believes the relative advantage can be considered the most determining factor because this is the primary reason a company seeks to adopt DDD. Another example of an interviewee who shared a similar argument stated: *"If you do not see the advantage of using it, you will not even consider implementing it because you are way too busy for this as an SME"* (Interviewee 6). As can be seen, it is crucial to understand the relative advantage of using DDD before the adoption takes place.

Moreover, one interviewee (Interviewee 5) shared that DDD may not benefit every SME online retailer. When discussing the critical determinants influencing the adoption of DDD by SME online retailers, the following was mentioned by interviewee 5: "*Also, context. So, does it make sense? Because it does not make sense for everyone in my opinion"* (Interviewee 5). This implies that it should be logical for the company to adopt DDD. The interviewee elaborates on this by giving an example: *"If you sell something very exclusive, such as art, you are an artist or you have an art dealership, that is very subjective. And then you might only sell something for like 100.000 or 30.000 euros twice a month. In such case you should ask yourself: To what extent is all this useful? But if you are just a shop who sells trinkets or souvenirs, that kinds of stuff, then you can analyse what sells well and during what time of the year. So, in such case, it is useful"* (Interviewee 5). The example given by interviewee 5 seems to imply that it should be logical for the SME online retailer to execute DDD. SME online retailers selling products which are not frequently sold and the reason for buying is hard to identify may benefit less from DDD than SME online retailers with high volume in total sales and the customers' reason for buying is easy to identify.

In summary, the relative advantage is considered a critical determinant among all the interviewees. The relative advantage was argued as the primary reason for SME online retailers to adopt DDD in the first place. The benefits that the company can gain from adopting should be considered in order to evaluate whether or not it makes sense to implement DDD.

Compatibility

In this research, compatibility refers to the degree to which the IT innovation is compatible with the current IT systems within the company. From the perspective of DDD adoption by SME online retailers, compatibility encompasses the level of compatibility between current IT systems (e.g. e-commerce platform) and IT applications to conduct a data analysis. The interviewees on the whole demonstrated that compatibility can be considered a critical determining factor influencing the adoption of DDD by SME online retailers. All respondents (Interviewees 1 - 6) concluded that there is a need for compatibility between current IT systems to ensure that data can be extracted and data analysis can be performed.

For example, interviewee 5 stated the following about the role of compatibility when discussing the technological factors concerning the adoption of DDD by SME online retailers: *"Compatibility also plays a role in this, of course. If you use a very obscure technology, or you use a very obscure database, or you use very little, or you use a turn-key platform to run a web shop, for example. And the data that comes out of it is in no way able to be exported or linked to a tool you want to do analysis with. Yes, of course that complicates this quite a bit"* (Interviewee 5). The quotes by interviewee 5 show that there is a need for compatibility between systems to analyse the data. In the online retail context, the interviewee elaborated that an e-commerce platform of the SME retailer that collects data should allow the exportation of data to the application for data analysis. Obviously, if the e-commerce platform cannot allow data to be exchanged with the desired application for analytics, the SME cannot make data-driven decisions. The interviewee also added: *"Access to data and the quality of data. I consider quality of data under data management. I think these two are the most important, because without that, I'm just thinking very practically, nothing will happen"* (Interviewee 5). Based on these quotes, the expert believes that the factors compatibility together with data quality are the most important factors concerning the technological context.

To conclude, the results suggest that compatibility can be considered a critical determinant for the adoption of DDD by SME online retailers. The current systems of SME online retailers should be compatible with the desired application to perform data analysis. Therefore, SMEs should carefully check whether their current systems are compatible with the desired application for data analytics.

Complexity

In this research, the complexity refers to the degree of which DDD is perceived as challenging to understand and use the system that enables DDD by the SME online retailer. When asked about the role of complexity, the interviewees were unanimous in the view that complexity can be considered a critical determinant influencing the adoption of DDD. It was suggested that the complexity of a system to execute DDD becomes even more relevant for smaller online retail enterprises adopting DDD.

The interviewees on the whole argued that a simple technological system to perform the data analysis would contribute to a higher degree of the organisation's DDD adoption (Interviewees 1 - 6). One participant commented the following when discussing the role of complexity in the adoption of DDD: *"In particular for smaller companies, we would advise just keeping it simple. In that regard, we prefer to work agile"* (Interviewee 1). Based on the quotes from interviewee 1, this emphasises that smaller SME online retailers should implement a relatively simple adoption of DDD into their business practices at their starting point of adoption. Another perspective on the influence complexity compromised: *(...) "Because when it is difficult, a pain point is actually added, instead of a pain point being removed. So, you will not be using it anymore. (...) technology should not get in your way, otherwise, you will do something else. That is the way how people are. It must be made easy for us"* (Interviewee 6).

As can be seen from these quotes, interviewee 6 suggests that employees will not be using DDD if the implementation becomes too complicated.

Another interviewee alluded to the notion of just maintaining a simplistic system for DDD. Interviewee 2 stated that one of the important success factors for the adoption of DDD is to start and remain the adoption simple. As the interviewee put it: *"Well, perhaps the most important success factor for companies is that they keep it simple. Because you can make it very complex and very extensive, but that usually does not make it any better"* (Interviewee 2). The quotes from interviewee 2 suggest that in many cases adding more complexity to the DDD practices of the company will not result in better decisions or significantly added value.

Furthermore, two interviewees (Interviewees 3 and 4) shared a slightly different perspective on complexity. For instance, interviewee 3 shared the following when asked about the influence of complexity on DDD adoption: "*Yes, that could be a thing. That could be some kind of barrier. If you are not used to working with data and you have always been used to working based on your intuition and you suddenly have to make that switch, then you may have to get used to it. But I think for the classic marketers in many organisations, they will be able to embrace tools like analytics fairly easily and really like it. They see much more in that case than they did before. (…) Yes, so I think that can differ per SME"* (Interviewee 3). These quotes suggest that the complexity also depends on the employees' data-related knowledge and skills to get used to the analytical tools. This view was also shared by interviewee 4 who mentioned that complexity highly depends on the employees' knowledge and skills to enable DDD. However, interviewee 4 illustrated that nowadays companies are trying to implement data analytical tools that are user-friendly in order to make it more accessible to people. As interviewee 4 put it: "*You see quite a lot of companies are now working with Power BI, Tableau, or Qlik Sense, for example. They do this to visualise data in such a way that almost everyone can do something with it. And that makes Data-Driven Decision Making much more accessible than when you say: you have to link all kinds of things in Excel with formulas. Because then there would be a substantial group of employees who may drop out because they think: this is not for me, I cannot do this"* (Interviewee 4). Thus, based on these quotes, interviewee 4 suggested that the user-friendliness of applications for data analytics should lead to a higher degree of DDD adoption throughout the company.

Hence, all interviewees considered complexity as a critical determinant influencing the adoption of DDD. It was suggested that the lower the degree of complexity concerning the system that enables DDD, the more likely a successful adoption of DDD will be achieved by the SME online retailer. Therefore, the majority of the participants argued that SME online retailers should opt for a simple technological system that can enable DDD within the company. Although everyone agreed with the advice of implementing a simplistic technological system for DDD adoption, a minority of the interviewees indicated that the complexity also depends on the data-related knowledge and skills of the employees who need to work with the data analytical tools. Nevertheless, it was suggested that a simplistic and user-friendly system for all employees can increase the overall adoption degree of DDD by the SME online retailer.

Data Management

In all cases, data management was recognised by all interviewees (Interviewee: 1 - 6) as a critical determinant influencing the adoption of DDD. For example, the degree of influence regarding data management for the adoption of DDD became apparent when discussing the influence of data management on DDD adoption with interviewee 5: *"Yes, data management is something I recognise a lot from practical experience. If data is poorly measured or saved poorly or saved in such a way that you cannot access it properly, or that it cannot be linked to anything, yes, then it becomes very difficult. (…) Yes, that is very important. It is a bit like the*

water supply" (Interviewee 5). Interviewee 5 uses the metaphor 'the water supply' which indicates the necessity of data management enabling proper DDD.

Moreover, a few essential components of data management were addressed by the interviewees that SMEs should consider when adopting DDD. The themes that were addressed as important within the data management field are data quality, data governance, data security, and data volume issues. The following paragraphs provide more insights into these essential components of data management.

To begin with, interviewee 4 and interviewee 5 explicitly mentioned that the quality of data is an essential component of data management. For example, interviewee 4 commented: *"When I looked at the list, I immediately thought of data quality. That is also an important factor. Because this can mean that you draw conclusions that ultimately turn out to be wrong due to an error in your data set, for example. So how do you pair what? And how do you maintain it? So, I actually think that is the most important one"* (Interviewee 4). As can be interpreted from these quotes, data quality should be addressed when adopting DDD in order to ensure that the data is correct. Errors within data might potentially cause that decision-makers draw wrong conclusions which could then lead to making wrong decisions. Other interviewees referred to data quality as ensuring that data should be correct (Interviewees 2, 3 and 6).

Furthermore, one interviewee (Interviewee 4) addressed the theme 'data governance' when discussing practical implications for these SME online retailers to ensure proper data management for DDD. For example, the interviewee mentioned the following: (…) *"You often work with a data governance system. That is basically a file that says: what are all the definitions of the fields that are in that source? But also: who is responsible for its maintenance? And for the analytical tool itself?"* (Interviewee 4). Clearly, interviewee 4 explains that data governance assists in ensuring consistency and reliability with data measurements, developing data definitions to understand what is meant by a specific data variable, and delegating roles and responsibilities concerned with data management. An example of this data governance was given for the SME online retail. "*For example, it can be that you measure page views with different systems. And then it may be that, for example, turnover is often measured in Google Analytics or Adobe Analytics. But often you also have a sales tool or an e-commerce environment in which you also measure that. And you see that those numbers slightly differ from each other. And that is why it is important that you determine in your data governance: what is the golden source? Which source do we use to measure our targets?"* (Interviewee 4). The example that interviewee 4 provided addresses the necessity of having a system in place to consistently measure data correctly to create and achieve reliable targets.

Similar to interviewee 4, interviewee 6 also referred to agreements within the organisation to ensure proper data management when discussing practical implications for SME online retailers. The interviewee said: "*In the end it really comes down to: agree together in advance what are the data definitions that will be used. (…) If I have to put this into the retail context, then this is mainly concerning sales, purchases and supply and demand. Then it must always be clear: where does this information come from? Do the people that use these sources also trust these sources? The frequency. Is it updated every hour? Or once a week, for example? That matters a lot" (Interviewee 6).* Based on these quotes from interviewee 6 and interviewee 4, both informants primarily emphasise that agreements should be made to ensure consistency and reliability of data analysis which is needed to ensure that data is consistently correct and valuable insights can be gained to make decisions.

Another interviewee mentioned data security, which can be considered a critical factor for the adoption of DDD. For example, when asking what critical determinants were missing in the technological context from the TOE model, interviewee 5 stated the following: "*Data Security. (...) You could place that under data management. However, in today's world I would*

mention it separately to highlight the importance of it" (Interviewee 5). As illustrated by the quote from interviewee 5, data security is suggested to be a critical factor influencing the adoption of DDD. Interviewee 5 referred to the necessity of data security due to the risk of data leakage which might include sensitive information.

Finally, one interviewee (Interviewee 1) reported that data volume is a critical determinant influencing the adoption of DDD. The interviewee suggested that most SMEs frequently encounter challenges considering sufficient data for analysis. For example, the following was mentioned by interviewee 1: *"I also think that the amount of data is often a problem, especially for smaller companies. And in particular, that it is not enough. Yes, that you do not have enough data as a small business to really do the interesting things with it. You do need a bit of scale to really take advantage of it. To be able to make truly data-driven decisions, the result I look at must make a significant difference"* (Interviewee 1). This perspective from interviewee 1 suggests that SMEs need sufficient data in order to make decisions that lead to results with a significant difference. The interviewee also added: *(...) "Buying data could be an option. However, smaller companies certainly run into the fact that data is often expensive to purchase. So, the investment does not outweigh the benefit you can gain with it. Because scale also plays a major role in this"* (Interviewee 1). Purchasing data could provide a solution to supply the SME with sufficient data. Notwithstanding this solution, particularly smaller online retails may face the problem that it is not worth the investment considering the results it could provide due to scalability issues.

To summarise, all interviews demonstrated that data management is considered a critical determinant influencing the adoption of DDD by SME online retailers. Several sub-factors of data management were explored of which the interviewees believe are essential for consideration when adopting DDD. These sub-factors are data quality, data governance, data security and data volume.

Process management

One interviewee (Interviewee 2) suggested that process management could be considered a critical determinant influencing the adoption of DDD by SME online retailers. The interviewee argued that process management is essential to enable DDD as the SME can get a good overview of the business processes within the company. When asking interviewee 2 what critical determinants might be missing in the TOE framework that influences the adoption of DDD, the interviewee stated: *"Yes, then I think of process management"* (Interviewee 2). The researcher tried to clarify what the interviewee meant by this and asked if this process management factor refers to developing an overview of the business processes within the company. The interviewee replied: *"Yes, on the one hand to report but also the reporting processes. And yes, also the agreements within the organisation that ensure that the person responsible for a KPI can also do something with it".* (Interviewee 2). Based on this quote, one can suggest that interviewee 2 meant that process management is needed to get an overview of a dashboard related to certain business processes of the organisation. These dashboards include Key Performance Indicators (KPIs). These KPIs function as checkpoints to evaluate whether or not someone within the organisation needs to take action or make a decision. To conclude, one participant suggested that process management is a critical determinant influencing the successful adoption of DDD.

4.2.2 Organisational context

This section will describe the organisational factors influencing the adoption of DDD by SME online retailers. In terms of organisational context, it was suggested that Top Management Support, Human Resources and a Data Driven Culture are critical determinants influencing the adoption of DDD. Data-Driven Culture was added to the initial theoretical framework as

suggested by half of total interviewees. Financial Resources were not considered a critical determinant for the adoption of DDD by SME online retailers. Instead, it was suggested that financial resources can be considered a driver for the adoption of DDD.

Top Management Support

In simple terms, top management support encompasses the willingness to understand, the encouragement and the implementation of an IT innovation within an organisation. Among all interviewees, top management support was suggested as a critical determinant influencing the adoption of DDD by SME online retailers (Interviewee: 1 - 6). It was argued that top management needs to evaluate the costs and efforts (e.g. investments in IT applications, Training, scaling up human resources if needed) versus the benefits gained from DDD to make the executive decision to adopt DDD in the organisation.

Moreover, it was suggested that top management plays an important role in the responsibility of integrating DDD within their business decision-making across their business functions. The major reason provided by all the respondents included that top management needs to believe in the value of DDD. For example, participant 2 stated: *"It is very simple. If the ones at the top of the organisation do not have the belief in the added value of DDD, the adoption will not happen because it will never get off the ground"* (Interviewee 2). A similar statement was also echoed by participant 5 who argued, *"Top management support is really key. If you do not have their support, then nothing is going to happen, period"* (Interviewee 5). Clearly, these interviewees believe that top management is critical determinant for the adoption of DDD within the organisation. Both interviewees (Interviewees 2 and 5) indicated that support from top management for the adoption of DDD is needed because otherwise the adoption will not take place at all. Another perspective shared by one of the interviewees (Interviewee 6) included: *"You really need the tone from the top to see, hey, we are going to change this. Because in the end, if the rest of the company is working data-driven, but the top management or the CEO says still says: if I think this, then so be it. Then it all makes no sense of doing it"* (Interviewee 6). Regarding the quotes of participant 6, it is suggested it makes no sense for the SME online retailer to execute DDD if, ultimately, executive decisions would still be made based on the intuition by top management.

Also, the majority of interviewees felt that DDD adoptions take place using a top-down approach. As one interviewee said: *"And that is why I specifically indicated the management levels. Because I notice that there it is actually where it starts, they are kind of the top of the pyramid and if they make their decisions in a data-driven way, then you see that the layers below get inspired and think: Oh cool, we are going to do it that way too. So that is why I think it is also very important that they set a good example"* (Interviewee 4). Based on these quotes by interviewee 4, it is suggested that it is essential that top management sets a good example of executing DDD to inspire lower-level employees within the organisation.

However, one different perspective was shared on how and where DDD adoption could start within the SME. In one case, the participant thought that using a bottom-up approach can also be appropriate for adopting DDD within the organisation. As the interviewee said: *"Yes, top management support can be a huge accelerator. Is it crucial? Well, yes. I actually think so. I think it is pretty crucial. You can also do it bottom up. So that you just start with some departments and just let it seep up that way. And by doing so, they can see what it does. And that is also part of our work. We show a lot of what we deliver: we have earned so many X this year with these tests. And, yes, that also enthuses the management layer, the CEO and Vice Presidents of this world. So yes, it has to be somewhere in the organisation, there has to be a culture, you should not be on your own, so there has to be a team that embraces this, at the very least"* (Interviewee 3). A shared statement between interviewee 3 and the other interviewees during the interviews was that there should be at least a team of ambassadors in

the organisation that embraces this way of decision-making. Important to note is that interviewee 3 states that when using a bottom-up approach, the organisation should allow that bottom-up approach to be accepted. For example, interviewee 3 thought that using a bottom-up approach in companies with a rather hierarchal organisational culture may hinder the acceptance of innovations initiated by employees lower in the organisational chart.

Furthermore, two interviewees (Interviewees 5 and 6) alluded very clearly to the notion of communication by top management. Communication was suggested to be an essential component when adopting DDD in the organisation. For example, interviewee 5 explained why communication is important and what should be communicated when adopting DDD. *"If you can make it clear to people that their lives will be better, more fun, easier, or whatever. And that they do not have to be afraid of anything during the process of adoption. And that their hand is being held the moment change sets in, then there is nothing much going on. And if you also communicate well and be honest about it, and above all, communicate very clearly about it. And the latter is seriously extremely important. That you communicate very clearly: What is it? What is it not including? When does it start? When does something stop? And when does something else start? Then you have already convinced half of your employees"* (Interviewee 5). A similar view by participant 6 included: *"So basically, what I see that is very important around the adoption of DDD is that people should feel included in the process of the adoption. There should be explained why the company makes the adoption of DDD. And that it is also clearly recognisable for them: hey, this what I have already done is now being done by that, and it is still correct"* (Interviewee 6). The main argument used by both interviewees is that DDD is a significantly different way of decision-making compared to traditional decision-making (using only intuition) and employees are generally resisted to change which causes a low adoption rate. Both interviews argue that the essential role of the top management layer is to include the employees in the adoption process by communicating very clearly throughout the organisation about the changes that will be made, the support that will be given, and the planning of the process of the adoption.

To conclude, all interviewees suggest that top management support is a critical determinant influencing the adoption of DDD. All interviewees argued that top management needs to be convinced of the value of DDD. Top management needs to apply this way of decision-making throughout the organisation. Whilst a minority mentioned that DDD adoption can also start using a bottom-up approach, the majority felt that the adoption starts from a top-down approach. And finally, there were some suggestions that communication is a highly important component for top management because communication assists in implementing DDD throughout the organisation.

<u>Organisational Readiness: Financial Resources</u>

The financial resources refer to the organisation's available budget to finance the adoption of a new IT innovation. The interviewees on the whole (Interviewees 1 - 6) demonstrated that financial capabilities are not a critical determinant influencing the adoption of DDD by SME online retailers. The informants believe that this factor is rather seen as a driver which motivates the adoption of DDD in the SME online retailer.

For example, when asking the interviewees about whether financial resources are required to adopt DDD, interviewee 2 mentioned the following: *"No, that is nonsense. And particularly when it comes to marketing because there are so many relatively cheap tools available that provide all kinds of insights. For sure in the marketing area. But also, in terms of sales and even in the field of processes"* (Interviewee 2). According to interviewee 2, it is suggested that a wide variety of tools are available that enable the adoption of DDD while working with limited financial resources. A similar response was given by interviewee 3, who also provided examples of working with limited financial resources: *"You can always go big,*

but you can also start very small. Well, since we have been talking about Google Analytics. That is just a tool. Put a script on it, and there you go. Well, at least then they are already collecting data. And then you can have access to some simple reports in which you gain a lot of insights. Or if you enable enhanced e-commerce, for example. You can already see there: how much the turnover is, which products are selling well, or your checkout, where are people dropping out. Then you can get an idea fairly quickly" (Interviewee 3).

Another example of an interviewee's perspective (interviewee 5) regarding financial capabilities included: *"No, you do not necessarily need them. Because you can do a lot yourself. You can also do a lot with Excel, for example. I think it has a lot to do with mindset and willpower. With that you can come a long way yourself. There are also enough books written about how can you become a data-driven company and how you can run a webshop successfully, for example. It does not just depend on money only. And yes sometimes, with just about everything in life, it is convenient if you do have it"* (Interviewee 5). The quotes from interviewee 5 suggest that when working with limited financial resources, the company's mindset and willpower to adopt DDD are highly important. Interviewee 5 also emphasises that when financial resources are available, this can be considered a driver to adopt DDD.

All the previous quotes from above (Interviewees 2,3 and 5) illustrate that SME online retailers can work with limited to no financial resources across different business departments. Examples of affordable tools to enable DDD were provided by the interviewees (e.g. Microsoft Excel, enhanced E-commerce, Google Analytics). A critical condition that needs to be considered is that the SME needs to have the time available and willingness to conduct research on how the SME can use such analytical technologies to adopt DDD with a limited budget. In addition, if the SME online retailer desires to opt for more advanced analytical tools (e.g. machine learning techniques), it was suggested that financial resources would become necessary. For example, interviewee 1 stated the following when asking if the adoption of DDD can be realised while working with limited financial resources: *"They surely can. However, then it is more a mindset rather than a complex technological implementation. (…) In such a case, you might not really have the cool machine learning models that big companies can build. But you can, for example, determine which products should be sold on what price level. You can do that on the basis of experimentation. And based on the insights that you gain from the experiments you make your decisions"* (Interviewee 1).

This view was somewhat echoed by interviewee 4. Interviewee 4 mentioned: "*In principle, it is accessible to everyone as long as you have data. But I do think that by investing in certain systems or certain programs, you can collect data more easily and with better data quality. It does not have to be some wild system right away. In that sense, you can implement Google Analytics, so to speak. Then you already have some data. Anyways, if you want something more with data, you have to be willing to spend some money on it. But that often outweighs the costs of what you get out of it. However, you do need to have money to make that investment in advance and also to make that choice to be willing to spend money on it"* (Interviewee 4). Interviewee 4 believes that adopting DDD is possible for SMEs working on a limited budget. Nevertheless, by investing in certain programs you will receive more value from DDD as data can be collected more easily and with better data quality.

One interviewee (interviewee 6) also stated that financial resources are not considered a critical determinant influencing the adoption of DDD, but a different argumentation was shared. Interviewee 6 argued: "*Because you can outsource this. You can put this outside the organisation. (…) Particularly for SMEs. Hiring someone full-time to maintain certain things just costs a lot of money. While, in a manner of speaking, if you can apply this technology 'as a service', this can amount to half the wage of a full-time employee. And also, because precisely the SMEs are so focused on their core business"* (Interviewee 6). One can conclude from the perspective of interviewee 6 that the costs of hiring an employee full-time to maintain the data

and to conduct analyses may result in a high amount of financial resources needed. Instead, interviewee 6 suggested that SMEs could outsource their data maintenance to minimise the financial resources needed. SMEs generally lack sufficient human resources for this data maintenance practice as they usually focus primarily on their core business.

Hence, all interviewees shared that financial resources are not a critical determinant for the adoption of DDD. Financial resources are rather perceived as a driver to motivate SME online retailers to implement DDD. However, it seems that financial resources may become more relevant along the way of maturing in the adoption of DDD.

Organisational Readiness: Human Resources

In all cases, the interviewees on the whole demonstrated that human resources in terms of relevant knowledge about DDD and the organisation's willingness to change can be considered a critical determinant for the adoption of DDD by SME online retailers (Interviewees 1 - 6). Relevant knowledge for DDD has been frequently addressed within all the interviews and can be identified as general knowledge about understanding DDD and technical knowledge to enable DDD. The up-following paragraphs will primarily break down these knowledge aspects of DDD.

First of all, general knowledge about the DDD principles needs to be understood by the employees of the SME online retailer that deal with decision-making. Within the interviews, the general knowledge about DDD refers to the capability of human resources to interpret the insights derived from the data, as well as understanding why decisions are being made because of the insights. For example, interviewee 2 argued the following: *"If a sales employee or a marketing employee has to deal with DDD, they must at least understand, in a global sense, why decisions are being made that way"* (Interviewee 2). This quote by interviewee 2 suggests that employees who deal with DDD must understand why those decisions are being made data-driven. Interviewee 2 also added (…) "*And that the decisions or let us say the expectations that they have, why those expectations may also be wrong. And if they do not understand that, they will not take the results of the data seriously"* (Interviewee 2). This quote implies that employees need to understand why decisions based on data may also lead to unexpected outcomes causing wrong decisions. The consequence of employees not understanding that wrong decisions based on data may occur could lead to a lower overall adoption rate of the organisation because the results of using data will not be considered valuable.

Secondly, technical knowledge encompassed knowledge about performing data analysis, properly executing data management, and dealing with data infrastructure to comply with the rules and regulations associated with data processing. For example, participant 1 recognised that human resources of smaller companies usually lack technical skills which are highly required to execute DDD. As the interviewee said: *"If you are particularly talking about smaller companies (...) One of the barriers which they frequently encounter is the lack of technical knowledge. To collect data, especially when it comes to online sales, e-commerce. Then you are talking about creating websites. You will soon come in contact with code, tracking, and scripts. And that is where most SMEs quickly get stuck. They often do not understand that. Therefore, I would say, that is the main primary barrier that they will face"* (Interviewee 1). Clearly, interviewee 1 suggested that often SME online retailers have a shortage of technical skills to perform a data analysis and ensure proper data management. A similar perspective was shared by participant 2. Participant 2 stated *"I think a dashboard is a nice example. We regularly implement Google Data Studios for clients. We then help them to use these dashboards. And yes, if something needs to be adjusted, they often knock on our door again. (…) For the setup and optimisation of it, and that applies to many tools, it requires fairly specific knowledge. To use it, not at all"* (Interviewee 2). These perspectives combined clearly suggested that technical knowledge is required for the setup and optimisation for data analysis.

It is important to note that the technical knowledge required also depends on the complexity of the analytical tool and the user-friendliness of the system as previously suggested in the technological factors section.

Also, technical knowledge in terms of data-related legislation was also being addressed in the interviews. During the interviews it became clear that technical knowledge about data-related legislation is required to perform DDD for SME online retailers as the company may use data from individuals which are privacy-sensitive. For example, interviewee 1 and interviewee 5 demonstrate the need of technical knowledge for data-related legislation. Interviewee 1 mentioned: *(...) "Quite a lot has happened in the field of legislation in recent years. And that applies for both large and smaller companies. For small companies, this is often a heavy burden because then you suddenly need quite in-depth knowledge in order not to accidentally break the law. Because it is seriously quite difficult to even collect data without violating the General Data Protection Regulation (GDPR). Then you should really know what you are doing"* (Interviewee 1). This suggests that technical knowledge in terms of data-related legislation is required in order not to violate the privacy rights of individuals (GDPR). Not complying with these rules and regulations can result in high penalties for the company. Interviewee 5 stated: *(...) "Sometimes I say to people: look, of course you can buy a book about legislation. Then you can also find out yourself whether something is allowed or what kind of constructions you can build. But who does that? The joke is that with technology, a lot of people think they can do that too. But that's not true. You must have studied to do so and have experience with it"* (Interviewee 5). As can be seen from the quote by interviewee 5, this further illustrates the necessity of technical knowledge to comply with data-related legislation.

Furthermore, the researcher discussed solutions to minimise the shortage of technical knowledge in most SME companies. A frequent solution noted by the majority of the interviewees included that outsourcing the activities that require technical knowledge to enable DDD is an adequate solution when this knowledge is not present within the company. However, one interviewee shared a disadvantage of this solution. The following was mentioned by interviewee 4 when discussing the necessity of DDD-related knowledge by human resources: *"And then what you see is that people do indeed acquire that knowledge by hiring an external partner. But that is actually a temporary solution of course. Because as soon as that external partner is gone, the knowledge is gone too. That is why I always try to transfer that knowledge as best as I can in my assignments and that you really leave it behind. So, the company starts working data-driven and not working with someone who works data-driven. And that is where I see the most room for improvement for companies to take steps towards becoming a data-driven company"* (Interviewee 4). These quotes by interviewee 4 illustrate that hiring a consultant might be considered a temporary solution because the technical knowledge will disappear when the consultant leaves the company. Therefore, interviewee 4 addresses acquiring technical knowledge internally to be one of the points for improvements among companies to become a truly data-driven organisation. Thus, this view suggests that it is crucial to consider learning technical knowledge from the external party if the company has the ambition to further mature as a data-driven organisation.

Moreover, a recurrent theme within all the interviews was that the willingness to change among employees could be considered a determining factor for the adoption of DDD (Interviewees 1 - 6). Some interviewees referred to this factor as general employee support to make the change of making decisions based on data rather than purely on intuition (Interviewees 1, 2, and 4). For example, interviewee 4 alluded to the notion of the need for general employee support for the adoption of DDD by mentioning: *(…) "If the organisation is not 100% internally motivated to do something with DDD, I do not know if you can make this a success. Because then you miss that piece of management support and employee support in general"* (Interviewee 4). In other words, the participants suggested that employee support is

needed because this will determine the adoption degree of the organisation as a whole. The other participants (Interviewees 3, 5, and 6) also addressed the highly essential importance of the employees' willingness to change for the adoption of DDD but elaborated on this factor in association with the company culture which will be explained in up following section.

Additional Factor: Data Driven Culture

In this study, the organisational culture was explicitly mentioned by half of the total interviewees to be one of the most critical determinants influencing the adoption level of DDD within the organisation (Interviewees 3, 5 and 6). These three interviewees argued that company culture highly influences whether or not people are willing to make the change to base decisions on data rather than purely using intuition.

For example, the following was mentioned by interviewee 3: *"Data-Driven Decision Making, that is, of course, also a kind of cultural thingy. You want to break with the culture of opinions and break with: we have always done it this way, of course, now we are still going to pursue that way nevertheless. And we do not do that anymore. And that is something. You have to be open to that"* (Interviewee 3). Clearly, this quote suggests that the DDD requires the willingness to change from employees to make decisions based on data. This willingness to change seems to be highly dependent on the organisational culture.

Moreover, interviewee 5 argued: *"Often there is also a certain type of culture within the company. That also matters a lot. I think if you have to put one thing in the TOE framework, you have to add company culture (…) All lights can be put on green, but if the culture is: we are completely against change or against data at all, then it will not work (…) The stumbling blocks you always encounter are people and culture. You can think of everything else so well. But if you do not pay the most attention to that, it is not going to happen"* (Interviewee 5).

Furthermore, a similar view as interviewee 5 was echoed by interviewee 6, who stated: *"Actually, it should not be seen as an IT implementation but really as a culture change (…) It is precisely the culture of the company that makes it a success factor for the implementation of working data-driven. For example, if the CEO really wants it, but the rest of the company does not have a flexible mindset at all, and is very much like: we will do it like we have always done, et cetera. Then you can still use the most beautiful data-driven tools, but it will not work out (...) When I look at the three dimensions, I see culture, company culture as the missing factor within this model. This is a very important factor that has a lot of influence on the level of adoption. Let us say that this is the determinant factor. Technology is rather a facilitating component within the adoption process"* (Interviewee 6). Based on these quotes, one can state that these interviewees clearly share the perspective that the organisational culture plays a key role in the level of DDD adoption by the organisation. The interviewees (Interviewees 3,5 and 6) argue that the SME online retailer should have a culture that is generally open and flexible to changes, as well as having a positive attitude toward the use of data to facilitate decision-making.

To summarise, half of the total interviewees from this study suggest that the company culture highly influences the adoption degree of adopting DDD. It was suggested that a company culture in which employees are generally flexible regarding organisational changes and who can embrace the use of data to support decisions can be considered a determinant influencing the adoption of DDD by SME online retailers. On the other hand, a company culture in which people have a high resistance to organisational changes and an aversion to using data to facilitate decision-making can be considered an inhibitor to the adoption of DDD by SME online retailers.

4.2.3 Environmental context

This section will describe the environmental factors influencing the adoption of DDD by SME online retailers. In terms of environmental context, none of the discussed factors were considered critical determinants influencing the adoption of DDD. Instead, partner adoption and competitive pressure were seen as drivers that influence the adoption of DDD by SME online retailers. Government Support and (Non-)Government Policy were considered as either a driver motivating the SME online retailer to adopt DDD or an inhibitor hampering the SME online retailer from adopting DDD. Non-Government Policy was merged with Government Policy because evidence was found that that webbrowser privacy policies could be considered an inhibitor hampering the adoption of DDD by SME online retailers.

<u>Competitive Pressure</u>

The interviewees collectively (Interviewee 1 - 6) shared the opinion that competitive pressure is not considered a critical determinant for the adoption of DDD by SME online retailers. For example, the researcher asked whether the interviewee experienced any cases in which the client said that they wanted to adopt DDD because of competitive pressure. Some examples of the answers included the following. Interviewee 6 mentioned: *"No. this is management information. Nobody knows exactly what the competitor is doing. And if they hear their competitor is running their business via dashboards. Then it is like: Yes, okay, but maybe their entire business is organised totally different. I have never heard of: I have to do it, because my competitor does it too"* (Interviewee 6). Based on this quote, interviewee 6 stated that it is hard to find out whether competitors adopted DDD within their company because this is management information. Nevertheless, in the event of an SME finding out that their competitor is making data-driven decision, it would not make sense for the SME to feel pressured by the competitor as their organisation might be very differently organised than its competition. Interviewee 6 did not experience any SME clients that stated that they wanted to implement DDD because its competition is doing so.

Another response to this question included: *"Usually it is the other way around. We usually say to our clients: your competitor is doing this and you are not doing that yet"* (Interviewee 2). Thus, this statement implies that the SME online retailer might not be even aware of competitive pressure related to DDD. A similar response was given by interviewee 1 who mentioned *"It is often the other way around for SMEs. They do not come to us because they want to work data-driven. Smaller companies come to us because they want certain advertising campaigns and do not have an in-house specialist or they want to develop a new website. And then we come to them, the other way around: yes, okay, but why do you want a new website? Do you need a new website? Is the conversion percentage of this website already that low that it is truly worth the investment to build something new at this moment? (...) To start working data-driven, I would not consider competitive pressure as the reason to adopt DDD"* (Interviewee 1). Similar to interviewees 6 and 2, interviewee 1 did not experience any clients that mentioned to seek the adoption of DDD because of competitive pressure. Based on the quotes by the interviewees (Interviewees 1, 2 and 6), one can suggest that interviewees believe that the competitive pressure is not a critical determinant for the adoption of DDD.

However, some interviewees (Interviewees 3, 4 and 5) explicitly mentioned that competitive pressure may be considered as having a motivational influence to start adopting DDD in retail SMEs. For example, interviewee 3 stated the following about the role of competitive pressure: *"I cannot imagine that there is an entrepreneur who does not look at competition. So, you will look at what they do and then this will certainly also be recognised at some point. Yes, you would like to know that. So, I think that definitely plays a role. It is an accelerator, but it is not a crucial element"* (Interviewee 3). Based on this quote, interviewee 3 suggested that competitive pressure cannot be considered a critical determinant. Competitors

adopting DDD is rather seen as an inspiration for the SME online retailer which has consequently a motivational influence on the adoption of DDD. A similar argument was used by interviewee 5 when discussing the external factors that influence the adoption of DDD. Interviewee 5 mentioned: *"A driver to become data-driven. Yes, it certainly can come from these kinds of things. That you see that competition is starting to do that too"* (Interviewee 5). Thus, this statement implies that competitive pressure may be seen as a driver having a motivational influence on the adoption of DDD.

Moreover, one interviewee (Interviewee 4) discussed that SMEs should not feel pressured to copy its competitor practices in terms of DDD. Interviewee 4 acknowledged that some clients mention that they want to start adopting DDD because of their competition. However, often it turns out that the company that wants to copy its competitor in terms of DDD is not ready for this implementation yet. Interviewee 4 mentioned: *"So, if you are just starting to work with data, you have very different opportunities and points of improvement compared to a situation in which you work already for years with data. Then you just have other issues. So, I think that everyone has their own route. You cannot just skip steps within that process".* (Interviewee 4). The quotes by interviewee 4 imply that the SME online retailer needs to evaluate their own situation in which one can implement DDD practices since the adoption of DDD is considered a process in which some steps certainly cannot be passed without completing.

To conclude, the participants' perspectives were diverse on the degree of influence from competitive pressure to implement DDD. Although half of the participants recognised that competitive pressure has a motivational influence on the adoption of DDD by SME online retailers, all interviewees stated that this factor cannot be considered a critical determinant for DDD adoption.

Partner adoption

All interviewees indicated that partner adoption cannot be considered a critical determinant influencing the adoption of DDD by SME online retailers (Interviewees 1 - 6). The feeling of pressure from partners to implement DDD for SME online retailers was not recognised in all of the interviews. However, one participant did mention that larger organisations in the retail industry are more and more requesting their partners for data exchanges nowadays. For example, interviewee 5 stated: *"So when you talk about partner adoption, you often see that larger players in the market start to enforce these kinds of things. That the standardisation of data is starting to become more relevant. Slowly but certainly"* (Interviewee 5). As can be interpreted from this quote, interviewee 5 believes that along the way of data standardisation in the upcoming years, this pressure from partners may become more relevant for SMEs as well.

Although partner adoption is not considered a critical factor for the adoption of DDD, four out of the six interviewees (Interviewees1, 2, 4 and 5) argued that partner adoption could have a motivational influence on the adoption of DDD by SME online retailers. The opportunities for data exchanges between the SME online retailers and their partners was mentioned as the primary reason partner adoption could be considered a motivational factor.

Some examples of these opportunities were explained by different interviewees. For example, one interviewee elaborated on the opportunities of data exchange between an online retailer and its suppliers to enhance the return of goods process and better service for complaint handling from customers. Interviewee 2 gave the following example: *"Particularly in e-commerce, you are responsible for handling customer complaints if you sell products from certain brands. And complaints handling is often a huge hassle because most brands are not looking forward to receiving these products back. And normally, agreements are made about that on how to deal with it when these complaints arise. But it is also not good for a retailer if this happens too often. A retailer I know well created a kind of complaint handling portal.*

Nothing complicated at all. So, if a customer comes back with a product that is broken, a complaint case will be registered in the portal and a message will be send to the supplier saying: this and this happened, what do you want us to do? By doing so, it will provide the retailer insights into how many complaints are registered by each brand, how fast complaints are being handled, and how fast these suppliers react to their complaint cases. So, on the basis of this information you can make agreements with your supplier. For example: look, you are taking each time a week to respond to my customer complaints. My customers are not happy about that, you need to do better. Or, you sell shoes from two different suppliers that are nearly similar. With one of these suppliers you do not have any problems, with the other supplier you always face problems. So, you make the decision to not purchase your goods from that supplier anymore" (Interviewee 2). As can be seen from the quotes by interviewee 2, evidence has been provided that online retailers can benefit from data exchanges with suppliers to enhance decisions for supply chain operations based on data. The results of these data exchanges could allow the SME to manage customer complaints more efficiently and eventually gain a better negotiation position. Thus, the benefits that can be gained from this data exchange with partners can be regarded as a motivational factor that influences the SME online retailer to adopt DDD.

On the other hand, one interviewee (interviewee 1) mentioned that partner adoption can also be regarded as an inhibitor. Interviewee 1 stated: *"It can be a barrier but also an opportunity. (...) It can be an obstacle if you work together with a lot of parties, whom all want something slightly different, which makes it become very fragmented. The whole story, unnecessarily complex"* (Interviewee 2). As can be seen from these quotes, interviewee 2 believes that partner adoption can also be considered an obstacle when working with many partners who demand data exchanges for better decision-making which makes the data landscape very complex. Clearly, the degree of complexity for data exchange when working with a lot of partners causes partner adoption to function as an inhibitor or driver to adopt DDD.

To conclude, this study showed that partner adoption is not considered a critical determinant influencing the adoption of DDD by SME online retailers. However, some interviewees felt that partner adoption could have a motivational influence on the adoption of DDD by SME online retailers as it provides opportunities for both parties (Partner and SME online retailer), which lead to value creation and better decision-making based on this data exchange. Finally, one interviewee stated that partner adoption can both be considered a driver and inhibitor influencing the adoption of DDD by SME online retailers. The reason for this inhibitor description comprised that the data landscape can become very complex when working with several partners whom all demand their own requirements for data exchange.

<u>Government Support & (Non-)Government Policies</u>

The majority of the interviewees (Interviewees 1 - 5) demonstrated that government support and policy are important factors to consider for the adoption of DDD by SME online retailers. It was suggested that government support & (non-)government policy can both be considered a driver and inhibitor to the adoption of DDD by SME online retailers.

On the one hand, the majority of the interviewees (Interviewees 1 - 5) noted that particularly data-related legislation could prohibit the adoption of DDD when using privacy-sensitive data. Not complying with the data-related legislation can lead to seriously high penalties from governmental institutions due to privacy concerns of individuals. For example, interviewee 4 mentioned: *"Yes, for sure, considering the part of ethics and privacy. That is undoubtedly an important factor because not complying to this data-related legislation can lead to very high penalties. So that is for sure something to look at"* (Interviewee 4). Another interviewee also addressed the regulatory environment by stating: *"The laws and regulations may make it more difficult to obtain certain insights that can increase the success of DDD. Especially when it comes to automated decision-making. So, building customer profiles and*

doing marketing activities based on that, you name it" (Interviewee 2). Clearly, interviewee 4 suggests that the data-related legislation might have a hampering effect on the adoption of DDD when using privacy-sensitive data from individuals to avoid the risk of potential penalties. Interviewee 2 adds that government data-related legislation can make it more challenging for companies to obtain certain insights that increase the success of DDD. Furthermore, as previously addressed in the human resource section, it was suggested that technical knowledge regarding data-related legislation must be obtained by SME online retailers when using privacy-sensitive data from individuals for DDD purposes. Thus, it can be concluded that the majority of the interviewees consider governmental regulations (in terms of data-related legislation) as an inhibitor to the adoption of DDD by SME online retailers.

On the other hand, government support for SMEs in terms of courses concerning DDD, clear communication about data-related legislation, and financial support (e.g. subsidy for courses related to DDD or analytical tools) could be considered a driver to motivate the SME to adopt DDD. Most interviewees shared the opinion that clear information and guidelines by governments regarding data-related legislation can be considered a driver to adopt DDD. When asked whether government support is needed to start adopting DDD, interviewee 5 elaborated very extensively on this question by stating the following: *"100 percent, but not only supporting them financially to just keep them alive. You should not sponsor companies that should not actually exist. I do not think the government will do so, but you can of course say: small Retail has a social function and they certainly do. There is a lot of diversity there that the big stores do not offer, and certainly with specialty shops and things like that. There is always an audience for that, there are always people for that. But we are also dealing with digitisation so the government should provide support, particularly in the form of knowledge. And maybe they need to provide financial recourses to sponsor tools for analytics that a lot of those small retailers need, so that they are not immediately highly impacted financially by acquiring such tools. (…) I think it is mainly about knowledge and mindset. Instilling the right mindset of: how are you in 2021 and beyond a successful retailer? And that has to do with digital knowledge" (Interviewee 5).* As can be derived from these quotes by interviewee 5, government regulations that assist SMEs in providing knowledge on DDD and general knowledge on digitalisation can stimulate the adoption of DDD by SMEs.

Besides the influence of governmental regulations, two interviewees (interviewee 1 and 3) referred to the influence of non-governmental policies for the adoption of DDD. It was suggested that webbrowsers introducing new data-related policies could be considered an inhibitor to the adoption of DDD by SME online retailers. These two interviewees noted that more and more webbrowsers will introduce more strict regulations considering the collection of online data due to privacy reasons of consumers. For example, interviewee 1 mentioned: *"Something that has a lot of influence in today's market is, on the one hand, that governments are now introducing legislation. And on the other hand, browsers add additional barriers on top of that due to privacy concerns. So, to even be able to collect data, clean data, your technical knowledge needs to improve continuously"* (Interviewee 1). Interviewee 1 suggests that it will become more challenging for companies to collect and analyse data from webbrowsers. Consequently, it will become more challenging to collect and extract value from this data to make better decisions. This is particularly relevant for SME online retailers since data usage from webbrowsers is often used in the online retail industry. In order to accomplish this data extraction from webbrowsers in the future, the technical knowledge of the SME online retailer needs to improve continuously to keep up with stricter policies of webbrowsers.

To summarise, this study provides evidence that (non-)government support and policy can either motivate or hamper SME online retailers from adopting DDD. Overall, the participants suggested that government regulations in terms of data legislation can be considered an inhibitor to the adoption of DDD when the organisation lacks technical

knowledge about how to deal with this data-related legislation in the event of using privacy-sensitive data from individuals. Not complying to these governmental regulations can lead to high penalties from governmental institutions. Additionally, two interviewees concluded that non-governmental policies (i.e. webbrowsers privacy policy) could also hinder the adoption of DDD by SME online retailers. Considering all these data-related policies together, this may suggest that the need for technical knowledge will become more and more critical for SME online retailers to adopt DDD. For categorising purposes, this factor has been included under non-governmental policies because the hampering effect of a webbrowser's privacy policy on the adoption of DDD is more relevant to an operational level (e.g. data-driven decision making for marketing purposes). Finally, government support in terms of clear information regarding data-related legislation, subsided courses to educate SME online retailers about DDD, and financial support to purchase analytical tools can be considered drivers for the adoption of DDD by SME online retailers.

5. Analysis

In this chapter, the findings from this research will be compared with the studies from the literature review which was conducted for this research. A similar structure as the results chapter will be used to compare the findings of this study with the literature. Thus, the first part of this chapter will review the definitions of DDD provided by the interviewees compared to definition used in this research. The second part encompasses a comparison between the explored determinants, drivers, and inhibitors influencing the adoption of DDD by SME online retailers and previous literature considering the factors influencing IT adoption using the TOE framework.

5.1 Understanding Data-Driven Decision Making (DDD)

As earlier presented, each interviewee was asked to provide their definition of DDD. After that, the interviewer presented the definition of DDD given by the authors Provost and Fawcett (2013) which was used in this research. All interviewees agreed that their definition was nearly similar to or complemented the definition used in this research.

Moreover, in this study, the role of intuition and feelings in DDD was also discussed during the interviews. The definition of DDD by Provost and Fawcett (2013) used in this research highlights: "the practice of basing decisions on the analysis of data **rather than** purely on intuition" (p. 3). One could interpret this definition in which intuition can still play a role in the decision that one makes as this description includes 'rather than purely on intuition'. Since the majority of the interviewees shared that intuition still plays a role in the decision making of DDD, it can be concluded that the majority of interviewees in this study shared a similar definition of DDD developed by Provost and Fawcett (2013).

5.2 Technology-Organisation-Environment

This section will compare the findings of this study in relation to the prior TOE-based studies about the adoption of big data analytics by firms. Each dimension of the TOE framework will be discussed in a similar structure as the result section. Table 6 provides an overview of the comparison between the explored factors for the adoption of DDD by SME online retailers and factors identified in the literature for data analytics adoption.

Table 6 Factors influencing the adoption of DDD by SME online retailers – Support from literature study

Factors identified from study	Evidence provided by Interviewee	Factor described as	Support from literature study
Relative Advantage	Interviewees: 1 - 6	Critical determinant	Supported
Compatibility	Interviewees: 1 - 6	Critical determinant	Supported
Complexity	Interviewees: 1 - 6	Critical determinant	Supported
Data Management	Interviewees: 1 - 6	Critical determinant	Supported
Process Management	Interviewee: 2	Critical determinant	New factor
Top Management Support	Interviewees: 1 - 6	Critical determinant	Supported
Organisational Readiness: Financial Resources	Interviewees: 1 - 6	Driver	Supported
Organisational Readiness: Human Resources	Interviewees: 1 - 6	Critical determinant	Supported
Data-Driven Culture	Interviewees: 3, 5 & 6	Critical determinant	Supported
Competitive Pressure	Interviewees: 1 - 6	Driver	Supported

Table 6 (continued)

Factors identified from study	Evidence provided by Interviewee	Factor described as	Support from literature study
Partner Adoption	Interviewees: 1 - 6	Driver	Supported
Government Support & (Non-)Government Policy	Interviewees: 1 - 5	Driver & Inhibitor	Supported

5.2.1 Technological context

This section compares the technological factors from this research with the studies from the literature. The technological context compromises the relative advantage, complexity, compatibility, data management, and process management.

Relative Advantage

The results from this study presume that the relative advantage can be considered a critical determinant for the adoption of DDD by SME retailers according to the interviewees. Therefore, these findings support current literature findings (Chen et al., 2015; Lai et al., 2018; Maroufkhani et al., 2020; Park & Kim, 2019; Sun et al., 2016; Sun et al., 2019). These literature studies conclude that the relative advantage or expected benefits that can be gained using the technology can be considered a critical factor for adopting IT Innovation. In particular, the interviewees shared a similar view concluded by Park & Kim (2019). These authors conclude that the relative advantage could be considered the primary determinant of implementing DDD because otherwise there would be no distinct reason for adopting the technology.

Compatibility

In terms of compatibility, the research findings of this study showed that compatibility is considered a critical determinant influencing the adoption of DDD by SME online retailers. Within this research, compatibility referred to the degree to which DDD is compatible with the business operations of the SME online retailer. The interviewees on the whole suggested that compatibility is an essential factor that concerns the data extraction from current IT systems to be transferred to the data analytical application to conduct data analysis. Within prior TOE-based studies on (big) data adoption, many of the earlier studies examined the influence of compatibility through both a business practice perspective or a cognitive perspective. This study is therefore to some extent in line with other studies who concluded that (big) data analytics should be compatible with the business practices of the company (Chen et al., 2015; Maroufkhani et al., 2020; Sun et al., 2016; Verma & Bhattacharyya, 2017).

Complexity

In this study, complexity was considered a vital determinant influencing the adoption of DDD by SME online retailers. The interviewees on the whole suggested that the lower the degree of complexity, the higher the probability of adopting DDD by the SME online retailer. And the other way around, the greater the simplicity of the system usage, the more likely the adoption of DDD by SME online retailers. This is in line with the majority of the previous studies that validated or explored the complexity of an IT system to be a critical factor for an IT innovation (Chaurasia & Verma, 2020; Maroufkhani et al., 2020; Sun et al., 2016; Verma & Bhattacharyya, 2017). These studies found that a higher degree of complexity hampers the adoption of big data analytics. In contrary, this finding refutes with the studies from Park & Kim (2019), Lai et al. (2018) and Li et al. (2018) who did not find a significant result for complexity to be considered a critical factor for the adoption of big data analytics among firms. A possible reason could be

that the sample firms considered within these studies are of such a particular company size that the company has sufficient resources (e.g. technical knowledge and skills and financial resources) that allows them to adopt technology more easily (Lai et al., 2018).

Data Management

In all interview cases, data management was suggested as a critical determinant influencing the adoption of DDD. It was primarily suggested that poorly executed data management could negatively impact insights from the data which eventually could lead to wrong decisions. Within the literature, several researchers highlighted the importance of data management elements which influence the adoption of IT innovation. The elements that were that were addressed in this study can be categorised as following: data quality; data governance; data security; and data volume. Except for data volume, all the other elements have been found in other studies to affect the adoption of big data analytics (Chaurasia & Verma, 2020; Lautenbach et al., 2017; Li et al., 2018; Maroufkhani et al., 2020; Park & Kim 2019; Sun, Cegielski, Jia, & Hall, 2016; Verma & Bhattacharyya, 2017). A possible reason why data volume has not been mentioned in other (big) data analytics adoption studies using the TOE framework is that these studies mainly included larger firms which usually collect more data than smaller firms. Further, one study contradicts the findings from this research in terms of data quality (Lai et al., 2018). The authors did not find significant result for the data quality affecting big data adoption in logistics and supply chain management. It was argued that exchanges among supply chain partners are temporal and objective-oriented. Meaning that there is frequently no critical value seen in consistent data definitions/elements, unbiased data inputting and data sharing (Lai et al., 2018).

Additional Factor: Process Management

In this study, a minority (Interviewee 2) suggested that process management could be considered a vital determinant factor influencing the adoption of DDD by SME online retailers. This finding suggests that proper process management could positively contribute to the adoption of DDD by SME online retailers. Process management helps the company to create dashboards which are coupled to certain business processes of an organisation. These dashboards include Key Performance Indicators (KPIs) which function as checkpoints to evaluate whether or not someone within the organisation needs to take action or to make a decision. Based on the systematic literature review conducted for this research, process management has not been examined as a critical determinant for IT adoption within prior TOE-based studies on (big) data analytics adoption by firms. Thus, according to the researcher's best knowledge, this is the first study of its kind who showed evidence of process management influencing the adoption of DDD by SME online retailers.

5.2.2 Organisational context

This section compares the organisational factors from this research with the studies from the literature. The organisational context compromises top management support, organisational readiness in terms of financial resources, organisational readiness in terms of human resources, and a data-driven culture.

Top Management Support

Previous studies have frequently emphasised the critical role of top management in adopting a new IT innovation (Park & Kim, 2019). In this study, data management is considered a critical determinant for the adoption of DDD by SME online retailers. This finding is consistent with all prior TOE-based studies from the literature review conducted (both prior quantitative studies (Chen et al., 2015; Chaurasia & Verma, 2020; Lai et al., 2018; Lautenbach, et al., 2017; Li et

al., 2018; Maroufkhani et al., 2020; Park & Kim, 2019; Sun et al., 2019) and prior qualitative studies (Sun et al., 2016; Verma & Bhattacharyya, 2017)). The results from this study showed that all interviewees consider top management as a critical determinant that influences DDD adoption of the SME online retailer. It was implied that the top management of SME online retailers need to encourage this way of decision-making in their operations.

Furthermore, two interviewees (Interviewee 5 and 6) suggested that particularly communication and guidance to employees positioned lower in the organisational chart are key to determining the degree of adoption among the entire organisation. It was suggested that top management needs to communicate within their company about the organisational changes as a result of adopting DDD, the support that will be provided, and the planning concerned with the adoption. To the researcher's knowledge, the emphasis of communication throughout the organisation by top management has not been mentioned within prior literature studies for the adoption of IT adoption.

Organisational Readiness: Financial resources

Within prior quantitative research, the financial capabilities are frequently used as a component for measurement to express the organisational readiness for adopting a new IT innovation (Maroufkhani et al., 2020; Park & Kim, 2019). Regarding SMEs in particular, the literature suggests that financial shortage is one of the main elements that restrict information system development in smaller organisations (Coleman et al., 2016; Dittert et al., 2017; Maroufkhani et al., 2020). In this study, a different result was found regarding the necessity of financial resources to adopt DDD by SME online retailers. The findings show that financial resources are not considered a critical determinant for the adoption of DDD by SME online retailers. Instead, the majority of the interviewees suggested that financial resources can be considered a driver which motivates the SME to adopt DDD. The majority of the interviewees suggested that there is a wide variety of tools available that enable the adoption of DDD while working with limited financial resources. One should note that the financial resources depend on the desires of the SME in terms of what it wants to achieve with DDD and in which business functions DDD will be applied. Certainly, these desires need to meet the human resources available with adequate skills and knowledge to enable DDD. Outsourcing the data maintenance and analysis activities is suggested to be an option to minimise the financial resources needed. Despite the fact that this factor is not seen as a critical determinant, this study complements the finding from Park and Kim (2019), Sun et al. (2016) and Verma and Bhattacharyya (2017) who reported that financial resources can positively influence the adoption of big data analytics. On the contrary, this study contrasts the findings by Lai et al. (2018) who did not find a significant positive influence for financial readiness having a positive influence on IT adoption.

Organisational Readiness: Human Resources

This research suggests that human resources are considered to be a critical determinant for the adoption of DDD by SME online retailers. It was suggested that human resources are needed in terms of technical knowledge, understanding DDD, and the employees' willingness to change. Technical knowledge encompassed skills and experience to ensure proper data management and performing data analysis as well as knowledge about data related legislation. In case the SME has a shortage of technical knowledge, some interviewees suggested that this knowledge can either be acquired through educating employees internally or acquiring this knowledge through consulting an expert who assist these companies with implementing DDD. All of the human resources elements have also been documented as one of the main determinants for big data analytics adoption within prior literature using the TOE framework (Chen et al., 2015; Chaurasia & Verma, 2020; Maroufkhani et al., 2020; Park & Kim, 2019;

Sun et al., 2016; Verma & Bhattacharyya, 2017). For example, Park and Kim (2019) state that a company's technological capabilities are related to human resources, training and education, skills, and experience. The authors argue that the higher the technological capabilities, the more likely the implementation and utilisation of big data analytics will lead to a success. Besides, the willingness to change has also been documented within prior literature as this element is associated to the compatibility factor (Chen et al., 2015; Maroufkhani et al., 2020).

Additional Factor: Data Driven Culture

In this study, a data-driven culture was suggested as a critical determinant influencing the adoption of DDD by SME online retailers by half of the total interviewees. It was suggested that a company culture in which employees are generally flexible regarding organisational changes and who can embrace the use of data to support decisions can be considered a determinant factor influencing the adoption of DDD by SME online retailers. On the other hand, a company culture in which people have a high resistance to organisational changes and an aversion to using data to facilitate decision making can be considered an inhibitor to the adoption of DDD by SME online retailers. Within prior literature focusing on the adoption of big data analytics using TOE, a data-driven culture is not frequently empirically tested or explored within the organisational context of TOE. Some prior studies measured a matching company culture to the adoption of big data analytics within the factor 'compatibility' (Chen et al., 2015; Maroufkhani et al., 2020). For example, Maroufkhani et al. (2020) conclude that their study findings support that companies who seek the adoption of big data analytics must first develop a coherent and unambiguous data-driven culture as well as IT infrastructure to make effective use of big data. However, half of the participants stated that a data-driven culture is one of the most critical determinants for the adoption of DDD. For that reason, data-driven culture has been included in the organisational context. Sun et al. (2016) explored in their study that an evidence-based decision-making culture is a critical factor for the adoption of big data in firms and positioned this factor distinctly in the organisational context. Therefore, this study particularly complements their findings.

5.2.3 Environmental context

This section compares the environmental factors from this research with the studies from the literature. The environmental context includes the competitive pressure, partner adoption, and government support & (non-)government policies.

Competitive Pressure

Within the literature, the competitive pressure has frequently been mentioned as an important factor influencing the adoption of big data among firms (Chaurasia & Verma, 2020; Chen et al., 2015; Lai et al., 2018; Lautenbach et al., 2017; Maroufkhani et al., 2020; Park & Kim, 2019; Sun et al., 2016; Sun et al., 2019; Verma & Bhattacharyya, 2017). The majority of the reviewed studies found that pressure from competitors showed significant positive influence on the adoption of (big) data analytics among firms (Chaurasia & Verma, 2020; Chen et al., 2015; Lai et al., 2018; Lautenbach et al., 2017; Maroufkhani et al., 2020; Sun et al., 2019). The findings of this research show that competitive pressure is not considered a critical determinant among the experts for the adoption of DDD by SME online retailers. However, half of the participants stated that competitive pressure can be considered a driver that motivates the SME online retailer to adopt DDD. These interviewees implied that DDD practices from competitors can inspire the SME online retailer to adopt DDD, rather than experiencing a high pressure from competition to start using DDD. In particular, this study complements the findings of Lautenbach et al. (2017) and Chen et al. (2015). Specially, Lautenbach et al. (2017) considered competitive pressure explicitly as a driver for the adoption of business intelligence and analytics

usage extent. Chen et al. (2015) argue that competitive pressure would likely stimulate imitative tendencies of top management because successful behaviours of competitors can assist in minimising the uncertainty of adopting new technology.

Partner Adoption

Overall, partner adoption was not considered a critical determinant for the adoption of DDD by SME online retailers in this study. However, the majority of the respondents claimed that partner adoption could motivate the SME online retailer to adopt DDD. The opportunities of data exchanges between the SME online retailers and its partners was mentioned as the primary reason partner adoption could be considered a motivational factor. One interviewee (Interviewee 5) mentioned that larger organisations that are active in the retail industry are more and more requesting their partners for data exchanges nowadays. Interviewee 5 added that pressure from business partners may not be highly present yet in SME retailers but will probably become more apparent in the future due to the developments in data standardisation. These results are consistent with the findings of Park and Kim (2019) and Sun et al. (2019) as their findings showed insignificant influence for pressure from business partners affecting the adoption of (big) data analytics. In contrary, these results are inconsistent with the work from Sun et al. (2016) who found that partner readiness is suggested to be a more important factor that significantly impacts the adoption of big data analytics than complexity or an evidence-based decision-making culture.

Government Support & (Non-)Government Policies

The results from this study illustrate that government support and (non-)government policy can be both considered a driver and inhibitor to the adoption of DDD by SME online retailers. The majority of the interviewees highlighted that particularly the data-related legislation could hamper the adoption of DDD when using privacy-sensitive data. The SMEs can receive significantly large fines from governmental institutions if the company violates data related-legislation (GDPR). This finding is consistent with Sun et al. (2019) who argue that that companies may have concerns about the consequences of information leakage and illegal data trading which could hamper the adoption of big data analytics. On the contrary, government support for SMEs in terms of trainings for DDD, clear communication about data-related legislation, and financial support (e.g. subsidy for courses related to DDD or analytical tools) could be considered a driver for SME online retailers to adopt DDD. With regards to government support, this is in line with the findings from most of the studies who found that support from government is a significant factor influencing the adoption of IT innovations (Lai et al., 2019; Park & Kim, 2019; Sun et al., 2019; Maroufkani et al., 2020).

Furthermore, a minority indicated that non-governmental policies could also influence the adoption of DDD by SME online retailers. It was suggested that webbrowsers introducing new data collection policies may hinder SME online retailers from adopting DDD when using data collected from these webbrowsers. Webbrowsers are rapidly introducing newer data collection policies that better protect the privacy-sensitive information from individuals. It was presumed that these policies could make it more challenging for SME online retailers to acquire and process data from consumers as technical knowledge and skills will become more necessary. Therefore, a webbrowser's privacy policy can be considered as an inhibitor hampering the adoption of DDD by SME online retailers. For categorising purposes, this factor has been included under non-governmental policies because the hampering effect of webbrowser's privacy policy on the adoption of DDD is more relevant to an operational level (e.g. data-driven decision making for marketing purposes). The notion of browser privacy policy is not mentioned within literature. A possible reason for this finding is that this factor is rather new since webbrowsers recently updated their policies on data collection.

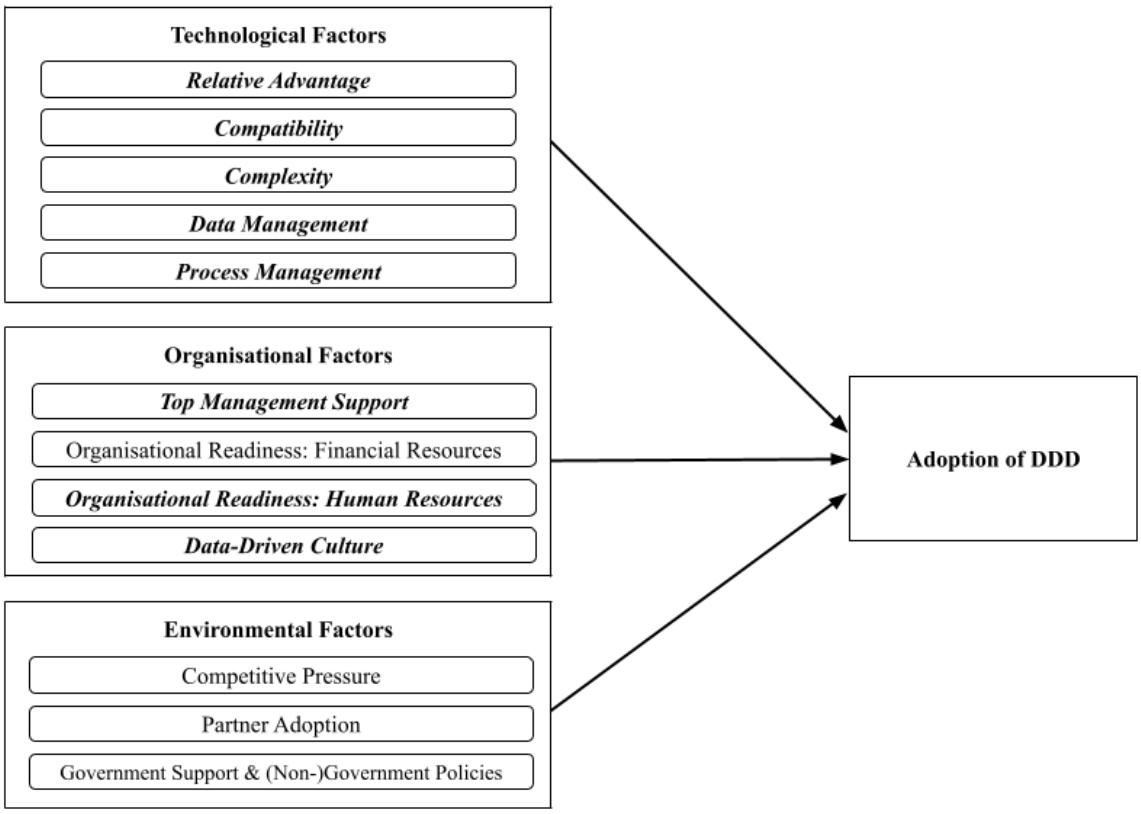
6. Discussion

This chapter answers the central research question of this study and provides a brief discussion of the key findings from this research. This chapter will also discuss the theoretical and practical implications that were realised by conducting this research. Finally, the limitations of this research will be discussed and future research suggestions will be provided.

6.1 Conclusion

The primary aim of this study was to explore the critical determinants influencing DDD adoption by SME online retailers. Therefore, the central research question was formulated as follows: "*What are the critical determinants influencing the adoption of DDD by SME online retailers?"*

Figure 3 Final theoretical framework for adopting DDD by SME online retailers – Critical determinants highlighted



Based on a literature review, an initial theoretical model including potential factors influencing the adoption of DDD with the aid of the TOE framework was developed. Thereafter, semi-structured interviews were conducted with experts to discuss the initial theoretical model and evaluate the factors in terms of their type of influence and whether these factors could be considered a critical determinant. Following this procedure led to the identification of the critical determinants influencing the adoption of DDD by SME online retailers. It can be concluded that the critical determinants are positioned in the technological and organisational context. In the technological context, it is presumed that *Relative Advantage*, *Complexity*, *Compatibility*, *Data Management* and *Process Management* can be considered critical determinants influencing DDD adoption. In the organisational context, it is suggested that *Top Management Support*, *Human Resources* and *Data-Driven Culture* can be considered critical determinants influencing the adoption of DDD. Figure 3 illustrates the final theoretical model that displays the factors influencing the adoption of DDD by SME online retailers. The critical

determinants influencing the adoption of DDD are marked in bold and are italicized. Other factors than critical determinants were drivers (Financial Resources, Competitive Pressure, Partner Adoption and Government Support) and inhibitors ((non-)government policies) that positively or negatively influence the adoption of DDD by SME online retailers.

Moreover, when comparing the results from this study with the literature, similar findings or suggestions have been identified within most prior research on (big) data analytics adoption regarding the majority of the critical determinants found (*Relative Advantage*, *Complexity*, *Compatibility*, *elements of Data Management, Top Management Support*, *Human Resources)* However, this research suggests some interesting findings which are different than those described within the literature or provide limited evidence within the literature.

According to one interviewee (interviewee 2), it was suggested that process management can be considered a critical determinant for the adoption of DDD. It was suggested that proper process management could positively contribute to the adoption of DDD by SME online retailers. Process management should assist the SME to develop dashboards which are coupled to certain business processes of an organisation. These dashboards include Key Performance Indicators (KPIs) which function as checkpoints to evaluate whether or not someone within the organisation needs to take action or to make a decision. To the researcher's best knowledge, this factor has not been mentioned within prior literature for the adoption of big data analytics.

Furthermore, this research posits a data-driven culture in the organisational context as a critical factor for the adoption of DDD. Although some prior studies on big data adoption refer with the compatibility factor to the congruity with the company culture (Chen et al., 2015; Maroufkhani et al., 2020), limited literature presents explicitly a data-driven culture as a critical factor influencing the adoption of big data analytics in the organisational context of the TOE framework (Sun et al., 2016).

Moreover, this research concludes that financial resources are not a critical determinant influencing the adoption of DDD. It was suggested that SME online retailers are able to adopt DDD with limited or non-financial resources. A common argument was shared that there are a variety of affordable tools that can enable DDD. Outsourcing DDD activities was also suggested to be a cost-effective solution when the SME has a shortage of technical knowledge or when limited time is available to organise and develop a system for DDD. Therefore, financial resources were rather considered as a driver which can motivate the SME to start adopting DDD or enhancing their system that enables DDD. This refutes the suggestion from the literature that states that SMEs with limited financial resources prevent SMEs from adopting (big) data analytics (Coleman et al., 2016; Dittert et al., 2017; Maroufkhani et al., 2020).

6.2 Theoretical implications

This research validated adoption factors from prior TOE-based research considering the adoption of (Big) Data Analytics. Discussing these factors during the interviews resulted in conceptualising a theoretical framework that include the factors influencing the adoption of DDD by SME online retailers. The researcher labelled these factors as critical determinants, inhibitors and drivers that influence the adoption of DDD. Researchers can use this theoretical framework to further investigate and empirically examine these adoption factors in similar research settings.

In addition, although with limited evidence, this research has identified process management as a new factor of which is presumed that it influences the adoption of DDD by SME online retailers. However, further investigation is needed to examine the degree of influence on DDD adoption. Future researchers can therefore include process management in DDD adoption studies concerning a similar research context.

Finally, the findings of this research contribute to the literature on IT innovations' adoption by using factors from the TOE framework to understand the critical determinants influencing the adoption of DDD by SME online retailers. This study therefore complements the TOE framework in its suitability to explore critical determinants influencing the adoption of IT innovations. However, this study focused only on using the TOE model to explore the determinants influencing DDD adoption by SME online retailers. Alternative technology adoption models were not taken into account. To provide a more holistic view of the factors influencing the adoption of DDD, future research could therefore focus on choosing appropriate alternative technology adoption models.

6.3 Practical implications

One of the objectives was to generate practical implications for SMEs online to guide their DDD adoption. The researcher has summarised the critical determinants and presents practical implications for SME online retailers to succeed in the adoption of DDD. These implications were derived from the interviews with the experts.

First, the relative advantage refers to the benefits that can be gained by the adoption of DDD. To make effective use of DDD, it is important that the benefits of DDD for the company are identified before the adoption takes place. This provides clear guidelines on the objectives DDD needs to fulfil. More importantly, these benefits can support evaluating what data needs to be collected and analysed to measure the objectives for accomplishment. Therefore, it is recommended to break down the main objectives into sub-goals.

Second, in order to get insights from data, data must be accessible for analysis. The current IT systems of the SME online retailer should be compatible with the desired application to perform data analysis. Therefore, it is necessary to assess whether or not data sources are available for export to conduct data analysis. For example, some e-commerce platforms may not allow data exportation to be analysed in analytical software that the company desires to use. The more compatibility between current IT systems and the tools for data analytics, the easier and the better the SME online retailer can fully adopt DDD.

Third, it was suggested to minimise the complexity of a technological system that enables DDD. In particular, small online retailers should maintain a simplistic DDD system. Tools for data analytics enabling DDD should be user-friendly and simplistic in terms of collecting data, data analysis, and data visualisation. It is recommended to begin with a pilot for the desired business process (e.g. online marketing, logistics, purchasing). More advanced features and data sources may be added along the way of maturing in DDD.

Fourth, data management was considered a critical determinant influencing the adoption of DDD. Some sub-factors were addressed by the experts that the SME needs to consider. These are ensuring data quality, data security, and generating sufficient data to make data analyses with significant impact. SME online retailers working with multiple data sources should consider data governance to ensure data is consistent and reliable among all the data sources.

Fifth, one informant suggested that process management could be considered a critical determinant that influences the adoption of DDD by SME online retailers. Proper process management could assist the company in creating dashboards which are linked to certain business processes of an organisation. These dashboards should include KPIs, which could function as checkpoints to evaluate whether or not a decisionmaker needs to take action.

Sixth, top management support was considered one of the most critical needs to be convinced of and understand the added value of DDD to make the adoption. More importantly, top management's role is to embrace DDD throughout the entire organisation to execute the adoption effectively. Some participants refer to this as a having data-driven mindset among management and employees. Particularly in medium-sized firms, it was suggested to create a team of ambassadors that embraces DDD. Another essential role of top management is to

involve their employees in the adoption process by clearly communicating about the organisational changes that will be made, the support that will be given, and a planning of the process for adopting DDD.

Seventh, this study showed that human resources in terms of relevant knowledge about DDD and the organisation's willingness to change can be considered a critical determinant influencing the adoption of DDD. Relevant DDD knowledge addresses understanding DDD and technical knowledge. Employees should understand DDD in terms of having the capability to interpret the insights derived from the data and understand why decisions are being made because of these insights. Technical knowledge and skills are required to execute proper data management, perform data analytics, and comply with data-related legislation when using privacy-sensitive information from individuals. Therefore, the SME online retailer should evaluate its current knowledge and skills related to DDD among its employees. When there is a shortage of this knowledge within the company, it was suggested that this knowledge could either be acquired through educating employees internally or acquiring this knowledge through hiring an expert who assists these companies with implementing DDD. Also, employee support for DDD is required as this will determine the adoption degree of the organisation as a whole. Top management should therefore consider strategies of change management to minimise the resistance to change among employees.

Eighth, half of the interviewees from this study indicated that a company's culture highly influences the adoption degree of DDD. These experts suggest that the SME should have a data-driven culture in which employees are generally flexible regarding organisational changes and embrace the use of data to make decisions. This may require a very different attitude from employees on how decisions will be made. Top management needs to develop this data-driven culture across the organisation. Studies on developing a data-driven culture can provide the SME online retailer insights to assist in realising such a culture.

6.4 Research limitations

Although this study accomplished its research objective, the result must be interpreted with caution and a number of limitations should be considered. To begin with, the primary limitation of this study is subject to the generalisation of the research findings as a consequence of using a qualitative research design. This study adopted a qualitative research approach using semi-structured interviews and open-ended questions, which is a rather inappropriate strategy to generalise the results of this study.

Secondly, the sample size for the interviews could be considered relatively minor. The time frame to conduct the interviews caused this relatively minor sample size. The interviews were conducted during the holiday period which could explain the lower repose rate to the interview invitations. This means that the researcher can only rely on the participants' answers. Also, the researcher chose to conduct interviews with external parties (experts that assist SME online retailers with implementing DDD) instead of interviewing SME online retailers who successfully adopted DDD. This choice could have resulted in a biased sample because the conclusions from this research have not been drawn from the actual population (Dutch SME online retailers).

Thirdly, the researcher chose to explore the determinants that influence the adoption of DDD by SME online retailers with the aid of the TOE framework (Tornatzky and Fleisher, 1990). The researcher believed to have found appropriate reasoning from the literature to use the TOE framework for exploring the determinants of DDD adoption by SME online retailers. However, no extensive review was conducted on which technology acceptance or adoption model would be the most appropriate to accomplish this research objective. Next to that, the researcher implemented measurements to limit the bias of not only structuring the data

collection during interviews around the TOE framework. However, one must note that there is still a probability that the findings are pre-dominantly subjected to the TOE framework.

Fourthly, the findings and the empirical support of this research are limited to the research scope of this study. This research is conducted in the Netherlands, which means that the findings of this research may not be applicable for other countries. Thus, the results of this research are limited to SME online retailers operating in a similar business environment as the Netherlands.

Fifthly, the findings of this research are limited in terms of industry representation. This study was focused on SME online retailers adopting DDD. Therefore, the results of this study may not apply to other industries in which SMEs operate. Although the factors for DDD adoption were focused on SME online retailers, the results are not found to be highly specific for SME online retailers. Some interviewees indicated that the determinants affecting DDD discussed in this research generally represent the entire group of SMEs regardless of their industry activities. This raises a particular interest for future research suggestions.

6.5 Future research suggestions

In response to the research limitations described in this study, this study imposes several research directions. First of all, future research can build upon the theoretical framework from this study to further examine the adoption of DDD by SMEs using qualitative and quantitative research methods to explore and examine the determinants influencing the adoption. In addition, quantitative research could examine whether moderating effects exist between the identified TOE factors affecting the relationship of the critical determinants influencing DDD adoption. For example, financial readiness or government support & (non-)government policies may strengthen or weaken the relationship between the critical determinants and DDD adoption by the SME. Doing so will enrich the theoretical basis of DDD adoption for SMEs. As a consequence, this could lead to more effective practical implications for SMEs seeking the adoption of DDD.

Secondly, similar future research could include larger sample sizes which increase the reliability and validity of these findings. Also, future research could execute the same research approach with a similar research context but include SME online retailers who successfully adopted DDD or seek the adoption of DDD in their sample of participants. This minimises the probability of a biased sample. The results of these studies can be compared with this study to check whether or not the findings are congruent with each other.

Thirdly, future research could investigate the same research context but include a more comprehensive review of technology acceptance and adoption models to evaluate the most appropriate model to be used for this research context. Another alternative would be to simply choose a technology acceptance or adoption model other than the TOE framework in a similar reteach context. As a result, the findings of these studies will be enhanced because differences and similarities can be identified between the studies. Additionally, this leads to a more holistic perspective on the factors influencing DDD adoption by SME online retailers.

Fourthly, the findings from this study are limited to the environmental business context that is similar to the Netherlands. Future research can execute similar research methodology strategies in other studies to validate these findings in other countries with a different business environment than the Netherlands. By doing so, differences and similarities between economic and regulatory environments can be identified. Also, within the literature, it is suggested that technology adoption can vary across countries due to cultural barriers (Sun et al., 2016; Park & Kim, 2019). A cross-cultural study can assist in assessing the generalisation of these findings documented in this study.

Fifthly, this research focuses on SME online retailers adopting DDD which limits the findings of this research to this online retail industry. Future research could focus on enlarging

the scope of research to the determinants that influence the adoption of DDD in all SMEs or another industry in which SMEs are highly active. By doing so, similarities and differences between the findings can be investigated, enhancing the validity and reliability of this study.

References

Anderson, C. (2010). Presenting and evaluating qualitative research. *American Journal of Pharmaceutical Education, 74*(8), 141. doi:10.5688/aj7408141

Bertello, A., Ferraris, A., Bresciani, S., & De Bernardi, P. (2020). Big data analytics (BDA) and degree of internationalization: The interplay between governance of BDA infrastructure and BDA capabilities. *Journal of Management and Governance*. doi:10.1007/s10997-020-09542-w

Bianchini, M., & Michalkova, V. (2019). Data Analytics by SMEs: Trends and Policies. *OECD SME and Entrepreneurship Papers, 15*. doi:10.1787/1de6c6a7-en

Bradlow, E. T., Gangwar, M., Kopalle, P., & Voleti, S. (2017). The role of big data and predictive analytics in retailing. *Journal of Retailing, 93*(1), 79-95. doi:10.1016/j.jretai.2016.12.004

Caro, F., & Sadr, R. (2019). The Internet of things (IoT) in retail: Bridging supply and demand. *Business Horizons, 62*(1), 47-54. doi:10.1016/j.bushor.2018.08.002

CBS. (2022, 22 April). ICT-gebruik bij bedrijven; bedrijfstak en bedrijfsgrootte, 2020 Gewijzigd op: 22 april 2022. Geraadpleegd op 30 juli 2022, van https://opendata.cbs.nl/statline/#/CBS/nl/dataset/84831NED/table?ts=1660054946743

Chaurasia, S. S., & Verma, S. (2020). Strategic determinants of big data analytics in the AEC sector: A multi-perspective framework. *Construction Economics and Building, 20*(4), 63-81. doi:10.5130/ajceb.v20i4.6649

Chen, D. Q., Preston, D. S., & Swink, M. (2015). How the use of big data analytics affects value creation in supply chain management. *Journal of Management Information Systems, 32*(4), 4-39. doi:10.1080/07421222.2015.1138364

Chen, H., Chiang, R., & Storey, V. (2012). Business intelligence and analytics: From big data to big impact. *MIS Quarterly, 36*(4), 1165. doi:10.2307/41703503

Chen, Y., Han, Z., Cao, K., Zheng, X., & Xu, X. (2020). Manufacturing upgrading in industry 4.0 era. *Systems Research and Behavioral Science, 37*(4), 766-771. doi:10.1002/sres.2717

Coleman, S., Göb, R., Manco, G., Pievatolo, A., Tort-Martorell, X., & Reis, M. S. (2016). How can SMEs benefit from big data? Challenges and a path forward. *Quality and Reliability Engineering International, 32*(6), 2151-2164. doi:10.1002/qre.2008

Davenpoort, T. H. (2018). From analytics to artificial intelligence. *Journal of Business Analytics, 1*(2), 1-8. doi:10.1080/2573234X.2018.1543535

Del Vecchio, P., Di Minin, A., Petruzzelli, A. M., Panniello, U., & Pirri, S. (2017). Big data for open innovation by SMEs and large corporations: Trends, opportunities, and challenges. *Creativity and Innovation Management, 27*(1), 6-22. doi:10.1111/caim.12224

Delen, D., & Zolbanin, H. M. (2018). The analytics paradigm in business research. *JOURNAL OF BUSINESS RESEARCH*, *90*(1), 186-195. doi:10.1016/j.jbusres.2018.05.013

Dittert, M., Härting, R. C., Reichstein, C., & Bayer, C. (2017). A Data Analytics Framework for Business in Small and Medium-Sized Organisations. In *Intelligent Decision Technologies 2017 - Smart Innovation, Systems and Technologies* (73rd ed., pp. 169-181). doi:10.1007/978-3-319-59424-8_16

Dutta, D., & Bose, I. (2015). Managing a big data project: The case of Ramco cements limited. *International Journal of Production Economics*, *165*, 293-306. doi:10.1016/j.ijpe.2014.12.032

EuroCommerce. (2017, March). Contribution of retail and wholesale SMEs to the EU economy [Press release]. Retrieved from https://www.eurocommerce.eu/media/135423/contribution_of_retail_and_wholesale_smes_to_the_eu_economy.pdf

European Commission. (2020). Entrepreneurship and small and medium-sized enterprises (SMEs). Retrieved from https://ec.europa.eu/growth/smes_en

Ghobadian, A., & Gallear, D. (1997). TQM and organization size. *International Journal of Operations & Production Management*, *17*(2), 121-163. doi:10.1108/01443579710158023

Goswami, A., Han, W., Wang, Z., & Jiang, A. (2015). Controlled experiments for decision-making in e-Commerce search. *2015 IEEE International Conference on Big Data (Big Data)*, 1094-1102. doi:10.1109/bigdata.2015.7363863

Grandhi, B., Patwa, N., & Saleem, K. (2017). Data-driven marketing for growth and profitability. In *EUROMED JOURNAL OF BUSINESS* (pp. 675-694). Rome, Italy: EuroMed.

Grewal, D., Roggeveen, A. L., & Nordfält, J. (2017). The future of retailing. *Journal of Retailing*, *93*(1), 1-6. doi:10.1016/j.jretai.2016.12.008

Günther, W. A., Rezazade Mehrizi, M. H., Huysman, M., & Feldberg, F. (2017). Debating big data: A literature review on realizing value from big data. *The Journal of Strategic Information Systems*, *26*(3), 191-209. doi:10.1016/j.jsis.2017.07.003

He, W., Wang, F., & Akula, V. (2017). Managing extracted knowledge from big social media data for business decision making. *Journal of Knowledge Management*, *21*(2), 275-294. doi:10.1108/jkm-07-2015-0296

Hossain, M. A., Akter, S., & Yanamandram, V. (2020). Revisiting customer analytics capability for data-driven retailing. *Journal of Retailing and Consumer Services*, *56*, 102187. doi:10.1016/j.jretconser.2020.102187

Hsieh, H., & Shannon, S. E. (2005). Three approaches to qualitative content analysis. *Qualitative Health Research*, *15*(9), 1277-1288. doi:10.1177/1049732305276687

Kesavan, S., & Kushwaha, T. (2020). Field experiment on the profit implications of merchants' discretionary power to override data-driven decision-making tools. *Management Science*, *66*(11), 5182-5190. doi:10.1287/mnsc.2020.3743

Kugler, P. (2020). Approaching a data-dominant logic. *Technology Innovation Management Review, 10*(10), 16-28. doi:10.22215/timreview/1393

Lai, Y., Sun, H., & Ren, J. (2018). Understanding the determinants of big data analytics (BDA) adoption in logistics and supply chain management: An empirical investigation. *The International Journal of Logistics Management, 29*(2), 676-703. doi:10.1108/ijlm-06-2017-0153

Lautenbach, P., Johnston, K., & Adeniran-Ogundipe, T. (2017). Factors influencing business intelligence and analytics usage extent in South African organisations. *South African Journal of Business Management, 48*(3), 23-33. doi:10.4102/sajbm.v48i3.33

LaValle, S., Lesser, E., Shockley, R., Hopkins, M. S., & Kruschwitz, N. (2011). Big data, analytics and the path from insights to value. *MIT Sloan Management Review, 52*(2), 21-31.

Li, H., Dai, J., Gershberg, T., & Vasarhelyi, M. A. (2018). Understanding usage and value of audit analytics for internal auditors: An organisational approach. *International Journal of Accounting Information Systems, 28,* 59-76. doi:10.1016/j.accinf.2017.12.005

Liu, Y., Soroka, A., Han, L., Jian, J., & Tang, M. (2020). Cloud-based big data analytics for customer insight-driven design innovation by SMEs. *International Journal of Information Management, 51*, 102034. doi:10.1016/j.ijinfomgt.2019.11.002

Lu, J., Cairns, L., & Smith, L. (2020). Data science in the business environment: Customer analytics case studies by SMEs. *Journal of Modelling in Management*. doi:10.1108/jm2-11-2019-0274

Marcinkowski, B., & Gawin, B. (2020). Data-driven business model development – insights from the facility management industry. *Journal of Facilities Management*. doi:10.1108/jfm-08-2020-0051

Maroufkhani, P., Wan Ismail, W. K., & Ghobakhloo, M. (2020). Big data analytics adoption model for small and medium enterprises. *Journal of Science and Technology Policy Management, 11*(4), 483-513. doi:10.1108/jstpm-02-2020-0018

McAfee, A., & Brynjolfsson, E. (2012). Big Data: The Management Revolution. *Harvard Business Review, 90*(10), 60-68. Retrieved from https://hbr.org/2012/10/big-data-the-management-revolution

Mikalef, P., Pappas, I. O., Krogstie, J., & Giannakos, M. (2017). Big data analytics capabilities: A systematic literature review and research agenda. *Information Systems and e-Business Management, 16*(3), 547-578. doi:10.1007/s10257-017-0362-y

Mlitz, K. (2021, January 22). Global big data market size 2011-2027 [Blog post]. Retrieved from https://www.statista.com/statistics/254266/global-big-data-market-forecast/

Morabito, V. (2015). Managing Change for Big Data Driven Innovation. In *Big data and analytics: Strategic and organisational impacts* (pp. 125-153). doi:10.1007%2F978-3-319-10665-6_7

Nuortimo, K., & Harkonen, J. (2019). Establishing an automated brand index based on opinion mining: Analysis of printed and social media. *Journal of Marketing Analytics*, *7*(3), 141-151. doi:10.1057/s41270-019-00060-9

O'Connor, C., & Kelly, S. (2017). Facilitating knowledge management through filtered big data: SME competitiveness in an agri-food sector. *Journal of Knowledge Management*, *21*(1), 156-179. doi:10.1108/jkm-08-2016-0357

OECD. (2019). *OECD SME and Entrepreneurship Outlook 2019*, OECD Publishing, Paris, https://doi.org/10.1787/34907e9c-en

OECD (2021), *The Digital Transformation of SMEs*, OECD Studies on SMEs and Entrepreneurship, OECD Publishing, Paris, https://doi.org/10.1787/bdb9256a-en

Ohlhorst, F. J. (2012). Best Practices for Big Data Analytics. In *Big data analytics: Turning big data into big money* (p. 93–109). doi:10.1002/9781119205005.ch9

Opdenakker, R. (2006). Advantages and Disadvantages of Four Interview Techniques in Qualitative Research. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, *7*(4). doi:10.17169/fqs-7.4.175

Park, J., & Kim, Y. B. (2019). Factors activating big data adoption by Korean firms. *Journal of Computer Information Systems*, 1-9. doi:10.1080/08874417.2019.1631133

PricewaterhouseCoopers. (2021). Data analytics. Retrieved from https://www.pwc.nl/nl/themas/digital/data-analytics.html

Provost, F., & Fawcett, T. (2013). Data science and its relationship to big data and data-driven decision making. *Big Data*, *1*(1), 51-59. doi:10.1089/big.2013.1508

Ramdani, B., & Kawalek, P. (2007). SMEs & IS innovations adoption: A review & assessment of previous research. *Academia Revista Latinoamericana de Administración*, *39*, 47-70. Retrieved from https://www.redalyc.org/articulo.oa?id=71603904

Reinhold, M., & Reinhold, S. (2014). Data-driven intelligence for SME E-business: A marketing and sales perspective. *Marketing Review St. Gallen*, *31*(4), 52-59. doi:10.1365/s11621-014-0381-8

Rejikumar, G., Asokan, A. A., & Sreedharan, V. R. (2020). Impact of data-driven decision-making in Lean Six Sigma: an empirical analysis. *Total Quality Management & Business Excellence*, *31*(3-4), 279-296. doi:10.1080/14783363.2018.1426452

Rogers, E.M. (1983). *Diffusion of Innovations*. The free press New York

Saleem, H., Li, Y., Ali, Z., Ayyoub, M., Wang, Y., & Mehreen, A. (2020). Big data use and its outcomes in supply chain context: The roles of information sharing and technological innovation. *Journal of Enterprise Information Management*. doi:10.1108/jeim-03-2020-0119

Santoro, G., Fiano, F., Bertoldi, B., & Ciampi, F. (2019). Big data for business management in the retail industry. *Management Decision*, *57*(8), 1980-1992. doi:10.1108/md-07-2018-0829

Sen, D., Ozturk, M., & Vayvay, O. (2016). An overview of big data for growth by SMEs. *Procedia - Social and Behavioral Sciences*, *235*, 159-167. doi:10.1016/j.sbspro.2016.11.011

Singh, R. (2013). Doing organized garment retailing business in India: A critical analysis. American Journal of Industrial and Business Management, 03(05), 472-479. doi:10.4236/ajibm.2013.35054

Steinfield, C., Bouwman, H., & Adelaar, T. (2002). The dynamics of click-and-Mortar electronic commerce: Opportunities and management strategies. International Journal of Electronic Commerce, 7(1), 93-119. doi:10.1080/10864415.2002.11044254

Sun, S., Cegielski, C. G., Jia, L., & Hall, D. J. (2016). Understanding the factors affecting the organisational adoption of big data. *Journal of Computer Information Systems*, *58*(3), 193-203. doi:10.1080/08874417.2016.1222891

Sun, S., Hall, D. J., & Cegielski, C. G. (2019). Organisational intention to adopt big data in the B2B context: An integrated view. *Industrial Marketing Management*, *86*, 109-121. doi:10.1016/j.indmarman.2019.09.003

Tian, J., Zhang, Y., & Zhang, C. (2018). Predicting consumer variety-seeking through weather data analytics. *Electronic Commerce Research and Applications*, *28*, 194-207. doi:10.1016/j.elerap.2018.02.001

Tornatzky, L. G., & Fleischer, M. (1990). *The Processes of Technological Innovation*. Lexington, MA: Lexington Books.

Tornatzky, L. G., & Klein, K. J. (1982). Innovation characteristics and innovation adoption-implementation: A meta-analysis of findings. IEEE Transactions on Engineering Management, EM-29(1), 28-45. doi:10.1109/tem.1982.6447463

Troisi, O., Maione, G., Grimaldi, M., & Loia, F. (2019). Growth hacking: Insights on data-driven decision-making from three firms. *Industrial Marketing Management*, *90*, 538-557. doi:10.1016/j.indmarman.2019.08.005

Verma, S., & Bhattacharyya, S. S. (2017). Perceived strategic value-based adoption of big data analytics in emerging economy. *Journal of Enterprise Information Management*, *30*(3), 354-382. doi:10.1108/jeim-10-2015-0099

Vitale, G., Cupertino, S., & Riccaboni, A. (2020). Big data and management control systems change: The case of an agricultural SME. *Journal of Management Control*, *31*(1-2), 123-152. doi:10.1007/s00187-020-00298-w

Wamba, S. F., Akter, S., Edwards, A., Chopin, G., & Gnanzou, D. (2015). How 'big data' can make big impact: Findings from a systematic review and a longitudinal case study. *International Journal of Production Economics*, *165*, 234-246. doi:10.1016/j.ijpe.2014.12.031

Wang, S., & Wang, H. (2020). Big data for small and medium-sized enterprises (SME): A knowledge management model. *Journal of Knowledge Management*, *24*(4), 881-897. doi:10.1108/jkm-02-2020-0081

Weltevreden, J., Effing, R., & Ectors, I. (2020). *Data-driven retail: Welke bijdrage aan de kennisontwikkeling binnen dit thema willen we leveren aan de retailsector? Position Paper*. https://www.retailinsiders.nl/docs/267f8465-8039-4ffc-973b-51a92fe400de.pdf

Appendix

Appendix 1 Systematic Literature Review

The theoretical framework of this research is created through a literature review. The literature was extracted from the Web of Science database. Some articles or books refer to other authors in their study. To elaborate more thoroughly on important constructs of this study, some of these articles have been used as well.

Specifications of the literature review

Data-Driven Decision-Making

Search terms: Topic	"data-driven decision making" OR "data-driven decision-making" OR “evidence-based decision making”	2081
Publication years	2010-2021	1809
Document types	Articles, Proceedings papers and Book chapters	1536
Web of science categories	Business & Management	72
Exclude associated web of science categories	Operations Research Management Science Engineering Industrial Regional Planning Psychology Applied Public Administration Public Environmental Occupational Health Social Issues Communication	30
Reading Abstract		28
Full text		7

(TS=("data-driven decision making" OR "data-driven decision-making" OR “evidence-based decision making”)) AND ((PY==("2010" OR "2011" OR "2012" OR "2013" OR "2014" OR "2015" OR "2016" OR "2017" OR "2018" OR "2019" OR "2020" OR "2021") AND DT==("ARTICLE" OR "PROCEEDINGS PAPER" OR "BOOK CHAPTER") AND TASCA==("MANAGEMENT" OR "BUSINESS")) NOT (TASCA==("OPERATIONS RESEARCH MANAGEMENT SCIENCE" OR "REGIONAL URBAN PLANNING" OR "ENGINEERING INDUSTRIAL" OR "PSYCHOLOGY APPLIED" OR "PUBLIC ADMINISTRATION" OR "COMMUNICATION" OR "SOCIAL ISSUES")))

Big data and SME

Search terms: Topic	"Big Data" AND "SME" OR "Small and medium enterprise"	800
Publication years	2010-2021	658
Search within results	Data analytics	35
Document types	Articles	19
Reading Abstract		18
Full text		11

(TS=("Big Data" AND "SME" OR "Small and medium enterprise")) AND (PY==("2010" OR "2011" OR "2012" OR "2013" OR "2014" OR "2015" OR "2016" OR "2017" OR "2018" OR "2019" OR "2020" OR "2021") AND ALL=(data analytics) AND DT==("ARTICLE"))

TOE and Technology

Search terms: Topic	“TOE” AND “Technology”	887
Publication years	2010-2021	758
Search within results	Data analytics	32
Web of Science Categories	Management, Computer Science Information Systems, Business	15
Reading Abstract		11
Full text		10

(TS=(“TOE” AND “Technology”)) AND (PY==("2010" OR "2011" OR "2012" OR "2013" OR "2014" OR "2015" OR "2016" OR "2017" OR "2018" OR "2019" OR "2020" OR "2021") AND ALL=(data analytics) AND TASCA==("MANAGEMENT" OR "COMPUTER SCIENCE INFORMATION SYSTEMS" OR "BUSINESS"))

Big Data and Retail

Search terms: All fields	“Big Data” AND “Retail”	478
Publication years	2010-2021	478
Search within results	Data analytics, decision	38
Web of Science Categories	Computer Science Information Systems, Business, Management	23
Reading Abstract		18
Full text		8

(ALL=(“Big Data” AND “Retail”)) AND (ALL=(data analytics) AND ALL=(decision) AND PY==("2021" OR "2020" OR "2019" OR "2018" OR "2017" OR "2016" OR "2015" OR "2013") AND TASCA==("COMPUTER SCIENCE INFORMATION SYSTEMS" OR "BUSINESS" OR "MANAGEMENT"))

Appendix 2 Interview protocol and list of questions

Inform interviewee about the outlay of the interview and the conditions associated.

- Introduce myself
- My thesis project is about how DDD can be implemented by SME online retailers. Therefore, the purpose of this research is to identify and discuss the critical success factors for SME online retailers to execute DDD in their organisation. Furthermore, it is important to generate practical implications that the SME online retailers can use to assess these critical success factors for their organisation. Therefore, questions about practical actions that SME online retailers can undertake to implement DDD for their organisation will be asked.
- The interview will be structured as follows. First, we start with creating a mutual understanding of DDD. After that, we will discuss the necessary critical success factors that SME online retailers need to adopt DDD. To discuss these critical success factors, a TOE framework will be used to classify the factors under each of the dimensions Technology, Organisation, and Environment.
- The interview will have a semi-structured approach by which open-ended questions will be asked. You are kindly asked to share your experiences and thoughts as a response to the questions that will be provided during this interview. Moreover, the interview will be audio recorded after which a transcription will be made of the recording. After that, an analysis will be made for completing this research. Your participation and input will be published anonymously, and the transcriptions will be handled confidentially. The transcriptions will be temporarily saved for scientific purposes only. By participating in this interview, you agree that you consent to these terms.

General questions regarding participant

1 What is your background in terms of data-driven decision making (DDD)?

Understanding Data-driven decision making

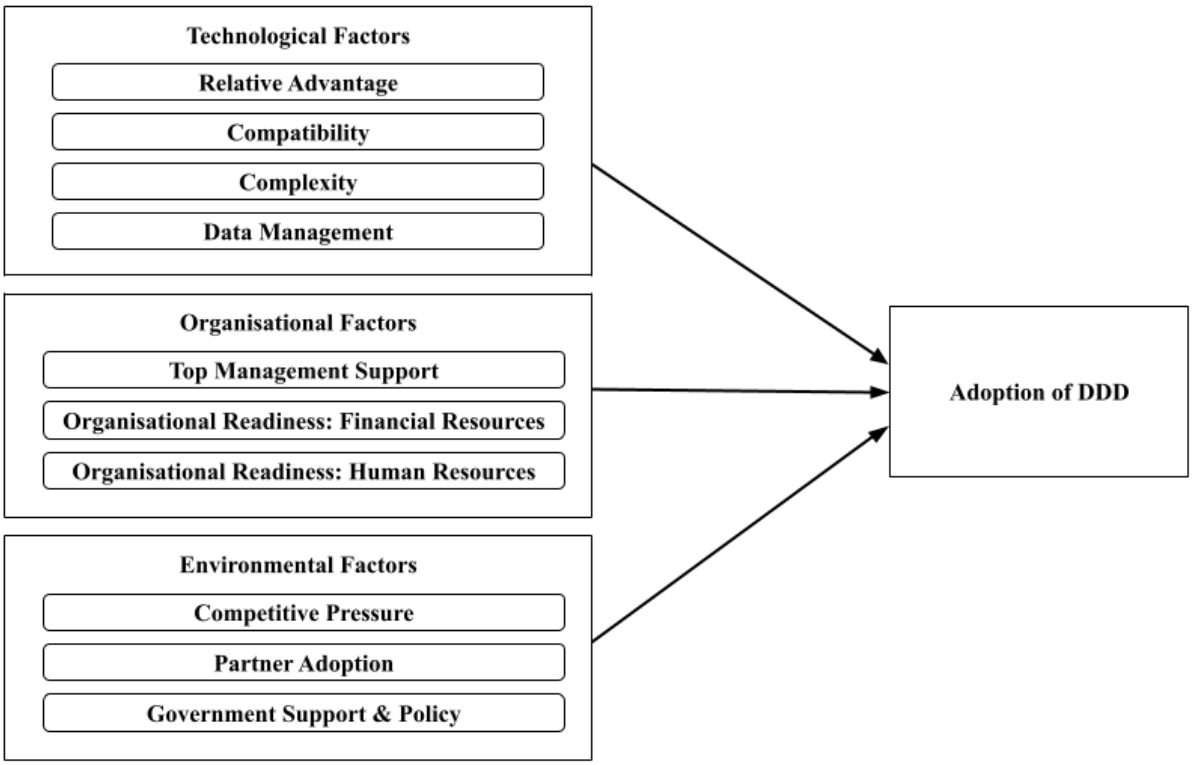
1. According to you, what is DDD? Discuss the definition used in this research
2. Why should companies make use of DDD?
3. According to you, can all companies from different size levels or industries benefit from DDD?
4. Could you elaborate on the specific benefits of DDD?
5. Also, could you also elaborate disadvantages of DDD?
6. Research shows that there is a low adoption rate among SMEs to implement DDD. Why do you believe that these rates remain to be relatively low compared to larger organisations?
7. What are specific barriers and challenges that SMEs face when implementing DDD?

Discussing the critical success factors for DDD with the aid of the TOE framework

Identify critical success factors for DDD without considering the TOE framework
Provide the opportunity to the interviewee to elaborate on critical success factors without asking for specific factors that can be placed in the TOE framework.

1. Before I show you the TOE framework with its factors, I would like to hear your opinion/view about the critical success factors that SME online retailers must evaluate to adopt DDD for their business. These factors do not have to be positioned within the TOE dimensions. So, according to you, what are the critical success factors for SME online retailers to adopt to DDD? Please elaborate on why you believe that those factors need to be taken into account as well.

Figure 1 The initial theoretical framework for adopting DDD by SME online retailers



(Show the participant the TOE framework with the identified factors from the literature). The TOE framework will be used to classify the factors that influence the adoption of Data-Driven Decision Making by SME. (In case the participant is not familiar with the TOE framework, elaborate briefly on the framework). Based on the current literature, the following factors are being considered as important and or showed a statistically significant influence on the adoption of firms using data analytics. If some of these factors are not clear to you, please let me know so I can elaborate on these factors. Together with you, I would like to discuss each of these 3 dimensions and its factors. I ask you to evaluate whether these factors are important to consider for SME online retailers and if there are any missing factors needed to implement data-driven decision making. Furthermore, we will discuss how the relevant adoption factors can be evaluated by SME online retailers to provide practical implications.

Technological dimension

1. Which of the technological factors as shown in the TOE framework do you consider as critical success factors for SME online retailers to implement DDD? Please elaborate on why you believe these factors are important.
2. According to you, are there any missing technological factors for the adoption of DDD by SME online retailers? If any, why?
3. How can SME online retailers evaluate the important factors for their organisation?

Organisational Dimension

1. Which of the organisational factors as shown in the TOE framework do you consider as critical success factors for SME online retailers to implement DDD? Please elaborate on why you believe these factors are important.
2. According to you, are there any missing organisational factors for the adoption of DDD by SME online retailers? If any, why?
3. How can SME online retailers evaluate the important factors for their organisation?

Environmental dimension

1. Which of the environmental factors as shown in the TOE framework do you consider as critical success factors for SME online retailers to implement DDD? Please elaborate on why you believe these factors are important.
2. According to you, are there any missing environmental factors for the adoption of DDD by SME online retailers? If any, why?
3. How can SME online retailers evaluate the important factors for their organisation?

Closing the interview

Is there anything you would like to add to this interview?

Thank the participant for their time and input.

Appendix 3 Code Book

ATLAS.ti Report

Thesis: DDD by SME online Retailers

Codes

○ Additional factor Environment

Groups:
- Environment

○ Additional factor Organisation

Groups:
- Organisation

○ Additional factor Technology

Groups:
- Technology

○ Amount of data

Groups:
- Technology

○ Amount of human resources needed

○ Better decisions

Groups:
- Benefits of DDD

○ Better internal policy

Groups:
- Benefits of DDD

○ Browser Privacy Policy

Groups:
- Environment

○ Communication within organisation

Groups:
- Solution to TOE factors

○ Compatibility

Groups:
- Technology

○ Competitive advantage

Groups:
- Benefits of DDD

○ Competitive pressure

Groups:
- Environment

○ Complexity

Groups:
- Technology

○ Corona

○ Culture

Groups:
- Organisation

○ Data definitions

Groups:
- Technology

○ Data governance

Groups:
- Technology

○ Data management

Groups:
- Technology

○ Definition of DDD

Groups:
- Definition of DDD

○ Definition of DDD: Intuition

Groups:
- Definition of DDD

○ Definition of DDD: Context

Groups:
- Definition of DDD

○ Employee support

Groups:
- Organisation

○ Environment: broadband connections

Groups:
- Environment

○ Facilitating role of data

Groups:
- Definition of DDD

○ Faster decisions

Groups:
- Benefits of DDD

○ Flexible mindset

Groups:
- Organisation

○ Government Support & Policy

Groups:
- Environment

○ Hire a consultant/expert

Groups:
- Solution to TOE factors

○ Knowledge

Groups:
- Organisation

○ Motivation

Groups:
- Organisation

○ National culture

Groups:
- Environment

○ Organisational readiness: Financial capabilities

Groups:
- Organisation

○ Organisational readiness: Human resources

Groups:
- Organisation

○ Overview risk/reward

Groups:
- Benefits of DDD

○ Partner adoption

Groups:
- Environment

○ Process management

Groups:
- Technology

○ Quality of data

Groups:
- Technology

○ Relative advantage

Groups:
- Technology

○ Security

Groups:
- Technology

○ Solution to culture

Groups:
- Solution to TOE factors

○ Solution to Environmental factors

Groups:
- Solution to TOE factors

○ Solution to Organisational factors

Groups:
- Solution to TOE factors

○ Solution to Technological factors

Groups:
- Solution to TOE factors

○ Something to measure or analyse

Groups:
- Technology

○ Practical implications for DDD

Groups:
- Solution to TOE factors

○ Technological tool

Groups:
- Technology

○ Time

Groups:
- Organisation

○ Top Management Support

Groups:
- Organisation

○ Type of business

Groups:
- Organisation

○ Vision

Groups:
- Organisation

○ Willingness to change

Groups:
- Organisation