The Impact of Digitalization on Headquarters of Denmark

A study of how digitalization will impact the way headquarters add value to the corporation

Student number: 92989
Pages: 79.9 (181,851 characters)

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15th of May, 2019

Master thesis

ABSTRACT

This thesis examines how digitalization impacts the way headquarters (HQs) add value to the corporation. Drawing on literature around the value adding activities of headquarters and recent research on the concept of digitalization, I analyse the opinions of 67 Danish HQ managers and find that digitalization is expected to increase the value-added of the HQ but that challenges still remain for HQs in realizing this potential. Enabled by better and more timely data, the findings suggest that HQ managers expect digitalization to assist the HQ in its entrepreneurial (i.e. value-creating) activities through better support of, and involvement in, its subunits' businesses. However, it is found that well over half of the HQs lack sufficient resources and capabilities to adapt to the digital transformation. Furthermore, four out of ten HQ managers do not agree that they have a clear understanding of how digitalization will impact the way their HQ operates. The results further indicate that the HQ managers expectations towards, and preparedness to adapt to, the digital transformation differ across HQ types, industries, and organizational levels. The conclusions in this paper are reached through an exploratory research method. The findings are based on a survey study and analysed using descriptive as well as inferential statistics such as exploratory factor analysis, t-tests, and ANOVA tests. With these findings, the study contributes to an important area of limited prior research within the academic field of digitalization and headquarters. Similarly, the study's conclusions have relevant business implications showing the high expectations Danish HQ managers have for the opportunities of digital technologies while likewise revealing the challenges and complexities associated with them.

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1. Introduction

1.1 Problem statement

HQs have long had a vital role in creating value for multidivisional corporations through guiding, supporting, and controlling the subunits they have under control (Goold, Campbell, & Alexander, 1994). However, with the rapid emergence of new digital technologies, the tools to undertake these activities are abruptly changing. The wave of digitalization is reshaping firms' competitive strategies as well as their intraorganizational way of working and coordinating (Matt, Hess, & Benlian, 2015; Snow, Fjeldstad, & Langer, 2017). Inevitably the digital technologies are also going to affect the activities of HQs and the way they add value to the corporation. Regardless, the existing literature on the topic remain sparse, and several researchers have highlighted this area as an important topic for future research to explore (Birkinshaw et al., 2018; Kunisch, Menz, & Collis, 2018; Ambos & Mueller-Stewens, 2017).

The concept of HQs value-added have received extensive attention in the existing management literature (Menz, Kunisch, & Collis, 2015). As HQs are not in themselves revenue generating entities, they must justify their existence solely by the value they are able to add to the subunits they have under control (Goold et al., 1994). Traditionally HQs have been known to add value to their subunits by undertaking two different roles that can be described as either administrative or entrepreneurial (Chandler, 1991; Foss, 1997). In interest of this study is the entrepreneurial role of the HQ which is characterized by being value creating as opposed to loss preventive. The HQ is said to create value to its businesses under control by e.g. by providing strategic guidance or generating synergies across them (Ibid.). Undertaking these activities require the HQ to understand the context of its subunits and to coordinate the activities across them (Campbell, Goold, & Alexander, 1995). All tasks that new digital technologies should have the potential to support. For instance, technologies leveraging recent advances within the area of artificial intelligence (AI) have worked well to assist decision makers in complex business contexts where an abundance of variables need to be considered (Jarrahi, 2018). In other areas, digital tools have proved useful when coordinating activities across subunits (Ambos & Ambos, 2009). Hence, digital technologies have already supported decision makers and management in activities similar to those HQs undertake. Yet, it is not evident whether, or to what extent, HQ managers likewise find that these technologies can benefit the HQ in their value adding activities. Neither is it clear how the technologies will impact the way HQs operate, or whether the HQs are prepared to realize the potential of these digital technologies. The latter is a particularly relevant concern, as organizations have been found to often struggle in realizing the opportunities offered by digital technologies (Ransbotham, Kiron, & Prentice, 2016).

This thesis aims to broaden our understanding of the above themes by investigating how managers from Danish HQs expect digitalization to impact the way HQs add value to the corporation. In this way, the thesis will on the one hand investigate a highly relevant topic for today's multidivisional corporations. On the other hand, the thesis will serve as a response to recent calls for more research within the area of HQs and digitalization.

1.2 Scope of research

1.2.1 Research question

To guide the research behind this thesis, I have formulated an overall research question that will serve as guideline for the study:

How does digitalization impact the way headquarters add value to the corporation?

To answer this question in a structured manner, I will focus on three sub-questions which will be guiding for my data collection, analysis, and later discussion of the study's findings:

***Sub-question 1*: Can digitalization be expected to increase the value-added of the HQ?**

***Sub-question 2*: How prepared are the HQs to realize the potential value-added?**

***Sub-question 3*: How will digitalization impact the way HQs operate in the future?**

How *headquarters*, *digitalization* and *value-added* is defined in the context of this study is explained below.

1.2.2 Definitions of key terms

Headquarters will in this study be defined as any regional, divisional, or corporate headquarter that undertakes parenting activities. The definition, and the reasoning behind it, will be explained in more detail in the Literature review.

Digitalization refers to recent advances in the areas of big data analytics, AI, machine learning, and automation. In particular, new means and tools available in organizations at both HQs and subunits as a result of digitalization. I adopted this definition from a paper by Schmitt, Decreton, & Nell (2019) whose study I likewise build my survey design on (See Section 3.2.1).

The **value-added** of the HQ will in this study refer to the performance enhancement of the individual subunits resulting from the HQ's ownership (Goold et al., 1998, 1994; Nell & Ambos, 2013). The value-adding activities of the HQ will be described in further detail in the Literature review.

1.2.2 The context of digital Denmark

The analysis and conclusions of this study will all be based on data obtained from HQs operating in Denmark. Having Denmark as a focal country of the research is interesting because of the country's digital maturity. For instance, the International Institute for Management Development (IMD) has ranked Denmark 4th highest in the world in their World Digital Competitiveness ranking which has the objective to "[…] assess the extent to which a country adopts and explores digital technologies leading to transformation in government practices, business models and society in general." (IMD, 2018, p. 16). Furthermore, the country ranks 1st in terms of

Future Readiness[1] for adopting to digitalization (ibid.). Similar high rankings of Denmark's digital maturity have been made by other guiding indexes such as the Digital Evolution Index (Chakravorti, Bhalla, & Chaturvedi, 2017) or the EU Commission's Digital Economy and Society Index (DESI) where Denmark ranked 1st in 2018 (Foley, Sutton, Wiseman, Green, & Moore, 2018). The priority of being on the forefront of digitalization is also reflected in Denmark's newly launched Digital Growth Strategy report which states that "[…] the Government's vision is for Denmark to be a digital frontrunner." (Ministry of Industry, Business and Financial Affair, 2018). Aside for the digital maturity of the country, Denmark likewise hosts a great variety of both regional and corporate HQs across different industries which can provide a good data variety for the study (Berthling & Andersen, 2015).

1.3 The structure of this thesis

The structure of this thesis is illustrated in Figure 1. In *Section 1*, the reader is introduced to the problem statement and research question used to guide this study. In *Section 2*, I will review the existing literature around: (1) the characteristics and activities of HQs, and (2) the possibilities and challenges of digitalization. In *Section 3*, I will describe the research method and design underlying this study, including methods used for data analysis. *Section 4* contains the analysis behind the study's conclusion and consist of three sub-sections: (1) the factor analysis used to extract the final scales from the survey responses, (2) the descriptive statistics which are used as an explorative tool to examine the patterns of my data in regard to my research question, (3) the inferential statistics in which I will test the overall findings and different trends within my data. In *Section 5*, I will discuss: (1) the implications of my findings in regard to the existing literature, (2) limitations, biases and assumptions that might influence the study's results, (3) the implications of this study's findings on future research and business practice. In section 6, I will conclude on my overall research question.

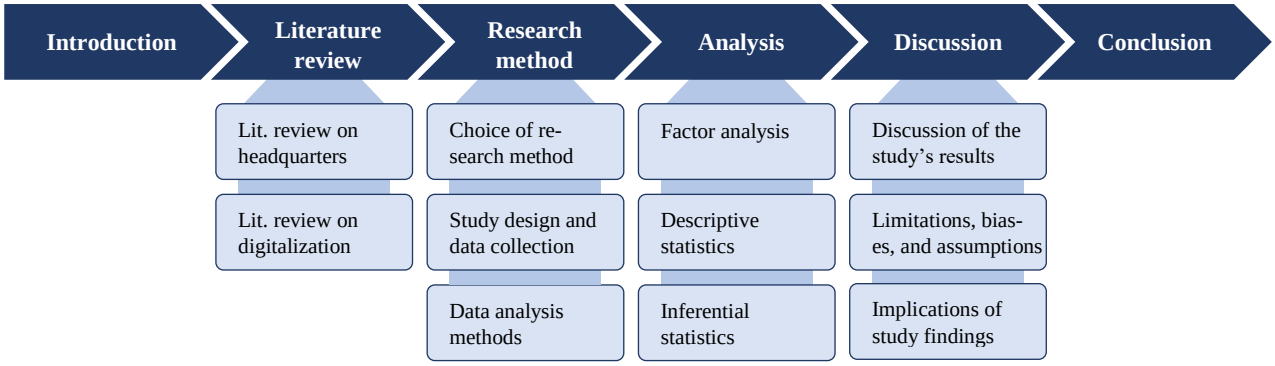

Figure 1: The overall structure of the thesis

[1] Future readiness takes into account the level of preparedness of an economy to assume its digital transformation. It incorporates three components: adaptive attitudes, business agility, and IT integration. See IMD (2018) for more info.

2. Literature review

2.1 Characteristics and activities of headquarters

In this section, I will review the existing literature around HQs and their activities. First, I will outline the basics of the HQ, describing the different HQ types and how they are justified within the modern corporation. Second, I will describe the different roles and activities associated with the HQ to clarify how HQs can add value to the corporation.

2.1.1 The basics of the headquarter

2.1.1.1 The different types of headquarters

Chandler (1962) gave one of the earliest descriptions of a HQ when he suggested the need for a corporate head office to manage multidivisional organizations. He argued that this unit would be at the top of the organizational hierarchy and consist of general executives and so-called staff specialists. Since then, a lot of literature on the topic have emerged with different definitions of what has been known as the corporate headquarter (CHQ). Early on, Mintzberg (1979) described the CHQ as the strategic apex, which ensured that "[…] the organization serve[s] its mission in an effective way […]" (p. 25). Later, Hansen & Peytz (1986) came up with a more explicit definition by describing the CHQ as "[…] the apparatus of CEO and other top managers, plus the staff advising them." (p. 128). The definition was later broadened to include more functions than those directly associated with the management of the firm. In this regard, Foss (1997) and Goold et al. (1994) describe that the CHQ within a multidivisional firm also hosts different staff functions that are not placed within the business divisions. In the same manner, Collis, Young, & Goold (2012) defined the CHQ as "[…] staff functions and executive management with responsibility for, or providing services to, the whole of (or most of) the company." (p. 12). Other definitions can be found in the literature (e.g. Stienstra, Baaij, Van Den Bosch, & Volberda, 2004; Birkinshaw, Braunerhjelm, Holm, & Terjesen, 2006; StraussKahn & Vives, 2009), but they come with limited variation. Menz et al. (2013) in their literature review on the topic, conclude that there seems to be consensus around the constructs of a CHQ within academia. They summarize the common definition of the CHQ as "[…] the firm's central organizational unit, (structurally) separated from the operating units (business and geographic units), hosting corporate executives and staff as well as central staff functions that fulfil various roles for the overall firm." (Menz et al., 2013, p. 4). Thus, in the academic literature, the CHQ is commonly defined as the central organizational unit which hosts executives and managers along with other staff functions to support the overall corporation.

In the traditional literature around HQs, most focus have been devoted to the constructs of CHQs (Menz et al., 2013). However, newer research suggests that the idea of only having one central unit to undertake all HQ activities seldomly reflects the reality (Egelhoff, Wolf, & Adzic, 2013). Multidivisional corporations frequently need to navigate and manage operations across dynamic and complex business areas often dispersed

across several geographies (Birkinshaw et al., 2006). This requires them to adopt more complex organizational structures in which the HQ activities are spread out to a subset of headquarters instead of just at a single HQ unit (Decreton, Dellestrand, Kappen, & Nell, 2017). The headquarters below the HQ are frequently referred to as either divisional headquarters (DHQs) or regional headquarters (RHQs), which oversee a group of businesses within a certain product domain or regional area (Kunisch, Menz, & Birkinshaw, 2019). Newer research on the relationship between DHQs/RHQs and CHQs suggest that the HQ activities across the different HQ-levels are more interrelated and complex than previously suggested (Nell, Kappen, & Laamanen, 2017). Hence, instead of being separated, many HQ activities require simultaneous involvement across several HQ-levels and the activities of the different HQs will often be overlapping and intertwined (Decreton et al., 2017; Paik & Sohn, 2004).

2.1.1.2 The value-added of headquarters

The true value of a HQ to the corporation is often difficult to measure in practice (Campbell & Szulanski, 2016). However, to understand its justification within the modern corporation it is necessary to view the HQ from the perspective of the value-added it provides. In contrast to the subunits within the multidivisional corporation, a HQ does not generate any revenue on its own. Consequently, the value which the HQ adds to the company will come from its support to, and control of, the individual subunits it oversees (Goold et al., 1998). When formulating the *parenting advantage framework*, Goold et al. (1994) therefore argued that the first test to justify the existence of a HQ must be to ask whether the subunits under control would "[…] perform better or worse in aggregate if they were stand-alone entities" (p. 13). The HQ must therefore seek to enhance the collective performance of its subunits to be value adding. The effect of the value-added must also exceed the cost of corporate overlay for the HQ to add a positive net value (Ibid.). Goold et al. (1994) extend the argument even further, by proposing that a net positive value is not enough to obtain a parenting advantage. Instead, they argue that the HQ must "[…] aim to create more value from its businesses than could be attained by any alternative owner." (Ibid., p. 14). Otherwise, at least in theory, the alternative owner should be willing to pay a premium for the control of the subunit's business (Ibid.; Campbell & Goold, 1995).

2.1.2 Roles and activities of the headquarter

The HQ performs several activities that allows it to add value to the subunits under its control. These activities are referred to as *parenting activities* and they are frequently associated with two separate roles which the HQ often assumes simultaneously, namely the *administrative* and *entrepreneurial* role (Chandler, 1991; Foss, 1997). Although the focus of this thesis is mainly on the activities related to the entrepreneurial role, I will briefly introduce both roles to give the reader an understanding of the traditional distinctions between them.

2.1.2.1 The administrative role

The rationale behind the administrative role is that the HQ should be loss preventive (Chandler, 1991). Originally, the tasks related to the administrative role were to monitor and control the activities of the subunits under control (Ibid.). Foss (1997) describes that the role is mostly about "avoiding the negative", e.g. opportunistic behaviour of the subunits such as sub-goal pursuit. The administrative HQ is therefore often guided by performance monitoring and control mechanisms with an aim to solve agency problems (Eisenhardt, 1985; Williamson, 1975). Menz et al. (2015) argue that the rationale of the administrative role can be extended to also encompass the *shared service activities* and the *minimum CHQ role* which HQs can also be responsible for. The shared service activities are related to Mintzberg's (1981) description of the support staff which provides indirect services to the rest of the organization. The employees responsible for providing the shared services will often be grouped in separate departments around e.g. IT systems, Human Resources, Finance, etc. (Goold, Pettifer, & Young, 2001). From grouping these services, the corporation can benefit from increased efficiency, improved coordination, more uniform policy administration, and similar scale benefits (Levitt, 1983). CHQs specifically will also be responsible for undertaking what is referred to as the minimum CHQ role and involves "[…] discharging the legal and regulatory obligations of the company and meeting minimum standards of due diligence in corporate governance." (Goold et al., 2001, p. 84). The role contains a few unavoidable activities a CHQ must undertake to maintain a corporate entity. These tasks are primarily legal in nature and involves preparing the annual reports, submitting tax returns, and ensuring general compliance with laws directly related to the corporate entity (Goold et al., 2001; Collis, Young, & Goold, 2007).

2.1.2.2 The entrepreneurial role

The rationale underlying the entrepreneurial role is that the HQ should be value creating (Chandler, 1991). From this perspective, the HQ is considered value adding when it "[…] determine[s] strategies to maintain and then strategic leadership to utilize for the long-term the firm's organizational skills, facilities and capital and to allocate resources-capital and product-specific technical and managerial skills- to pursue these strategies." (p. 33). Foss (1997) explains that the HQ from this perspective should be viewed as a "creator of the positive", e.g. by exploiting synergies in-between the subunits' businesses. Scholars have identified a wide array of activities that could be categorized as value creating over the years (Menz et al., 2015, 2013). However, for the purpose of this paper, I will focus on the activities related to (1) deciding what businesses the corporation should be in through business portfolio planning and (2) managing the corporation's different subunits to maximize their value creation.

Business portfolio planning

The tasks of deciding what businesses the corporation should be in is viewed as business *portfolio planning*, as it is concerned with the allocation of resources in-between new and existing businesses (Grant, 2016; Porter,

1987). Essentially, this incorporates the tasks Campbell et al. (1995) describe as *corporate development activities* such as pursuing acquisitions, divestments, alliances, redefinitions, and new ventures. The essential consideration is to determine whether the corporation has the right mix of businesses dependent on both the characteristics of i) the individual businesses and ii) the characteristics of the overall portfolio. To determine the attractiveness of the individual business, the HQ must consider factors such as market attractiveness (Porter, 2008), competitive advantage in the market (Barney, 1991), ability to generate cashflows (Bausch, Hunoldt, & Matysiak, 2008), etc. Nevertheless, from the perspective of a HQ, individual business attractiveness is not enough in itself to justify having a given business within the business portfolio. As described previously, the HQ should also consider whether it is able to create more value than any alternative owner (Goold et al., 1994; Campbell & Goold, 1995). In this regard, the HQ needs to determine whether they are the best owner to manage the individual business and ensure it benefits from, and contribute to, the exploitation of potential synergies with other businesses in the portfolio (Ibid.).

Maximizing the value of individual subunits

The other central strategic priority of the HQ is maximizing the value creation of the individual subunits under control. This is a dual process in which the HQ can i) improve the strategic and operational management of the individual subunit and ii) manage linkages across subunits within the portfolio.

The process of strategic and operational management of the individual subunits is referred to by Goold et al. (1994) as *standalone influence.* The HQ exercises standalone influence primarily through its involvement in the strategic decision making of the subunits (Ibid.) This involvement can come in the form of approving/rejecting budgets and strategic plans as well as influencing the shape and implementation of such plans (Grant, 2016). Chandler (1991) finds that this direct involvement in decision processes often results in increased integration of the administrative and entrepreneurial role of the HQ, as the involvement is frequently followed by increased monitoring from the HQ (i.e. tasks related to the administrative role). Besides involvement in the decision processes, the HQ can also add value as part of the strategic planning process on a business level, e.g. by finding and proposing new opportunities for the subunits' businesses (Campbell et al., 1995), or by providing sparring to the management around strategic challenges (Kaplan & Norton, 2005). Thus, the standalone influence come in many forms and, as Menz et al. (2015) concludes in their literature review, will often be contingent on the environmental and organizational context of the corporation.

Aside from the standalone influence, the HQ also has a central role in managing the intraorganizational linkages across the subunits. It is argued that these linkages can be particularly valuable to transfer skills and knowledge across the corporation's subunits (Gupta & Govindarajan, 2000; Winter & Szulanski, 2001). An example of this could be the French LVMH conglomerate which transfers both brand management and distribution capabilities among its different luxury brands (Grant, 2016). Value from transferring skills requires that

the same capabilities are applicable to the different businesses. Hence, businesses that share similarities among its buyers, value activities, or value chain is often better set for interchanging skills and knowledge in-between them (Porter, 1987). In this regard, the HQ is responsible for setting up the right governance mechanisms for facilitating interactions across the subunits (Foss, 1997; 2007). A formal setup for information exchange has later been proposed in the form of centers of excellence (Frost, Birkinshaw, & Ensign, 2002). These are subunits that are intended to share best practices across the subunits in a multidivisional corporation enabling better organizational learning (Ibid.). Besides transferring skills, subunits can also benefit from sharing activities such as R&D facilities to benefit from economies of scope (Teece, 1980). Fostering this kind of collaboration does require the HQ to take extensive involvement (Goold et al., 2001) and the set-up of a formal governance to support it (Foss, 2007; Porter, 1987).

2.1.3 Conclusion: Towards a definition of headquarters

As the literature review shows, HQs come in many forms and are complex constructs that undertake different roles and activities. To capture this complexity, I will therefore adopt a broad activity-based definition of *headquarters* as any regional, divisional, or corporate headquarter that undertake parenting activities. A definition also proposed by Nell et al. (2017). As described, parenting activities refer to activities related to the HQ's support and control of its subunits. These activities can either be entrepreneurial or administrative by nature. The latter referring to activities that are mainly loss preventing and the former to activities that are value creating.

2.2 Possibilities and challenges of digitalization

In this section, I will briefly review the existing literature on digitalization in relation to HQs. I will first give a brief introduction to the current research within the area. Next, I will explain the potential opportunities emerging from the increased digitalization. At last, I will describe the challenges frequently associated with adopting digital technologies.

2.2.1 Digitalization's impact on corporations and HQs

In recent years, digitalization has become a central imperative for many corporations. The term digitalization, also known as digital transformation, is referred to in the literature as the adoption or increased use of digital or computer technology by an organization, industry, or country (Brennen & Kreiss, 2014; Reis, Amorim, Melão, & Matos, 2018). In the context of corporations, the term is therefore frequently used to describe new ways in which digital technology can be used to create and capture value (Gobble, 2018). Enabled by rapid advancements in the worldwide IT infrastructure, these new digital technologies are constantly emerging and transforming the way we live, work, and organize across industries and geographies (Mazzei & Noble, 2019;

Degryse, 2016). For instance, the emergence of new digital information and communication technologies have improved firms' abilities to coordinate across subunits (Ambos and Ambos, 2009) and provided new tools to predict business opportunities and threats (Matt et al., 2015).

Despite the many ways' digitalization is predicted to change how firms operate and organize, only limited research has been made into how it might impact HQs. For instance, Ambos & Mueller-Stewens (2017) argue that new digital management tools and means have the potential to enhance the way HQs develop and steer their subunits, but they conclude that the topic remains largely unexplored. Similarly, in a "call for papers" around HQs in the 21st century, Kunisch et al. (2018) explicitly ask for more research on how technology and automation will affect tasks at the HQ. Several other researchers have made similar requests for more research within this area (e.g. Birkinshaw et al., 2018; Menz et al., 2015). Despite the general lack of literature in the area, Schmitt et al. (2019) just recently contributed with a paper on the topic; 'How corporate headquarters add value in the digital age' in Journal of Organization Design. Here they investigated the subject within the context of CHQs in Austria. As will be elaborated in the Section 3.2, this thesis builds on their survey design and I will therefore also discuss my finding in regard to their study in Section 5. In brief, they found that CHQ managers expect their CHQ to become more powerful and involved in their subunits' businesses as a result of digitalization, and that this would be driven by better and more timely data. Although these changes were expected to increase the value-added of the CHQ, they likewise cautioned that the benefits might not be easily obtained (Ibid.). In a similar manner, I will in the next sub-sections describe the potential opportunities of digitalization for HQs and the challenges commonly associated with realizing digital opportunities.

2.2.2 The potential of digitalization for HQs

2.2.2.1 The value of digitized data

Although *digitization* and *digitalization* are often used interchangeably among practitioners, then the two terms differ substantially in meaning. As already described, the term digitalization refers to the adoption or increased use of digital or computer technology to create new sources of value for the corporation (Brennen & Kreiss, 2014; Gobble, 2018). Digitization, on the other hand, refers to the preceding process of converting analog information into digital data; e.g. transmitting key documents via email instead of paper (Orellana, 2017). Gobble (2018) accurately describes how the process of digitization works as an enabler of digitalization: "In digitalization, digitized data is the basis of knowledge that can be used to take action and generate change." (p. 56). Consequently, digitization can be viewed as a prerequisite for digitalization. At the beginning of this decade, digitization had been such an integrated part of organizations, firms, and societies that a new paradigm had started emerging in the academic literature, namely *big data* (Mauro, Greco, & Grimaldi, 2016). In a frequently cited paper on the topic, McAfee & Brynjolfsson (2012) described the central constructs of the *big data* movement as being *volume*, *velocity*, and *variety* in data flows which were all increasing by an

unprecedented speed. *Volume* refers to the amount of available data; *velocity* to the rate of data creation; and *variety* to the different forms and sources of data that were used. Today, these constructs are widely known, and the movement from analog to digital processes have been initiated and completed across most firm activities already (Brennen & Kreiss, 2014). Consequently, the availability of data no longer seems to be a concern for most of today's modern corporations. Instead, companies have turned their focus towards sorting through the vast data amounts and converting it into actionable insights at the strategic level of the corporation (Grover, Chiang, Liang, & Zhang, 2018; Chen, Chiang, & Storey, 2012).

2.2.2.2 Opportunities of digital technologies

In order to create insights from data, most companies have intensified their digitalization efforts as processing and making inferences from vast data sets requires much more advanced analytics and technologies than what has previously been needed (Mauro et al., 2016; Constantiou & Kallinikos, 2015). In the academic literature, several qualitative and quantitative studies have already described how digitalization can enable better strategic decisions by converting data into insights (Liu, Han, & DeBello, 2018; Newell & Marabelli, 2015; Sharma, Mithas, Kankanhalli, 2014). For instance, Davenport (2014) is documenting how companies like Bank of America and Macy's are using big data to generate insights on their customers across multiple channels to evaluate current and future business opportunities. Most firms in his study leveraged digital technologies to enhance the quality of data used in decision making and to quicker react to new market trends and tendencies (Ibid.). In a similar manner, Jarrahi (2018) finds that AI techniques such as machine learning and neural networks can enable better sensemaking of complex business situations in which many variables and large amounts of data need to be considered. In other areas, the increased use of digital technologies has enabled better communication and coordination across subunits, e.g. through new digital platforms and tools that enable easier information sharing (Snow et al., 2017; Bughin, Chui, Harrysson, & Lijek, 2017). Many of these digital opportunities seem to translate well into the context of HQs where they have the potential to support HQs in tasks such as strategic decision making, portfolio planning, and information sharing across subunits.

2.2.3 The challenges of going digital

Despite the opportunities of digital technologies, practitioners frequently seem to be struggling in capturing the value of the digital opportunities (Günther, Mehrizi, Huysman, & Feldberg, 2017). For instance, in a survey study of more than 2,000 corporate managers' attitude towards the use of digital analytics, Ransbotham et al. (2016) find that more than one-third of the respondents do not agree that the use of digital analytics has lived up to the hype. The difficulties of digitalization are also documented in the newest edition of McKinsey's Global Institute survey among executives and IT respondents. The survey indicates that while 85% of respondents wanted to deliver large scale digital solutions internally in their corporations, only 18% were able to do it currently (Dhasarathy, Khan, Rahul, & Reynolds, 2018). Similarly, Bughin, LaBerge, & Mellbye (2017) who

examined digitalization efforts across a wide range of industries, find that only around half of all digital projects are able to generate a return of investment (ROI) above the cost of capital. Thus, generating value from digital solutions is not an easy task and it requires corporations to ensure that the right setup is in place to support the digitalization efforts (Günther et al., 2017).

To make use of digital opportunities, firms are required to have at least two things in place: (1) they need to have a clear understanding of how the digital opportunities can support their operations, and (2) they need to have the right resources and capabilities to implement the digital solutions. The former requires firms not only to understand the digital opportunities available, but likewise to understand how these will impact the firm's operations through structural changes, i.e. variations in the firm's organizational setup such as the placement of new digital initiatives within the corporate structure (Matt et al., 2015). In the same way, to make a successful digital transformation, a firm needs to understand how it expects the digital technologies to add value instead of merely implementing the technologies without a clear purpose (Günther et al., 2017; Heavin & Power, 2018). This likewise requires a more focused approach in which the company should not expect to transform all parts of the firm at once (Westerman, Bonnet, McAfee, 2014). Yeow, Soh, & Hansen (2018) also highlight the importance for firms in having a clear understanding of how they will leverage digital technologies prior to initiating digital projects. Building on Teece's (2014) dynamic capability framework, Yeow et al. (2018) describe how the first step for managers in undertaking digitalization efforts is to be *sensing* towards the digital opportunities, meaning that they should be "[…] able to identify and understand the changes that are required and how these changes can be implemented as part of their strategic approach." (p. 46). In the context of HQs, it is reasonable to believe that at least some of these elements will also hold true, meaning that HQs must first have some understanding of how digitalization can support their operations before embarking on a digital journey.

Another requirement frequently associated with realizing the value of digital opportunities is the need to have the right resources and capabilities in place (Trevor & Varcoe, 2017). In this regard, a minimum requirement is to ensure that sufficient financial resources are available to support the digitalization efforts as these can be costly to undertake (Mithas, Tafti, & Mitchell, 2013; Bughin et al., 2017). However, what most companies struggle with is having the right capabilities and knowledge to pursue digital opportunities, as the supply of skilled IT people does not meet the rapid growing demand for IT competencies (Dhasarathy et al., 2018; Milano, 2019; Hoberg, Krcmar, Oswald, & Welz, 2017). This was also the conclusion in Kane, Palmer, Nguyen-Phillips, Kiron, & Buckley's (2017) study among 3,500 managers and executives worldwide. They find that only 27% of the respondents agree that their organizations have sufficient talent today to support their organizations' digital strategy. Another important consideration related to the access of the right capabilities is whether to pursue outsourcing strategies on the IT-front which has been common practice among many corporations previously (Yang & Huang, 2000). Yet, having IT capabilities outsourced rather than in-house can

be a challenge for companies when trying to build a strong digital foundation due to the difficulties and hidden cost associated with outsourcing core activities (Tadelis, 2007). On the other hand, partnerships with high-quality outside vendors have also been argued to be a beneficial enabler in digital transformation when niche-knowledge or specific expertise are needed in areas outside the competencies of the in-house IT team (Krüger & Teuteberg, 2016; Daub & Wiesinger, 2015). In sum, having the right resources and capabilities appear to be an important priority for firms in pursuing on digital opportunities. Consequently, HQs would also need to have sufficient resources and capabilities in place in order to realize the potential of digital technologies.

2.2.4 Conclusion: The opportunities and challenges of digitalization

Digitalization is offering new ways of putting digitized data to use and provides valuable opportunities for firms to enhance internal coordination and communication. However, realizing the digital opportunities require firms to have a clear understanding of the impact of digitalization along with sufficient resources and capabilities to adapt. Existing literature have covered these themes within the broad context of corporations. However, besides the study from Schmitt et al. (2019), limited research has been made to understand the effects digitalization will have on the specific activities of HQs. Consequently, I will also draw on the conclusions from the broader digitalization literature when analysing and later discussing the findings of this study.

3. Research method

This section will cover the research method applied in this study. First, I will explain the reasoning behind my choice of research method. Second, I will explain the structure of the study focusing on the design of the survey and the subsequent data collection. Third, I will briefly introduce the different statistical tests and methods applied in my data analysis.

3.1 Choice of research method

The research method and format of a study can take many different forms depending on the research objective (Blaikie, 2003). Overall, a research method can be characterized as either *exploratory*, *descriptive*, or *casual* in nature (Zikmund, 2003; Zikmund, Babin, Carr, & Griffin, 2013). The choice of research method is often influenced by the uncertainty around the situation motivating the research (Zikmund et al., 2013). In this regard, exploratory research is conducted to clarify an ambiguous situation to which limited prior research have been made. These types of studies are not intended to produce conclusive evidence around a given situation (Balikie, 2011). Rather, they are made in order to guide and refine subsequent research (Zikmund et al., 2013). The descriptive research often succeeds the exploratory study and tries to examine more specific issues that have been covered in the exploratory research. This type of study is more strictly guided by a clear research question often supported by hypotheses trying to describe the given issues (Zikmund et al., 2013; Zikmund, 2003). When more certainty has been gained around the topic, then casual research will be most appropriate. With the purpose of clarifying the '*why*' of the situation, these types of studies will frequently seek to identify cause-and-effect relationship about the topic to gain a more in-depth understanding of it (Zikmund et al., 2013; Blaikie, 2003). As such, the exploratory study can often be viewed as the initial research trying to describe an ambiguous situation. Afterwards, descriptive and causal studies will succeed it to broaden our understanding of the situation.

As covered in the literature review, the topic of digitalization's impact on HQs remains a mostly undiscovered area within the existing academic literature (e.g. Menz et al., 2015). These circumstances make it difficult to base this study on prior knowledge about the topic, apart from general understanding of HQs' operations and what is already known about the impact of digitalization in broader settings. Consequently, an exploratory research method has been chosen to guide this study. As briefly explained, the exploratory research method is used to "[…] develop an initial rough description or, possibly, an understanding of some […] phenomenon." (Blaikie, 2003, p. 11). The most frequent way to collect data for this type of research is through the use of qualitative methods as they can enable the researcher to get a broad initial understanding of an existing situation (Blaikie, 2003; Zikmund et al., 2013). Regardless, this method does have limitations when it comes to investigating the construct of HQs. As described by Menz et al. (2013) HQs often differ significantly in size, form, and activities, e.g. some focus more on entrepreneurial other on administrative activities of the HQ.

Hence, using a qualitative study would likely be inadequate to encapsulate the broader perception of digitalization's impact on the way HQs add value to the corporation which was the overall purpose of the study. Adding to this complication are the significant differences in corporations' existing digitalization efforts on a strategic level (Ransbotham et al., 2016), which makes it even more difficult to get a broader understanding from looking at only a few individual cases. Consequently, I have chosen a quantitative research design to broaden the perspective. The quantitative design is supported by an online survey to collect the data. Using the survey-format enabled me to reach a wide range of firms and thus explore the expectations towards digitalization across different HQ settings. Limitations and biases related to the method will be discussed in Section 5.2.

3.2 Study design and data collection

3.2.1 Building on the survey design of Schmitt et al. (2019)

As mentioned earlier, the survey design of this study builds on a survey structure that was developed and applied by Schmitt et al. (2019) in their recent work. This means that the questions for this study are also adopted from their original questionnaire, although minor wording adjustments were made to individual items. I chose not to make any substantial adjustments to the original questions, as Schmitt et al. (2019) had already pre-tested the questions through qualitative fieldwork. I therefore expected that this would ensure a higher validity of the individual scale items than producing them myself. Furthermore, I also relied on their findings when defining the term digitalization in the survey. Schmitt et al. (2019) found that practitioners predominately have not yet adopted a more formal definition of digitalization as the one put forward by e.g. Brennen & Kreiss (2014). Consequently, I adopted their broad definition of digitalization which refers to "[…] recent advances in the areas of big data analytics, artificial intelligence (AI), machine learning, and automation. In particular, […] the new means and tools available in organizations at both CHQs and subunits as a result of digitalization." (Schmitt et al., 2019, p. 2). In this study, however, the term will refer to digital tools available in *HQs* rather than strictly focusing in *CHQs*. Despite the similarities, the studies are not overlapping in their findings as Schmitt et al. (2019) selectively focus on CHQs within Austria as opposed to this study which focuses on HQs in Denmark. In addition, they only present their findings around a small subset of the items explored within this thesis. In the next sub-sections, I will present the structure of the survey design.

3.2.2 The design of the survey

Undertaking a survey-study requires several considerations regarding the survey questions and the distribution of the survey (Vaus, 2014). With this study's focus on how HQs add value to the corporation, a natural first consideration would be how to quantify a HQs value-added. From an academic perspective the value-added can be explained as *the performance enhancement to the individual businesses units resulting from the HQ's ownership* (Goold et al., 1998, 1994; Nell & Ambos, 2013). However, such measure is cumbersome, if not

impossible, to construct in practice. Instead, the study would need look at the *perception* of value-added as perceived by the survey respondents. To this end, Vaus (2014) argue that it can be beneficial to ask questions related to sub-dimensions of the overall concept when investigating more abstract concepts such as 'perceived value-added'. He refers to this process as *descending the ladder of abstraction*, meaning that the survey should be "[…] moving from the broad to specific, from the abstract to the concrete." (Ibid., p. 45). The sub-dimensions are then made to partly explain the overall concept in a more specific manner which is easier for the survey participants to comprehend. In this study, I likewise used sub-dimensions to explore different overall concepts. I refer to the overall concepts as *categories* in the remainder of the thesis. An example of the relation between categories and sub-dimensions is presented in Figure 2.

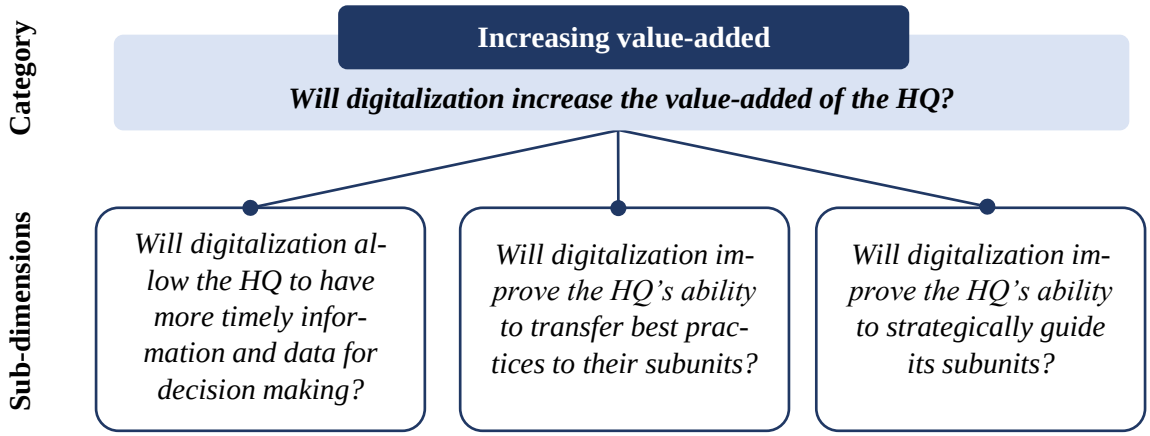

Figure 2: Example of a category with three sub-dimensions to it

The most common approach to investigate different sub-dimensions and their categories is through the use of Likert scales (Boone & Boone, 2012; Jensen & Knudsen, 2014). When using Likert scales the sub-dimensions are referred to as individual *items* which the respondents must rate on a scale from e.g. 'strongly agree' to 'strongly disagree' (Joshi, Kale, Chandel, & Pal, 2015). The statements to each item are then converted into numeric values and thereupon added together to form a joint score for the overall category (Ibid.). For the purpose of this study, I used the same approach by applying a 6-point scale as illustrated below for each individual item.

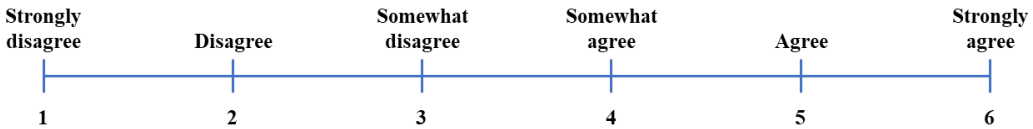

Figure 3: The 6-point scale used for single items in this study

In total, the survey consisted of 29 items spread out on four different categories in my survey. To develop the final Likert scale for each category, I took an average of the scores for the individual items within the category. Furthermore, I re-labelled the average Likert scores using the below methodology to provide a more intuitive understanding of the scores that fall in-between the different intervals. It is important to notice that all scores that fall between "Somewhat disagree" and "Somewhat agree" will be categorized as "Neutral".

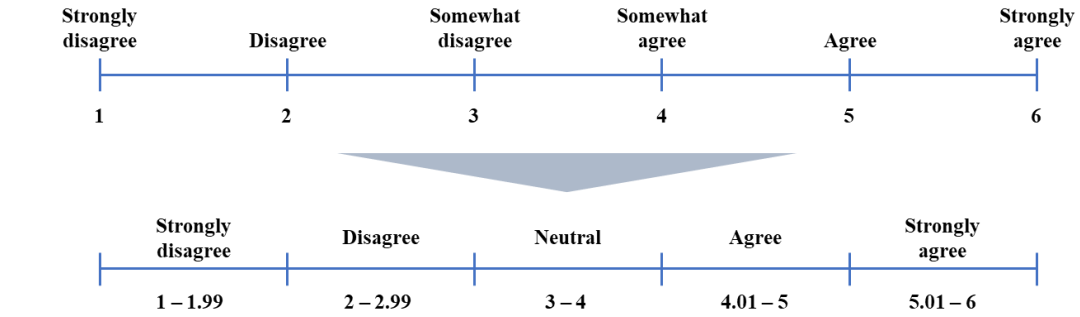

Figure 4: The converted 6-point Likert scale used in the analysis

The four overall categories are meant to each provide clarity towards the sub-issues from the problem statement. An overview of the four categories can be found below.

	Increasing value-added	Understanding impact	Resources & capabilities	HQ operations
What does the catego-ry explore?	*Will digitalization increase the value-added of our HQ?*	*Have the HQs developed a very clear idea of how digitalization will impact their HQ?*	*Do the HQs have sufficient resources and capabilities to adapt to the digital transformation?*	*How will digitalization change the way HQs operate?*
Items in category	**8**	**4**	**7**	**10**

Table 1: Overview of the different categories in the survey

Increasing value-added is meant to examine the first sub-issue of my problem statement. *Understanding impact* and *Resources & capabilities* are meant to investigate the second sub-issue. *HQ operations* is meant to explore the third one. Besides ranking the items in the survey, the respondents were asked to answer a few questions about their HQ and their own role within it. An overview of the different categories and their items can also be found below in Table 2 and the full survey can be viewed in Appendix 2

1. Increasing value-added	*The digital transformation will …*	
	Q1	allow our HQ to have better information and data for decision making (e.g. through more sophisticated data mining tools)
	Q2	allow our HQ to have more timely information and data for decision making (e.g. through real-time dashboards)
	Q3	enable our HQ to better predict relevant factors (e.g. better sales forecasts via predictive analytics)
	Q4	improve performance feedback for the overall corporation
	Q5	improve our ability to strategically guide our subunits (e.g. communicating new insights of how customer benefits can be achieved)
	Q6	improve our ability to transfer best practices to our subunits (e.g. through advanced gap analysis and process mining)
	Q7	improve our ability to identify and implement synergies between subunits (e.g. due to more and better information about the subunits' contexts)
	Q8	allow us to better allocate our attention to real issues in our subunits (e.g. through AI-driven alert systems)

2. Understanding impact	*We have developed a very clear idea of digitalization's impact on …*	
	Q1	how our HQ functions
	Q2	how our HQ adds value to the firm in the future
	Q3	what resources and capabilities our HQ needs
	Q4	what the organizational setup of our HQ shall be

3. Resources & capabilities	*To what extent does your HQ have sufficient resources & capabilities to adapt your HQ to the digital transformation?*	
	Q1	Our HQ have the required know-how to drive digitalization
	Q2	Our HQ have sufficient financial resources
	Q3	We are well aware of digitalization opportunities for our HQ
	Q4	All key functions of our HQ are in-house and not outsourced (e.g. IT)
	Q5	We have enough well-qualified/skilled employees in our HQ
	Q6	Our HQ are the technology scout for digitalization within the organization
	Q7	We have already established a good set of external partners (e.g. with consultants) that help our HQ with digitalization

4. HQ operations	*What is the effect of digitalization on the way your HQ managers operate?*	
	Q1	There will be more room for intuition by top managers
	Q2	Our HQ will be able to involve itself more in subunits businesses
	Q3	Our HQ will get much "closer" to the subunits
	Q4	Our HQ will become more powerful vis-à-vis its subunits
	Q5	Our HQ will have more room for strategic thinking
	Q6	Personal accountability will become more important
	Q7	Personal relationships will become more important
	Q8	Our HQ will take over more activities (more centralized approach)
	Q9	Our HQ will refocus on activities that machines and AI cannot do
	Q10	Our HQ becomes more data-driven

Table 2: The survey categories and related items

When examining the survey categories, it can be seen that category 4, *HQ operations*, is not strictly referring to one single overall concept. Instead, the items within this category are meant to explore several different aspects of how digitalization might change the way HQs operate. I will later use factor analysis to determine, how related these items are upon collecting the data (See section 4.1). The remaining categories are more traditional with the items referring to only a single overall concept.

3.2.3 Distributing the survey

Using a survey design to reach a narrow target group, i.e. managers at Danish HQs, requires a targeted distribution method to ensure only the relevant people respond to the survey. To fulfil this aim, I decided to distribute the survey via e-mail as this is a viable low-cost method to reach a targeted audience (Dillman, Smyth, & Christian, 2014). The initial steps to make this distribution was 1) to identify companies' and HQs relevant for the analysis, and 2) to find e-mail addresses on the relevant contact persons within these HQs.

In deciding what companies and HQs to contact two key criteria were considered. First, the company needed to be large enough to undertake parenting activities across several subunits. Secondly, the company should have either a CHQ, RHQ, or DHQ in Denmark. Deciding whether a company is sufficiently large to take on HQ activities is not clear-cut, but an often-used metric in studies of HQs is the number of employees or full-time equivalents (FTEs) under control by the HQ[2] (e.g. Collis et al., 2007). Similarly, this study aimed to only contact companies with HQs that had more than 250 employees under control. The threshold value was based on Eurostat's classification of large enterprises which is defined as companies with more than 250 persons under employment (Eurostat, n.d.). To identify the HQs that were operating in Denmark, I exclusively looked at companies which were part of the Danish Central Business Registration (CVR) database. This allowed me to also identify companies that might only have a RHQ in Denmark (but their CHQ abroad) as these companies in most cases would also have a unique Danish CVR number to them. In addition, the companies must publicly disclose the approximate number of FTEs under employment to the CVR database. This enabled me to sort out companies with less than 250 FTEs under control. From this search strategy, I Initially derived a list of ~600 companies with Danish CVR codes.

In identifying the relevant employees to contact from my company-list, it was important that the employees had either a strategic role within the HQ function or that they were involved in digitalization processes within the HQ. Furthermore, the survey would be distributed via e-mail which required that I was also able to find an e-mail address for the person. I would therefore use various databases to extract this contact information; e.g Orbis, LinkedIn, and company webpages. In my datamining strategy, I would primarily search for employees with strategic or digital responsibility within the executive board of the firm (e.g. CEOs, CIO, COO etc.). If it

[2] *FTEs under control* refers to total number of FTEs employed in the business units under control by the HQ.

was not possible to find employees from the executive board, or the HQ was either regional or divisional, then I would search for relevant senior managers within the HQ, e.g. managers within the HQ's strategy department or managers with responsibility for the digital processes of the HQ. With this search strategy, I was able to collect e-mail addresses on 1,038 managers and executives from 420 companies. Afterwards, I ran a last check on the characteristics of the managers' HQ. Here, I removed any employee whose HQ could be characterized merely as a subsidiary (i.e. with limited parenting activities) rather than a CHQ, DHQ, or RHQ. This reduced the list to a total of 943 contact persons who would receive an e-mail with a survey-link. 58 of the recipients were also contacted directly via phone or LinkedIn messages to ask for their participation. Furthermore, follow-up mails were sent out two weeks after the initial mail distribution to ask the contact persons for their participation. In total, 103 survey responses were initiated and 67 were fully completed. With 943 recipients altogether, this gives me a total response rate of 7.1%. An overview of the whole data collection process can be found in Figure 5 on the next page.

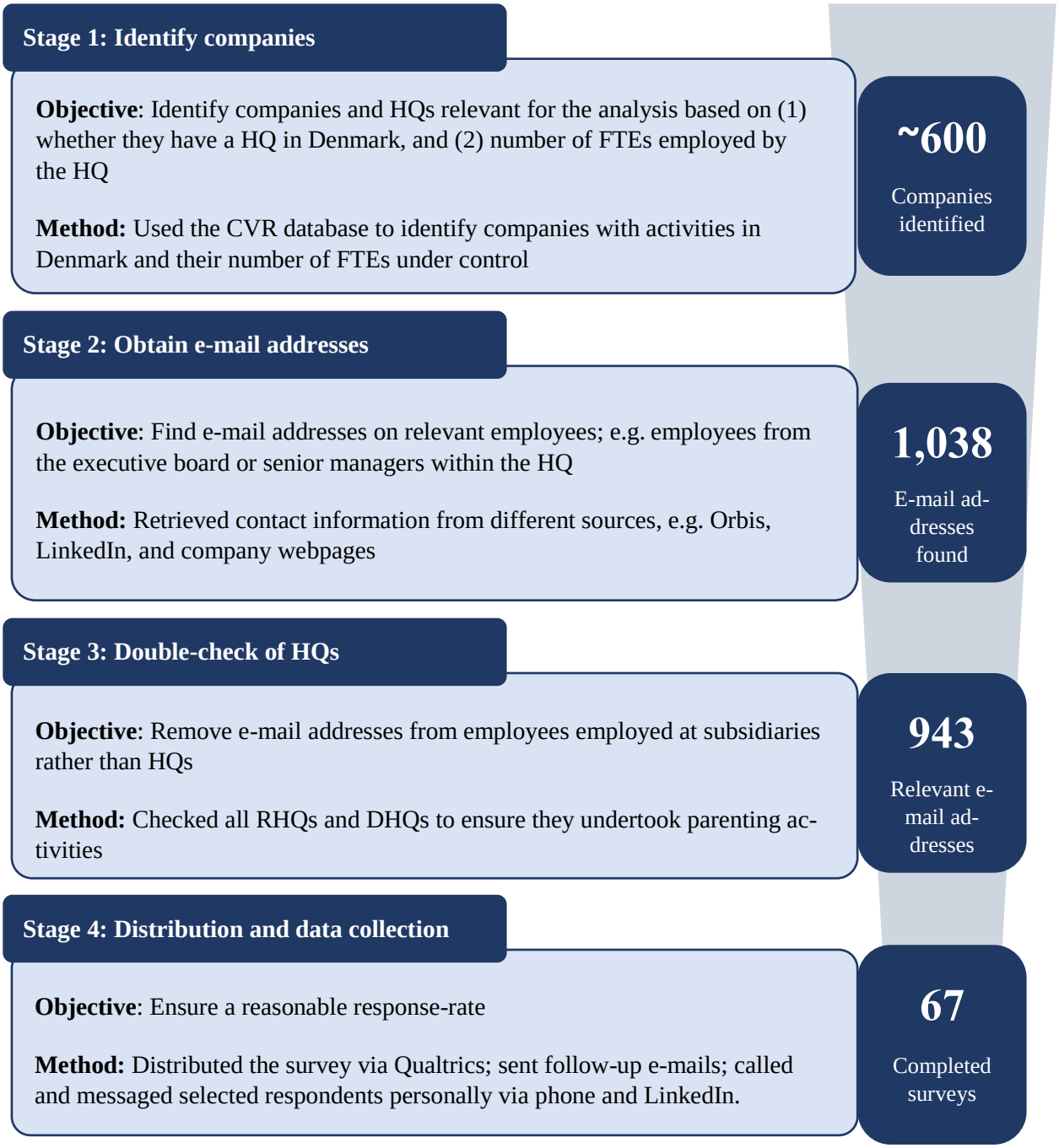

Figure 5: Overview of the data collection in this study

3.2.4 Description of sample

3.2.4.1 Personal characteristics of the respondents

In this sub-section, I will briefly describe the characteristics of the survey respondents. In terms of organizational level, almost half of the respondents were part of the executive board within their respective firms, and 76% were either in the executive board or 1-level below it. Furthermore, 81% of those respondents who were more than 1 level below the executive board were either holding a direct strategic role or working with IT within the corporation. The managers holding a strategic responsibility are highly relevant for this survey as

they are expected to also be involved in the strategic planning activities of their HQ. On the other hand, the managers with IT responsibility would be expected to possess a good understanding of the digital initiatives within the HQ. An overview of the respondent distribution can be found in Figure 6 below.

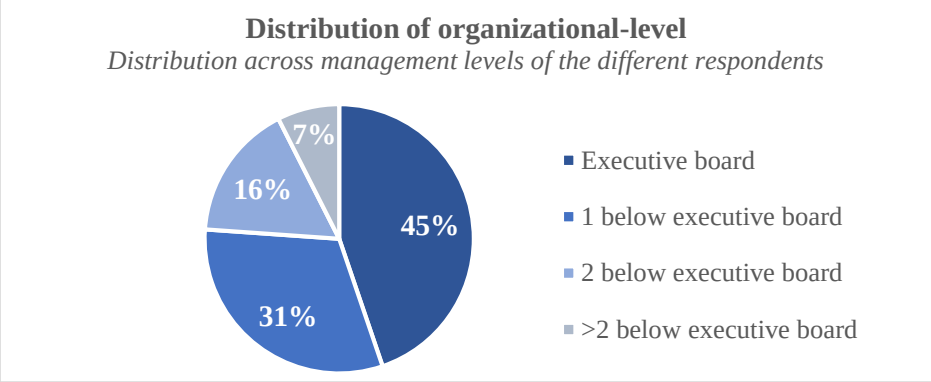

Figure 6: Distribution of respondents based on management level

3.2.4.2 Characteristics of the respondents' HQs

Besides the personal characteristics of the respondents, I also gathered information related to the characteristics of their HQs. In total, HQs from 14 different C25 companies were represented in the survey. In terms of industries, the HQs were categorized into six overall industry types. The industries were determined by the companies' industry codes which are the Danish equivalent to the NACE and ISIC classifications used to categorize the industries of European corporations (Torma, Simbold, Sørensen, Madsen, & Skjelbo, 2015). Afterwards some of the industries were grouped together to form the categorizations used for further analysis in this study (See Appendix 3 for more information on the industry groupings). An overview of the respondent split across industries can be found in Figure 7 below.

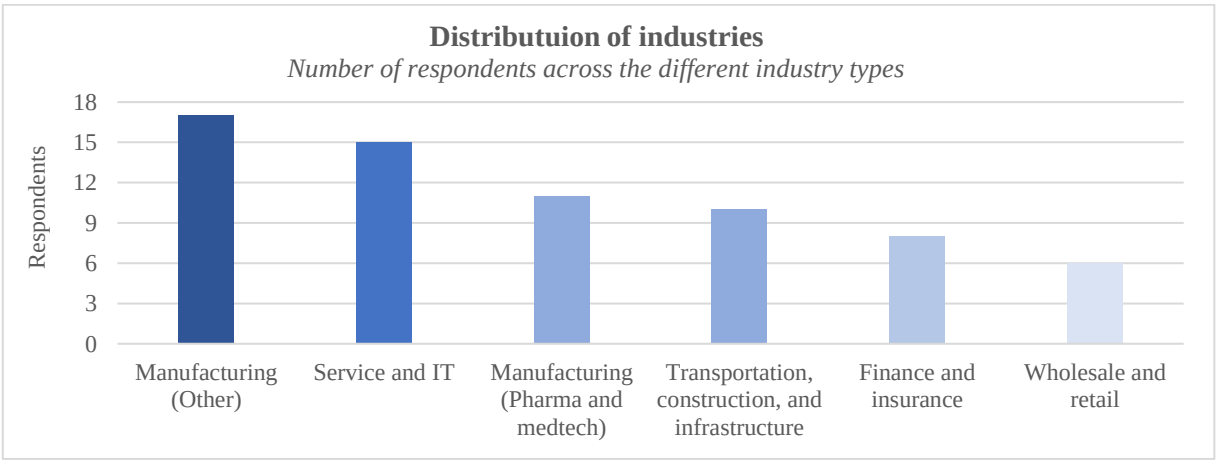

Figure 7: Distribution of the respondents based on industries of the HQ[3]

[3] The industry *Manufacturing (Other)* covers the manufacturing companies that were not operating within the fields of pharma and MedTech, e.g. electronics, FMCG, heavy machinery, etc. For more info see Appendix 3.

Although the HQs operated within different industry domains, the respondents mainly represented the same type of HQs with 82% of the respondents working within the CHQ of their corporations and only 18% representing regional or divisional HQs. In terms of size, the average amount of full-time equivalents (FTEs) under control by the HQ was 6,500 [min. 250; max. 76,000]. I divided the different HQs into three overall size categories: Small (<500 FTEs under control) with 23% of the respondents; Medium (500-2000 FTEs under control) with 37% of the respondents; and Large (>2000 FTEs under control) with 40% of the respondents. A full overview of the different type of sizes can be found in Figure 8 below.

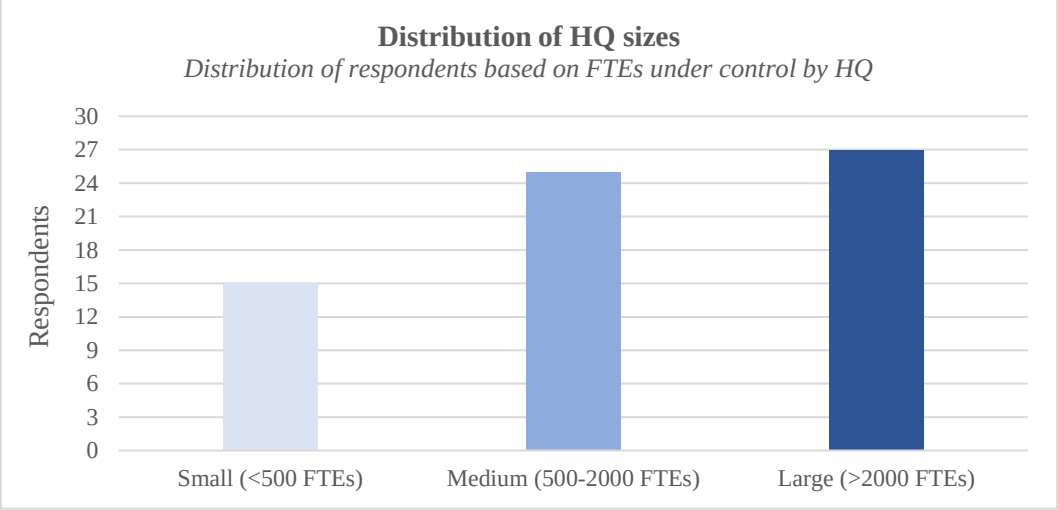

Figure 8: Distribution of respondents based on FTEs under control by the HQ[4]

3.3 Data analysis methods

In this section, I will describe the statistical methods used for my quantitative analysis in this thesis. First, I will briefly describe why I use exploratory factor analysis in the study. Afterwards, I will explain the logic behind the different statistical tests and methods used as part of the inferential statistics.

3.3.1 Exploratory factor analysis

When working with scales that are constructed from multiple items, it is important to consider how the individual items relate to each other (Vaus, 2014). More specifically, a set of item scores cannot be reduced to a single category without being properly associated with each other (Ibid.). Different statistical methods exist for this type of scale development and data reduction, but one of the most widely recognized methods is exploratory factor analysis (Vaus, 2014; Sharma, 1996; Field, 2018). Explorative factor analysis seeks to identify underlying factors that can explain the intercorrelation among the items in a survey study (Sharma, 1996). The

[4] *FTEs Under control* refers to total number of FTEs employed in the business units under control by the HQ.

method can therefore help me understand whether the survey items share one (or several) latent factors which I initially expected they would with their overall categories. Consequently, I will use exploratory factor analysis as a first step of my analysis with the aim of:

(1) Decide whether my pre-determined categories might consist of several underlying factors that were not distinguished between in the initial categorization.
(2) Understand whether any of the items within the categories might be unrelated to the others and therefore not measuring the same category.

The individual steps of the exploratory factor analysis will be covered as I use the method in Section 4.1. I will generally refer to the explorative factor analysis as *factor analysis* in this thesis. The factor analysis, along with the other statistical tests in this study, was made using the statistical software package Stata.

3.3.2 Other methods for the inferential statistics

3.3.2.1 One sample t-test

The one sample t-test is a test statistic used to compare a sample mean against an expected population mean to determine whether the two means are significantly different (Field, 2018). The generic null hypothesis for the test can be described as follows:

$$H_0: X_1 = X_2$$

$$H_A: X_1 \neq X_2$$

The test is performed by first calculating the T-statistics[5] for the sample which is then converted into a p-value that can be used to decide whether the results are statistically significant at different significance levels (Field, 2018). For a t-test to give unbiased results, it is important that at least four assumptions are not violated:

1. The dependent variable should be continuous, i.e. measured at interval or ratio level
2. The independent variable should consist of two or more categorical and independent groups
3. The assumption of independence: The observations should be independent of each other, i.e. there can be no relationship between the observations in each group
4. The assumption of normality: The dependent variable must be approximately normally distributed within each group of the independent variable

To determine whether the assumption of normality holds, I will use the Shapiro-Wilk test and Q-Q plots to examine the distributions of my observations. See Section 3.2.2.3 for more information on these two tests.

[5] $t = \frac{\bar{X}-\mu}{SE}$, $\bar{X} = observed\ mean; SE = standard\ error\ for\ sample; \mu = expected\ population\ mean$

3.3.2.2 One-way ANOVA test

The one-way analysis of variance (ANOVA) is a test used to determine whether there is a statistically significant differences between the means from two or more independent groups (Field, 2018). The test is an omnibus test and cannot be used alone to determine which groups are different. Instead, it can simply tell us whether at least one of the groups tested are significantly different from the other. ANOVA therefore tests the below null hypothesis:

$$H_0: X_1 = X_2 = X_3 \dots X_h$$

$$H_A: \text{The means are not equal}$$

The ANOVA test is performed using F-statistics[6] which measure the ratio of systematic variation, i.e. the variation explained by the model, to unsystematic variation, i.e. the variation explained by unsystematic factors (Field, 2018). Upon finding the F-statistics, the results can be converted into a p-value with the same degrees of freedom to decide whether the results are statistically significant at different confidence levels. For ANOVA to give unbiased results, it is important that the following assumptions hold:

1. The dependent variable should be continuous, i.e. measured at interval or ratio level
2. The independent variable should consist of two or more categorical and independent groups
3. The assumption of independence: The observations should be independent of each other, i.e. there can be no relationship between the observations in each group or between the groups themselves
4. The assumption of normality: The dependent variable must be approximately normally distributed within each group of the independent variable
5. The assumption of homoscedasticity: The variance of the independent groups that are measured must be approximately equal in the population, i.e. there needs to be homogeneity of variances

As for the one sample t-test, I will test the assumptions of normality using both the Shapiro-Wilk test and Q-Q plots (See next section). To test the assumption about homoscedasticity I will use Levene's test and residual plots (See Section 3.3.2.4).

Post hoc procedure

The ANOVA test can tell us whether the difference between means of two or more groups are statistically significant. However, the test is not able to tell us which of the groups that are significantly different from each other. To investigate this, a post hoc tests needs to be carried out after the ANOVA test. A post hoc test is used to make pairwise comparisons across the different categories within the independent variable. It then tells whether the differences between each of the groups are in themselves statistically significant (Field, 2018).

[6] $F = \frac{SS_M}{df_M} / \frac{SS_R}{df_r}$, $SS_M = Sum\ of\ squares\ from\ the\ model; SS_R = Total\ sum\ of\ squares; df = degrees\ of\ freedom$

The post hoc test takes into account the inflated familywise error rate that comes as a result of testing multiple groups at once. That is, it would be easier to find statistically significant results by chance when comparing multiple groups at once, therefore I need adjust the required significance level accordingly (Ibid.). To control for the familywise error rate many different types of post hoc tests can be applied (Kim, 2015). In this study, I will use Tukey's method also known as the *Honestly significant difference* (HSD)[7] test. The HSD test makes pairwise comparisons using the differences between each group's mean to find the t-statistics of the individual comparison. It then compares the individual value from the t-statistics to the 'Studentised Range' to determine the critical value that the comparisons must exceed to be significant (Abdi & Williams, 2010). The 'Studentised Range', unlike the normal t-statistics, takes the number of means being compared into account to reduce the familywise error rate (Barnette & McLean, 1998). The HSD test is normally problematic to use when the different groups are of unequal size as in this study (Kim, 2015). When this is the case, the HSD test can be modified using the Tukey-Kramer method (Lee & Lee, 2018), which is automatically applied by Stata when using the HSD test on groups of different sizes. To use the HSD test, the assumptions about normality and homoskedasticity still need to hold (Barnette & McLean, 1998). A discussion of why the HSD test were preferred over the frequently used Bonferroni method can be found in Appendix 4.

3.3.2.3 Testing normality: Shapiro-Wilk test and Q-Q plots

The assumption about normality requires that the dependent variable must be approximately normally distributed for each group among the independent variables (Field, 2018). To test whether the assumption about normality holds it is often recommended to examine the data both visually and through test statistics such as the Shapiro-Wilk test (Ibid.). The Shapiro-Wilk test was originally a test statistic made to check whether the normality assumption holds for smaller sample sizes (Razali & Wah, 2011). The test is frequently highlighted as one of the better test statistics to examine the normality assumption (Yap & Sim, 2011; Şahintürk & Özcan, 2017). The test compares the observed scores in the sample to a set of normally distributed scores with the same mean and standard deviation as the sample. It then tests whether the distributions are statically significantly different from each other. If the test is non-significant, p-value of >0.05, then it tells us that the distribution is not significantly different from a normal distribution and it can therefore be assumed to be normally distributed (Field, 2018).

In most cases it is suggested to supplement the Shapiro-Wilk test with a visual examination of the data (Field, 2018). To do this it is recommended to use the *quantile-quantile (Q-Q) plot* which plots the observed quantiles from the data against the expected quantiles of a normal distribution in a straight line based on z-scores (Hahn & Meeker, 2011; Field, 2018). The kurtosis, referring to the degree to which scores cluster at the ends of the

[7] $HSD = q\sqrt{\frac{MS_w}{n_k}}$, *q is found via a q-table based on df and number of groups;* $MS_w = mean\ square\ within; n = obs.$

distributions, can be interpreted by how much the observed values are sagging above or below the line of expected quantiles. If the distribution exhibits fat tails then the theoretical quantiles are much smaller in the ends, in absolute terms, than the observed quantiles – and vice versa for thin tails. The skew, referring to whether the data distribution is symmetric or not, can be interpreted from whether the observation has a positive (right skew) or negative (left skew) exponential distribution (Field, 2018).

3.3.2.4 Testing homoscedasticity: Levene's test and residual plots

The assumption about homoskedasticity, or homogeneity of variance, in its essence requires that the variance of the dependent variable should be approximately equal for each group among the independent variables (Field, 2018). I can control to what extend the assumption hold by examining the data visually or by using test statistics such as the Levene's test (Anderson, 2006). Levene's test uses a one-way ANOVA on the deviation scores from the different groups, i.e. the absolute differences between each score and the mean of the group from which it comes from. It then tests the null hypothesis that the variance within the different groups are equal. If the test is non-significant, p-value of >0.05, then the differences in the sample variance within the groups is not significantly different from each other and I can therefore assume that the assumption of homoscedasticity holds (Field, 2018).

To examine the data visually I will need to make a *residual plot* which is a scatterplot comparing the predicted values against the residuals from the data. Here the observations are plotted with their residuals against a line of the expected values. If the homogeneity assumption holds, then there should be no systematic relationship between the residuals in the data and the predicted values. For the scatterplot, this means that the residuals should be equally scattered in a non-systematic way against the line of the expected values. Hence, any clear patterns in the data can indicate violations of the homogeneity of variance assumption (Field, 2018).

4. Analysis

4.1 The factor analysis

The factor analysis performed in this study consists of four steps. First, I determine whether the data from my sample is appropriate for factor analysis. Second, I extract the initial set of factors to determine what factors and items are relevant for the subsequent analysis. Thirdly, I perform a factor rotation and examine the factor loadings of the items to decide on the final item groupings. Fourthly, I test the internal consistency of the different item groupings. Upon completing the factor analysis, I decide on the final labelling of the item groupings.

4.1.1 Step 1: Determining whether the data is appropriate for factor analysis

The literature is full of different guidelines for what type of data is appropriate to be used for factor analysis (Field, 2018). Most commonly, the discussion is reduced to a debate of the necessary sample size (Gudagnoli & Velicer, 1988). Some propose a minimum between 100 and 300 observations as rough rules of thumb (e.g. Comrey & Lee, 1992; Loo, 1983; Ferguson & Cox, 1993). Others suggest that it depends on the number of items and that one should have 5 to 15 as many participants as the number of items in the study (Nunnally, 1978; Cattell; 1978). In practice, however, less than 30% of the management literature that use factor analysis have sample sizes of more than 100 observations (Lingard & Rowlinson, 2006). Furthermore, newer literature on the topic has generally been prone to accept the use of factor analysis even with small sample sizes of 50 down to 10 respondents (Winter, Dodou, & Wieringa, 2009). With 67 respondents, this study is closer to the lower-end values for the suggested minimum number of observations. Consequently, I have chosen to first use the Kaiser-Mayer-Olkin (KMO) measure of sampling accuracy to check whether the sample size is in fact sufficient (Kaiser, 1970). The KMO statistics is a frequently recommended pre-test used to ensure that the data is appropriate for factor analysis (Field, 2018; Sharma, 1994; Vaus, 2014). The KMO value is based on the correlation matrix between the items and compare the magnitudes of the observed correlation coefficients in relation to the magnitudes of the partial correlation coefficients (Kaiser, 1970). The KMO values varies between 0 and 1. A value of 0 indicates that the patterns of correlation between the items are relatively different making them less appropriate for factor analysis. Contrary, a value of 1 indicates more compact patterns of correlation meaning that factor analysis can yield more reliable factors (Ibid.). Interpretation of the KMO value can be made in accordance with the recommendations of Kaiser & Rice (1974) displayed in Table 3.

KMO value	Interpretation
0.90 and above	Marvellous
0.80-0.89	Meritorious
0.70-0.79	Middling
0.60-0.69	Mediocre
0.50-0.59	Miserable
below 0.5	Unacceptable

Table 3: Guidelines for interpretation of data appropriateness (Kaiser & Rice, 1974)

Hence, groups of items with a KMO value of below 0.5 should generally not be used for factor analysis (Kaiser & Rice, 1974). Values above 0.5 can be used for factor analysis, but values in the lower bounds (0.5-0.6) still indicate low patterns of correlation that one should be aware of (Sharma, 1994). The KMO statistics for each of the question categories are illustrated below in Table 4.

	1. Increasing value-add	2. Understanding impact	3. Resources & capabilities	4. HQ operations
Items	8	4	6	10
KMO statistics	0.72	0.67	0.67	0.52

Table 4: KMO statistics for the four overall categories

As the KMO values above indicate, then all of the categories in this study are acceptable for factor analysis. However, the low KMO value of *HQ operations* indicates a low correlation among the items in this grouping meaning that not all items are closely related (Field, 2018; Sharma, 1994). As already described in the Section 3.2.2, then the *HQ operations* category was likewise meant to explore different themes that might only have limited affiliation with each other. Hence, it is not surprising that the patterns of correlation between the items is seemingly smaller.

As a second preliminary step to the factor analysis, I had a look at Pearson's correlation coefficients for the items of each category. I did this to ensure that no items had a too strong correlation and could therefore be viewed as measuring the same items of the overall category (Vaus, 2014). Pearson's correlation coefficients for the item pairs can be found in Appendix 5. Only two of the item pairs, namely Q1 & Q2 and Q3 & Q4 in the category *Understanding impact*, had correlation coefficients of >0.7 (they were 0.75 and 0.82, respectively). I decided, however, not to drop these items as the conceptual ideas behind the items are somewhat intertwined, thus explaining the high correlation.

4.2.2 Step 2: Extracting an initial set of factors

As explained earlier, actor analysis has the objective of identifying underlying latent factors that correlate with the items in question. Hence, the items are assumed to be produced by some other common factor(s) to which the different items will be correlated (Vaus, 2014). I identify these by creating factors that are able to reproduce as much of the variance as possible from the different items (Field, 2018; Sharma, 1994; Mooi et al., 2018). The part of the variance within each item that is shared with the factors produced is defined as the *communality* (Field, 2018; Mooi et al., 2018). A communality of 0 means that none of the variance within an item is shared with the factors identified, whereas a score of 1.0 means that all of the variance can be explained by the identified factors (Mooi et al., 2018). I therefore aim to identify the underlying factors that produce high communality scores for the items I am testing. Although, there is no common agreed upon threshold for an item's communality, it is widely recognized that items with too low communality scores should be dropped (Field, 2018; Vaus, 2014). In this study, all items with a communality score of <0.16 will be dropped. The threshold is set at 0.16 as this is the maximum communality score that allow me to keep items with factor loadings of 0.4 for the categories with only one factor.[8] See Section 4.2.3 for a description of my 0.4-threshold for factor loadings.

Using a statistical software package, I can easily extract the first set of factors for each question category. Initially, I will be able to produce as many factors as I have items in the model (Field, 2018). However, many of these factors are expected to share only a limited amount of the variance from the items. Consequently, I will need to select only the factors that appear to be sharing a substantial part of the variance (Sharna, 1994). The best way to determine this is generally accepted to be by looking at the *Eigenvalues* of the factors (Field, 2018; Vaus, 2014; Mooi et al., 2018). The eigenvalue is a measure of how much of the total variance a given factor is able to explain (Mooi et al., 2018). Put simply, the eigenvalue of one item's total variance can be said to be 1.0 (Ibid.). Hence, if I have five items the maximum eigenvalue a factor could obtain would be 5.0, if it is able to explain the full variance of all the five items. In deciding how many factors to keep the *Kaiser Criterion* is often used, suggesting that all factors with an eigenvalue of above 1.0 should be retained (Kaiser, 1970). The reasoning being that each factor with an eigenvalue greater than 1.0 accounts for more variance than a single item making it more reliable than a single item would be (Mooi et al., 2018). Below is a summary of the eigenvalues of the initial factor extraction. The factor analysis was run on each category separately and not run as one combined factor analysis.

[8] Communality scores are the sum of squared factor loadings for the items. Hence, an item that only loads on one factor and has a factor loading of 0.4 would have a communality score of 0.16, as $0.4^2 = 0.16$

		1. Increasing value-add	2. Understanding impact	3. Resources & capabilities	4. HQ operations
Factors	Factor 1	**2.74**	**2.47**	**1.84**	**1.37**
	Factor 2	0.86	0.40	0.17	**1.10**
	Factor 3	0.49	0.09	0.05	0.69
	Factor 4	0.08	0.18	0.01	0.42
	Factor 5	-0.04		-0.11	0.16
	Factor 6	-0.18		-0.30	-0.04
	Factor 7	-0.20			-0.16
	Factor 8	-0.26			-0.17
	Factor 9				-0.27
	Factor 10				-0.34

Table 5: Eigenvalues of the extracted factors for each question category

As demonstrated above, five factors (marked with green) within the four categories had an eigenvalue of >1. I therefore dropped the remaining factors and ran the analysis again for each of the four categories with only one or two factors instead. This left me with the below communality scores for each item. Note that Q1, Q2, etc. refers to different items depending on the category (See Table 2 for an overview of all 29 items).

		1. Increasing value-add	2. Understanding impact	3. Resources & capabilities	4. HQ operations
		Factor 1	Factor 1	Factor 1	Factor 1 +2
Items	Q1	0.36	0.57	0.52	0.31
	Q2	0.36	0.55	0.16	0.50
	Q3	0.37	0.68	0.51	0.36
	Q4	0.30	0.67	0.18	0.01
	Q5	0.43		0.27	0.10
	Q6	0.34		0.21	0.13
	Q7	0.30		0.12	0.49
	Q8	0.28			0.14
	Q9				0.32
	Q10				0.12

Table 6: Communality scores for each of the items

As Table 6 demonstrates, then most items from the first three categories were above the 0.16 communality threshold. However, as expected by the low KMO value, many of the items within *HQ operations* were below the threshold value (marked with red) meaning that they only shared little of the variance with the two extracted factors. As a result, these items were dropped for the remainder of the analysis. Furthermore, Q7 within *Resources & capabilities* was likewise dropped.

4.2.3 Step 3: Using factor rotation and examining factor loadings

The last part of the factor analysis is to determine which items relate to each of the extracted factors. This is mainly relevant for the category *HQ operations* because it has more than one factor to it and items will load on both factors at once. Deciding what items best relates to each factor is done by examining the *factor loadings* which refers to the correlations between the factors and the items (Mooi et al., 2018). The factor loading can take values between -1 to +1 depending on the extend of the correlation and whether the correlation is negative or positive. The factor that receives the highest absolute loading for a given item is considered to be the factor which the item relates to (Ibid., Field, 2018).

When items load on multiple factors at once, it is generally recommended to use factor rotation (Field, 2018; Vaus, 2014; Sharna, 1994; Mooi et al., 2018; Balikie, 2003). A factor rotation ensures that the factors are kept separate from each other by maximizing the items' factor loadings on one factor and minimize the loadings on others (Balikie, 2003). Thus, it allows for easier interpretation of the data (Sharma, 1994). For this analysis, I applied the frequently used orthogonal *varimax rotation* (Costello & Osborne, 2005). I only used factor rotation for the questions within *HQ operations*, as the remaining items only loaded on one factor. The factor loadings of all items are demonstrated below in Table 7.

		1. Increasing value-add	2. Understanding impact	3. Resources & capabilities	4. HQ operations	
		Factor 1	Factor 1	Factor 1	Factor 1	Factor 2
Items	Q1	0.60	0.76	0.72	0.13	0.61
	Q2	0.60	0.74	0.42	0.66	0.05
	Q3	0.61	0.82	0.70	0.65	0.13
	Q4	0.55	0.82	0.44		
	Q5	0.66		0.54		
	Q6	0.58		0.41		
	Q7	0.55			-0.43	0.42
	Q8	0.53				
	Q9	0.60			0.10	0.54
	Q10					

Table 7: Factor loadings after orthogonal varimax rotation

From the above table it is apparent that the items Q2 and Q3 within the *HQ operations* category relates to Factor 1 whereas Q1, Q7, and Q9 relates to Factor 2. Likewise, all other items appear to have factor loadings of above 0.4, which is the most commonly used threshold for factor loadings in deciding what items to keep in practice (Costello & Osborne, 2005). As a result, I will keep all items from Table 7 for the subsequent analysis.

4.2.4 Step 4: Reliability test and deciding the scale

One of the most widely used procedures of testing the reliability of a scale is through the use of *Cronbach's alpha* (Jensen & Knudsen, 2014; Field, 2018; Mooi et al., 2018). The value is used to measure a scale's internal consistency meaning how closely related the items are as a group (Field, 2018). The value is calculated as the mean of all split-half coefficients resulting from different ways of splitting the scale items (Cronbach, 1951). The Cronbach alpha varies between 0 and 1, in which a higher score indicates a higher internal consistency and vice versa (Mooi et al., 2018). Most literature on the topic suggest that survey items should have a minimum Cronbach alpha value of around 0.6 to 0.7 to be grouped into a combined measure (Field, 2018; Mooi et al., 2018). The alpha values for the different factors in my study can be found below in Table 8.

	1. Increasing value-added	2. Understanding impact	3. Resources & capabilities	4. HQ operations	
	Factor 1	Factor 1	Factor 1	Factor 1	Factor 2
Cronbach alpha	0.79	0.86	0.71	0.68	0.57

Table 8: Cronbach alpha values for the five different factor groupings

Compared to the recommended threshold for Cronbach alpha values, Factor 2 under *HQ operations* falls short with a score of 0.57 indicating a low internal consistency. Despite loading on one factor, the items from Factor 2 are also less homogenous in describing a single underlying concept as can be seen from the items' statements in Table 9. As a result, I will only group the items of Factor 1 into one measure and instead keep the items separated for Factor 2 in the subsequent analysis.

Factor 2	Q1	There will be more room for intuition by top managers
	Q7	Personal relationships will become more important
	Q9	The HQ will refocus on activities that machines and AI cannot do

Table 9: The items related to Factor 2 under *HQ operations*

4.2.5 Labelling the item groupings

With the factor analysis complete, it is necessary to qualitatively examine and label the identified item groupings (Vaus, 2014). The items under the categories *Increasing value-added, Understanding impact,* and *Resources & capabilities* were only strongly related to a single factor. Consequently, I will keep these item groupings as measures of their pre-determined categories and label them accordingly. However, I need to decide on a new aggregate label for Factor 1 under *HQ operations*.

Factor 1	Q2	The HQ will be able to involve itself more in subunits businesses
	Q3	The HQ will get much "closer" to the subunits

Table 10: The items related to Factor 1 under *HQ operations*

As Table 10 illustrates, then the item grouping formed by Factor 1 within *HQ operations* relates mainly to whether the HQ will get closer and more involved in its subunits' businesses. I will therefore refer to this item grouping as *Increasing involvement* examining whether the HQ will involve itself more in its subunits' businesses as a result of digitalization. This leaves us with the below categories (Table 11) which will be used in the remainder of the analysis. The category names and "grouped statements" will be used interchangeably in the subsequent sections.

	1. Increasing value-added	2. Understanding impact	3. Resources & capabilities	4. Increasing involvement
Grouped statements	*Digitalization will increase the value-added of our HQ*	*We have developed a very clear idea of how digitalization will impact our HQ*	*We have sufficient resources and capabilities to adapt our HQ to the digital transformation*	*Our HQ will involve itself more in its subunits' businesses as a result of digitalization*
Items	**8**	**4**	**6**	**2**
Min. factor loading	**0.53**	**0.74**	**0.41**	**065**
Cronbach alpha	**0.79**	**0.86**	**0.71**	**0.68**

Table 11: Summary of new categories and results of factor analysis

4.2 Descriptive statistics

In this section, I will first give a short overview of the descriptive statistics for the four categories. Afterwards, the statistics from each category will be used to analyse the sub-questions of my overall research question. Hence, I will analyse: (1) Whether the respondents believe digitalization can be expected to increase the value-added of the HQ; (2) whether the respondents believe that their HQ is able to realize the potential value-added; and (3) how the respondents believe digitalization will change the way their HQ operates in the future. Being an exploratory study, there are no predetermined hypotheses I seek to explore. Instead, I will use a more explorative approach by seeking to identify different structures and patterns in the data.

4.2.1 Overview of the descriptive statistics

After averaging each respondents' answer as described in Section 3.2.1, I obtained the mean scores across the respondents for each of the final categories. As the scale-scores can take any value between 1 and 6 (from "strongly disagree" to "strongly agree"), the expected average across the categories would be 3.5 under the assumption that the respondents would on average stay neutral to the statements. As showed in Figure 9, the average respondent scores highest on the items related to *Increasing value-added* with an average of 4.8, indicating high expectations towards the potential benefits of digitalization. The other three categories score closer to the expected average with scores of 4.0 (for *Resources & capabilities*), 4.1 (for *Understanding impact*), and 4.2 (for *Increasing involvement*).

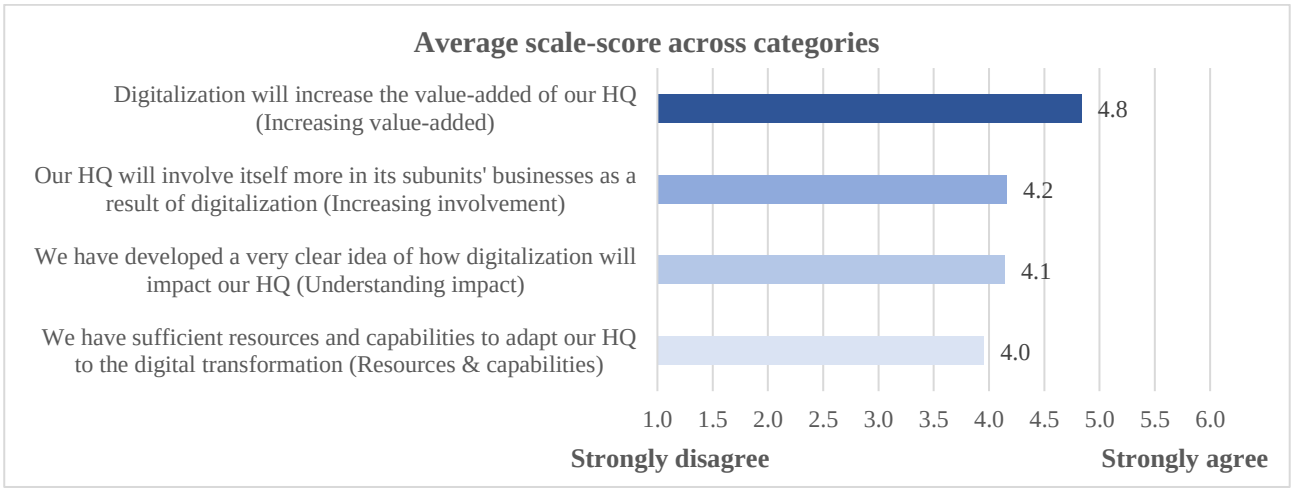

Figure 9: Average scale scores across the four categories

A box plot of the response distribution can be found in Figure 10. When comparing the categories, it is evident that the spread in distributions are smallest for *Increasing value-added* showing that the opinions do not vary a lot for this category. In contrast, the category *Understanding impact* appears to have a considerable higher spread than many of the other categories with a 25th percentile of 3.5 and a 75th percentile of 4.75. This indicates large deviations in whether the respondents believe that their HQ has developed a clear understanding of how

digitalization will impact them. The high spread also explains why the median value for *Understanding impact* is a 0.25 higher than that of *Increasing involvement* even though the two categories share almost identic means.

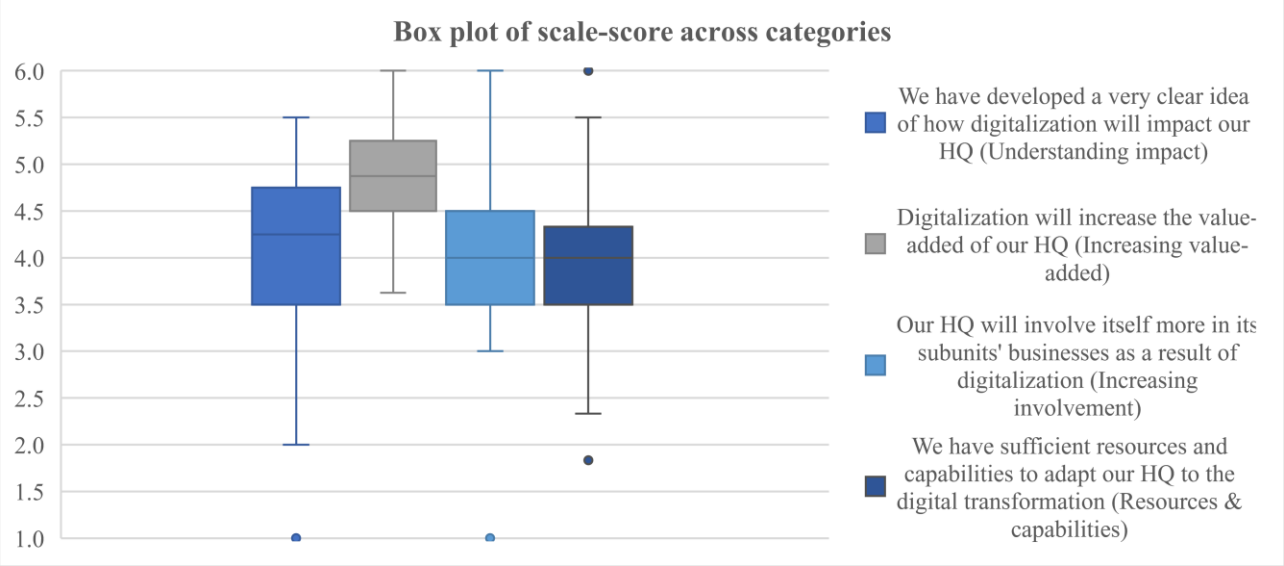

Figure 10: Boxplot of the results from the different categories

Although the above figures provide a decent overview of the data from the study, it still has limited practical interpretability, e.g. it remains unclear how many respondents actually agree that their HQ has sufficient resources and capabilities or whether the agreeing respondents might share some common traits. In the next subsections, I will therefore seek to provide more clarity on what practical interpretations and inferences that can be made from the data.

4.2.2 Digitalization and value-added

4.2.2.1 Overview

As outlined in the problem statement, the first objective of this study was to examine whether digitalization can be expected to increase the value-added of the HQ. To shed more light on this topic, I will look into the responses to the category *Increasing value-added* which sought to explore whether the HQ managers believed that digitalization will benefit the HQ in its value adding activities. Overall, the study participants have a very favourable view of the benefits from digitalization. More specifically, 91% of the respondents agree (or strongly agree) that their HQ will be able to increase its value-added to the corporation as a result of digitalization (See Figure 11).

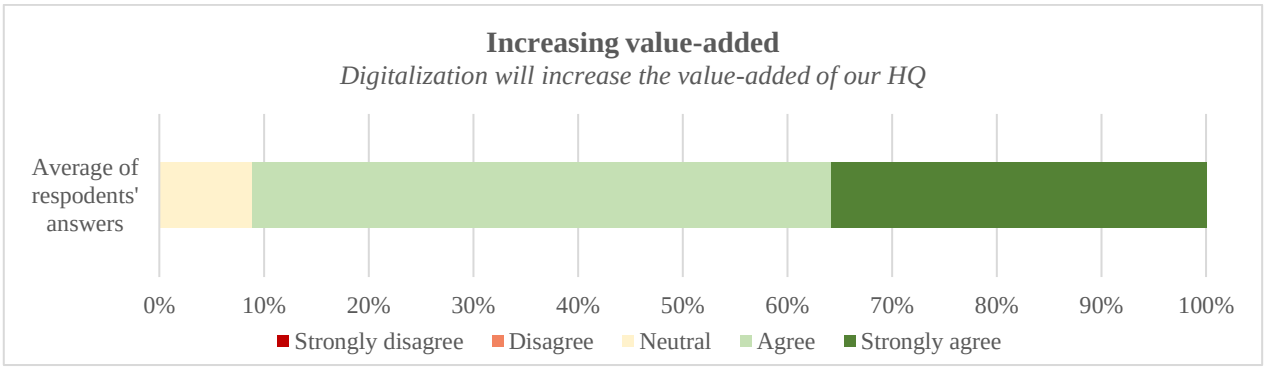

Figure 11: The average response distribution related to the *Increasing value-added* category

When examining the eight individual items of the *Increasing value-added* category, it is evident that the most out-spoken benefit from digitalization is expected to be the improvement of decision-making through *better* and *more timely data* (Q1 and Q2) which all of the respondents agree with to some extent. Less certainty exists around whether digitalization can improve *the HQs ability to identify and implement synergies between subunits* (Q7) and *allow them to better allocate attention to real issues in their subunits* (Q8) which only around half of the respondents agree (or strongly agree) to. Nevertheless, it is less than 15% of the respondents that disagree with these two statements, demonstrating the overall positive attitude towards the impact of digitalization. For more details see Figure 12.

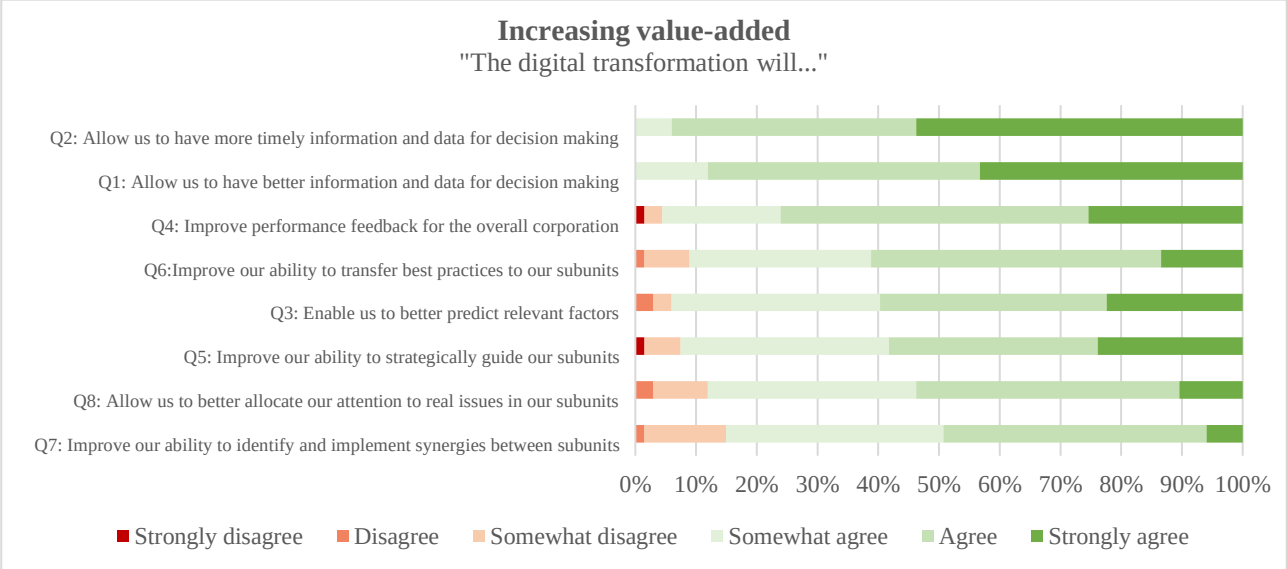

Figure 12: Response distribution for the items of the *Increasing value-added* category

In the next sub-sections, I will focus on how the response distributions changed across the organizational levels of the respondents and across the different HQ characteristics.

4.2.2.2 Organizational level of respondents

Although most respondents agree (or strongly agree) that digitalization will increase the value-added of the HQ, the data do show nuances depending on how the respondents are grouped. For instance, managers two or more levels below the executive board are more than twice as likely to strongly agree that digitalization will enable the HQ to add more value to the corporation than executives (See Figure 13). When examining the average scores across the individual items for the three groups, it is evident that the differences are driven by differences within two individual items, Q3 and Q5. Compared to executives, managers two or more levels below the executive board score 14% higher on Q3, *the digital transformation will enable us to better predict relevant factors*, and 18% higher on Q5, *the digital transformation will improve our ability to strategically guide our subunits* (See Appendix 6). Especially the scores on the latter item is interesting, as a plausible explanation for the difference could be that the managers working at lower organizational levels are collaborating more directly with the subunits than managers at the higher levels. In turn, they might be more prone to see the benefits of digitalization related to the direct strategic support they provide than more distanced executives are.

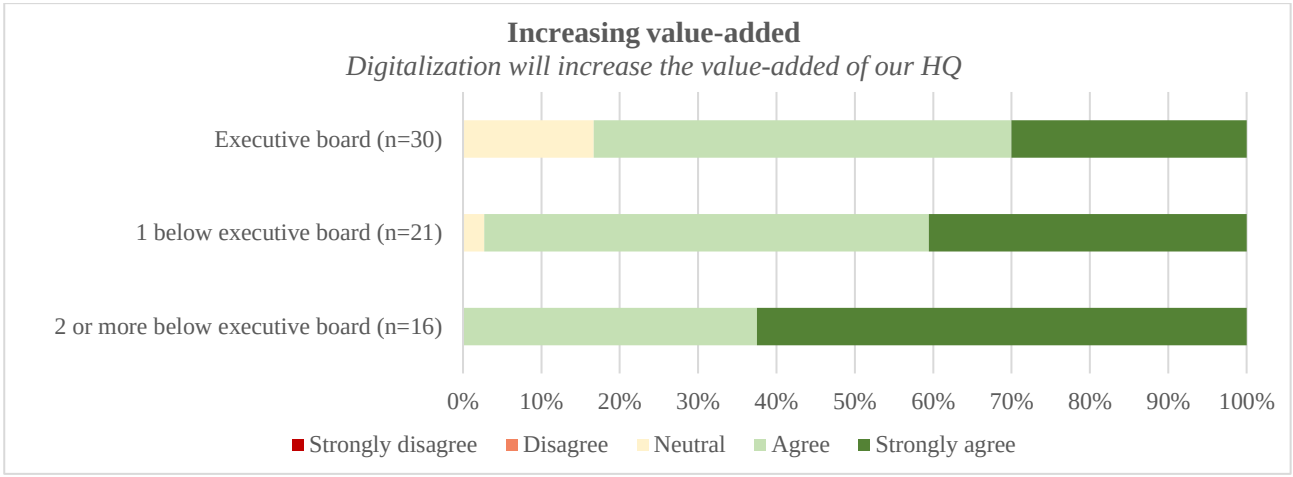

Figure 13: Response distribution for *Increasing value-added* based on organizational level

4.2.2.3 Differences across HQ type and size

Turning the perspective towards the organizational characteristics of the HQs, then differences are only modest. When examining the opinions across HQ types, respondents from DHQs or RHQs were slightly more optimistic than respondents from CHQ in regard to the increase in value-added from digitalization. For DHQs/RHQs they had a slightly higher share of respondents that could be characterized as agreeing or strongly agreeing than CHQs (See Figure 14). However, the differences are small and could perhaps be attributed to variations due to the low number of observations (n=12) within the DHQ/RHQ grouping.

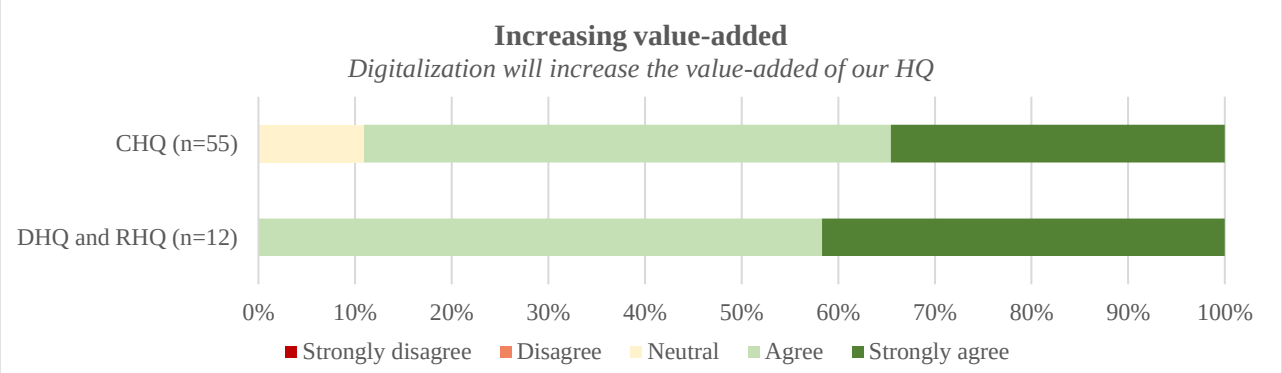

Figure 14: Response distribution for *Increasing value-added* based on HQ type

When grouping the HQs based on FTEs under control, then the amount of respondents agreeing (or strongly agreeing) that digitalization will increase the value-added of the HQ is slightly higher for large (96%) and medium (92%) HQs as opposed to small HQs (80%) (See Figure 15). The differences are again rather small, but it does indicate that respondents from medium and large HQs see a bit more potential in the digital opportunities. The spread is widened when exclusively examining CHQs (see Appendix 7 for a detailed view of CHQs only).

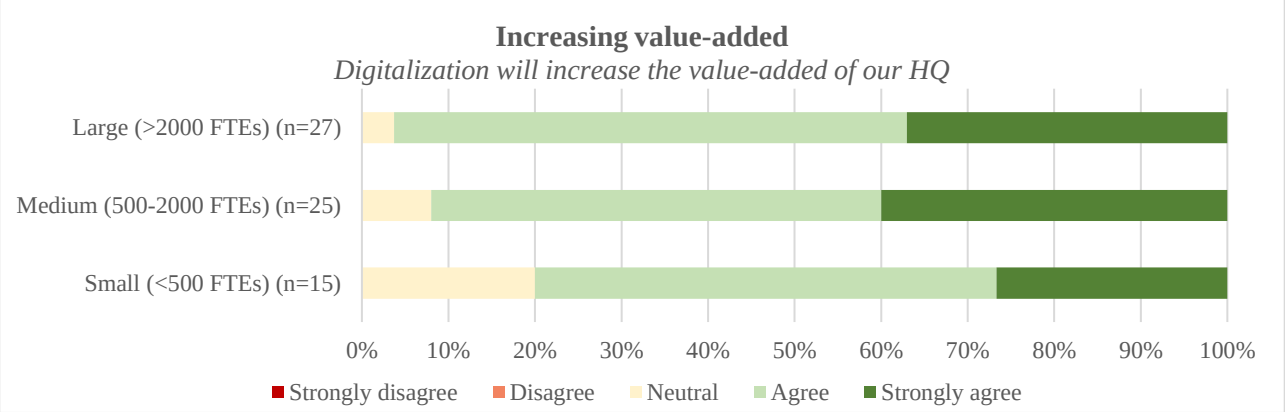

Figure 15: Response distribution for *Increasing value-added* based on FTEs under control by the HQ

4.2.2.4 Differences across industries

One of the most substantial differences in attitudes towards *Increasing value-added* are found when comparing respondents' answers based on the industry which the HQ is associated with (See Figure 16). For instance, respondents within the industry groupings *Manufacturing (Pharma and MedTech)*, *Service and IT*, and *Wholesale and retail* all agree (or strongly agree) that digitalization will increase the value-added of the HQ. Within *Wholesale and retail* alone, two out of three respondents strongly agree that digitalization will increase the value-added of the HQ. At the other end of the scale, respondents within *Transportation, construction, and infrastructure* and *Other manufacturing* (including manufactures of electronics, FMCG, heavy machinery, etc.) appear to be less strongly convinced of the digitalization benefits with only 10% and 29% strongly

agreeing, respectively. When comparing the average scores across the individual items, then it is apparent that the *Wholesale & retail* industry is leading on almost all parameters. Specifically, on the items Q4, Q5, Q7, and Q8, they score between 16-19% higher than the average across the remaining industries (See Appendix 8). Q4 and Q8 are both associated with the HQ obtaining a better understanding of the contexts of the subunits through digitalization. Q5 and Q7 are related to whether digitalization will improve the HQs ability to strategically guide its subunits (Q5), and whether it is able to better implement synergies in between them (Q7). Hence, HQ managers from the *Wholesale & Retail* industry expect digitalization to help them obtain a more contextualized understanding of their subunits. Furthermore, do also expect digitalization to assist them in value creating activities such as implementing synergies between subunits (Foss, 1997).

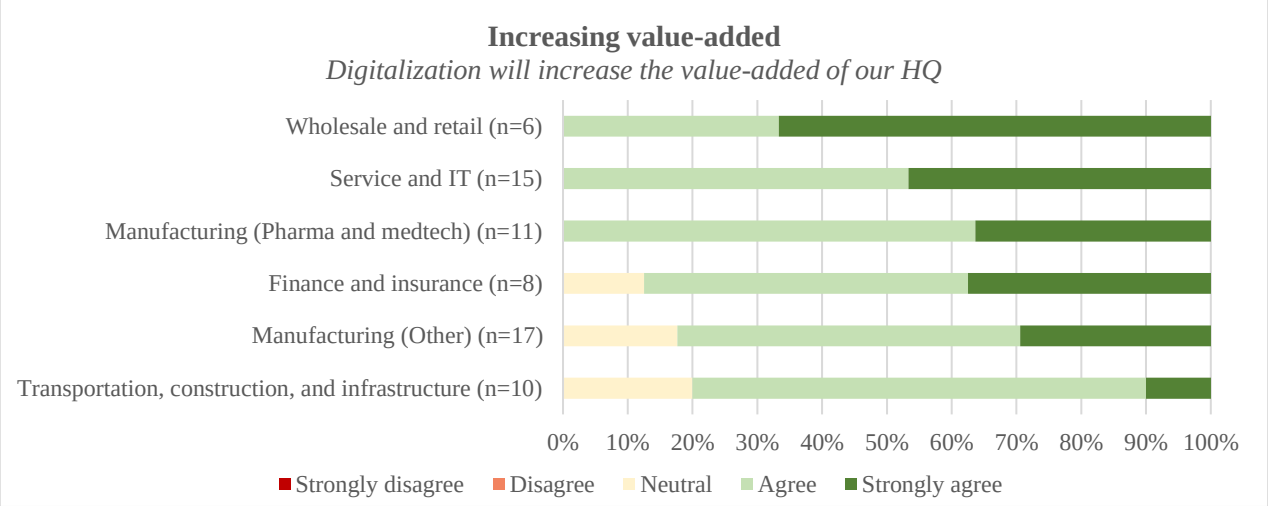

Figure 16: Response distribution for *Increasing value-added* based on industry

4.2.2.5 Conclusion: Increasing value-added

In sum, the respondents overall have a very optimistic attitude towards whether digitalization will increase the value-added of the HQ. Particularly, the respondents seem confident that digitalization will improve decision making through better and more timely data. Furthermore, managers that were not part of the executive board on average have a more positive view towards the digital opportunities than executives. When grouped by type of HQ differences were found, albeit modest. For the size categories, respondents from medium and large HQs have slightly higher expectations to the digital potential for the HQ than respondents from small HQs. The differences in expectations appeared to be most substantial when compared across industry types. In particular, respondents from the *Wholesale and retail* industry appear to be the most positive, whereas the optimism is considerably smaller for the industry groupings *Manufacturing (Other)* and *Transportation, construction, and infrastructure*.

4.2.3 How prepared are the HQs?

4.2.3.1 Overview

The second part of my problem statement was to investigate how prepared the HQs are to realize the potential value-added from digitalization. This implies examining the responses within the two distinct categories:

> **Understanding impact:** Understanding whether the respondents believe their HQ have developed a clear idea of how digitalization will impact them.
> **Resources & capabilities:** Understanding whether the respondents believe their HQ have sufficient resources and capabilities to adapt to the digital transformation.

The first category, *Understanding impact*, is made up of four items, in which the respondents were asked whether they believed that their HQ has developed a clear idea of how digitalization would impact: *how the HQ adds value to the firm in the future* (45% agree or strongly agree); *what the organizational setup of the HQ shall be* (40% agree or strongly agree); *how the HQ functions* (40% agree or strongly agree), and *what resources and capabilities the HQ needs* (37% agree or strongly agree). For all items, the respondents are more likely to have a positive attitude than a negative one, albeit less so than for the individual items within *Increasing value-added*. An overview can be found in Figure 17 below.

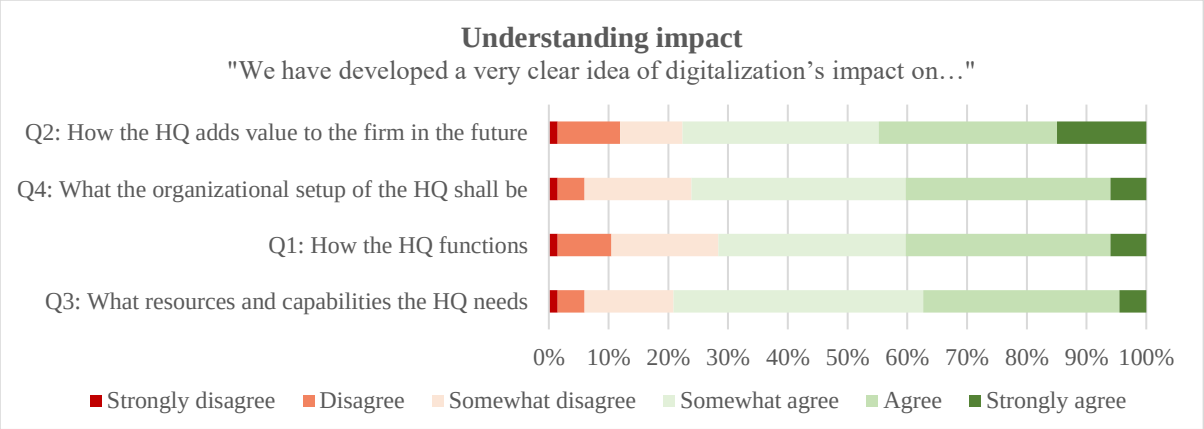

Figure 17: Response distribution of the items within the *Understanding impact* category

For the second category, *Resources & capabilities*, I ended up dropping one item, namely *we have already established a good set of external partners that help us with digitalization* (Q7), due to its low correlation with the underlying factor as concluded in the factor analysis. It is in itself a peculiar observation, that the responses to this item are not strongly correlated with the underlying factor for *Resources & capabilities*. It could indicate that a good set of external partnerships might not be vital for the HQ in ensuring that they are ready to adapt to the digital transformation, or at least that this is not strongly associated with other relevant sources of preparation. The results from the item itself indicate that only about one out of four respondents agree (or strongly agree) that they have established strong partnerships with external partners (e.g. consultants) to support their

digitalization efforts. This is a considerably small number compared to how big a role external partners have been argued to hold in many larger digital transformations (Krüger & Teuteberg, 2016; Daub & Wiesinger, 2015). The responses to Q7 is included in Figure 18, but the item will not be used in the remainder analysis when investigating the average of *Resources & capabilities*.

The item, *all key-functions are in-house and not outsourced* (Q4), appears to be the question that most (55%) of the respondents agree (or strongly agree) with. However, 22% of the respondents also disagree (or strongly disagree) with the statement, leaving only limited ground for the two more neutral middle-responses and implying a more fat-tailed answer-distribution. An explanation for this pattern could be, that most HQs have either outsourced a large part of their key functions all at once, or instead chosen to keep most of all their key functions in-house. Another interesting finding is that only few of the HQs seem to believe that financial resources are a constraint for the digital adaption. Prioritizing the financial resources to undertake digital initiatives have otherwise been cited as a problem among practitioners in other countries (e.g. Bendor-Samuel, 2017). Well over half of the respondents agree (or strongly agree) that they have sufficient financial resources to adapt to the digital transformation, whereas only 6% disagree with this question. Instead, two of the main struggles for HQs appear to be *having enough well-qualified/skilled employees in the HQ* (Q5) and *having the required know-how in the HQ to drive digitalization* (Q1), to which more respondents disagree (or strongly disagree) than agree (or strongly agree). Hence, lack of capabilities rather than resources appears to be the main concern for many of the HQs. A pattern clearly in line with the findings in other organizational areas where lack of digital capabilities has been highlighted as a main constraint in taking advantage of digital opportunities (e.g. Kane et al., 2017). For an overview of the individual items see Figure 18.

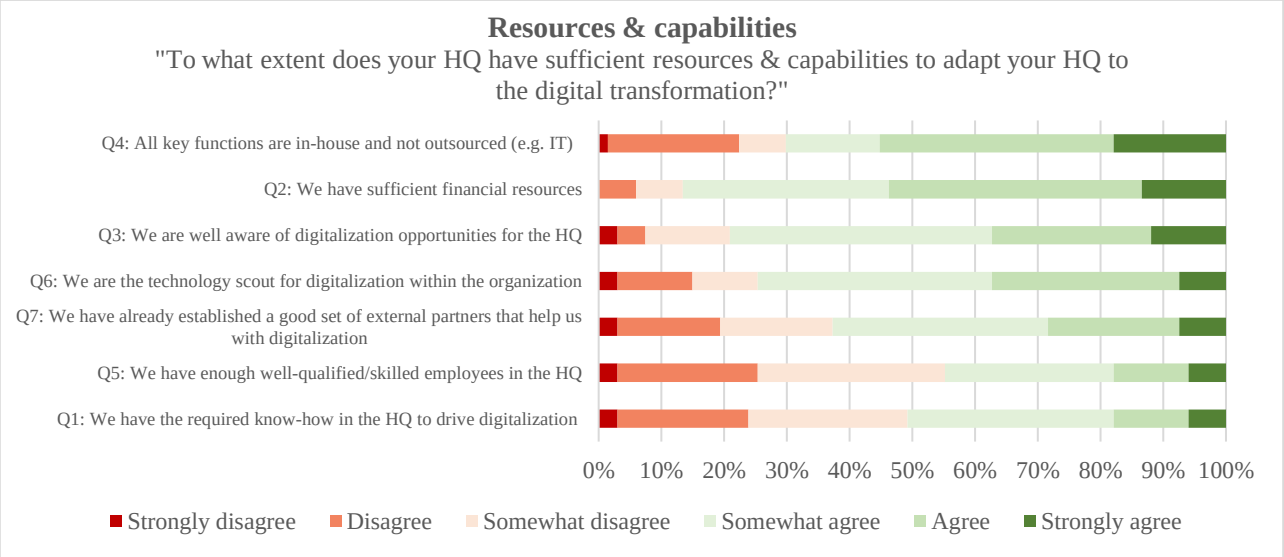

Figure 18: Response distribution of the items within the *Resources & capabilities* category

When the item scores are averaged to construct their overall category scales, then the respondents on average exhibited more scepticism than for *Increasing value-added*. From Figure 19, it is apparent that only 54% of the respondents agree (or strongly agrees) that they have a clear idea of how digitalization will impact their HQ, and less than half (43%) agree (or strongly agree) that they have sufficient resources and capabilities to adapt the HQ to the digital transformation. These numbers indicate that albeit respondents expect digitalization to increase the value-added of the HQ, then uncertainty remains around whether the HQs are able to realize the potential. Apparently, a lot of HQs have not yet made the crucial first steps in regard to digital adaption, namely to (1) obtain an understanding of how digitalization will impact their operations (e.g. Yeow et al., 2018), and (2) ensuring that they have sufficient resources and capabilities to support the digital adaption (Günther et al., 2017).

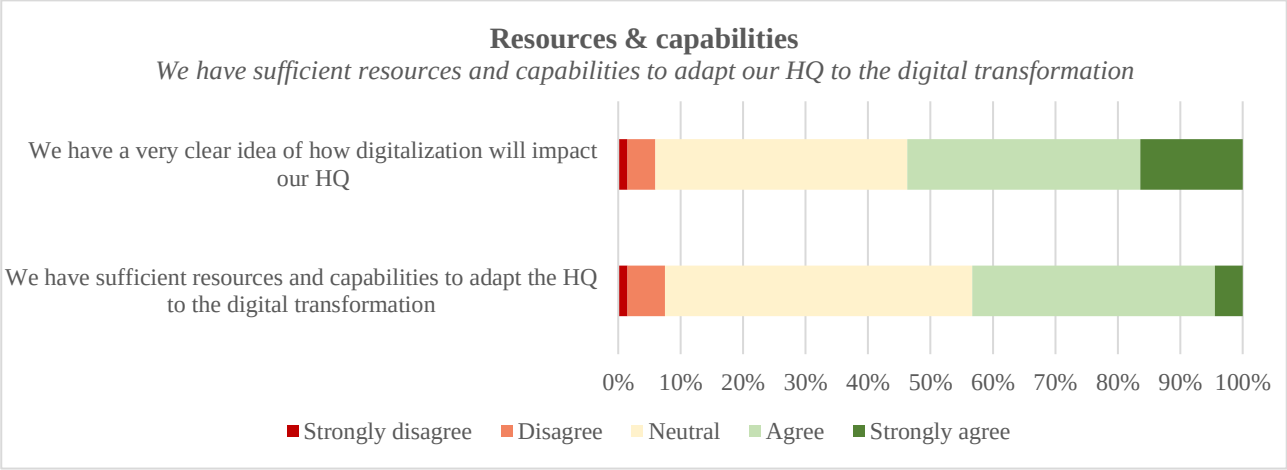

Figure 19: The average response distribution for *Resources & capabilities* and *Understanding impact*

4.2.3.2 Preparedness and expectations to the value-added

An interesting pattern appear, when examining the relationship between whether: (1) the respondents agree (or strongly agree) that their HQ is prepared to meet the digital transformation, and (2) their expectation towards an increase in the value-added of the HQ from digitalization. As Figure 20 shows, then there appears to be a small positive (10%) difference in the value-added expectations between the HQs that have a clear idea about digitalization and those which do not. However, this difference is substantially bigger (36% increase) for respondents who believe that their HQ has sufficient resources and capabilities. On the one hand, these results could imply that understanding how digitalization will impact the HQ might help reveal some of the value-added potential of digitalization, but that the true potential is first fully understood when the HQ has the right resources and capabilities in place. This claim finds some support in the existing academic literature in which it is argued that digital opportunities more frequently reveal themselves ex-post the organization starts adopting more digital technology (Günther et al., 2017). On the other hand, the results could also simply signal that HQs

with higher expectations towards the potential value-added are more prone to invest and prioritize having the right resources and capabilities in place.

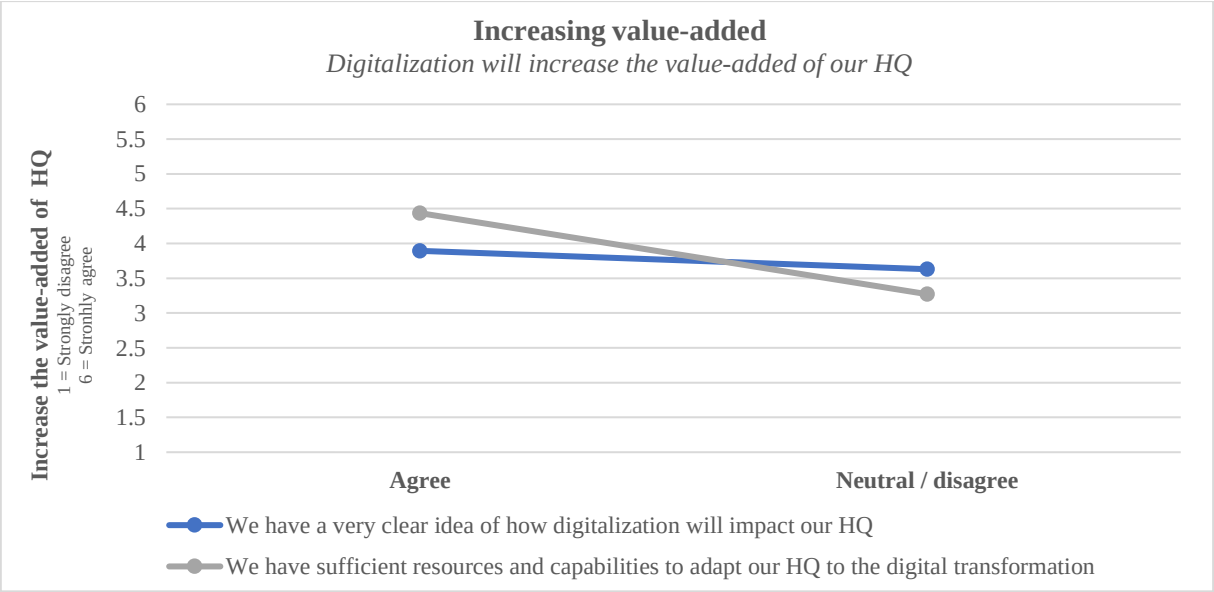

Figure 20: Average score for *Increasing value-added* dependent on HQs preparedness for digitalization

4.2.3.3 Organizational level of respondents

The difference between executives and managers at lower levels appeared to be quite small for both categories (See Figure 21). Managers that were 2 or more levels below the executive board are slightly more likely to believe that their HQ understand the impact of digitalization, as they on average score 8% higher in the category *Resources & capabilities*. For *Understanding impact*, the lower-level managers only score 2% higher.

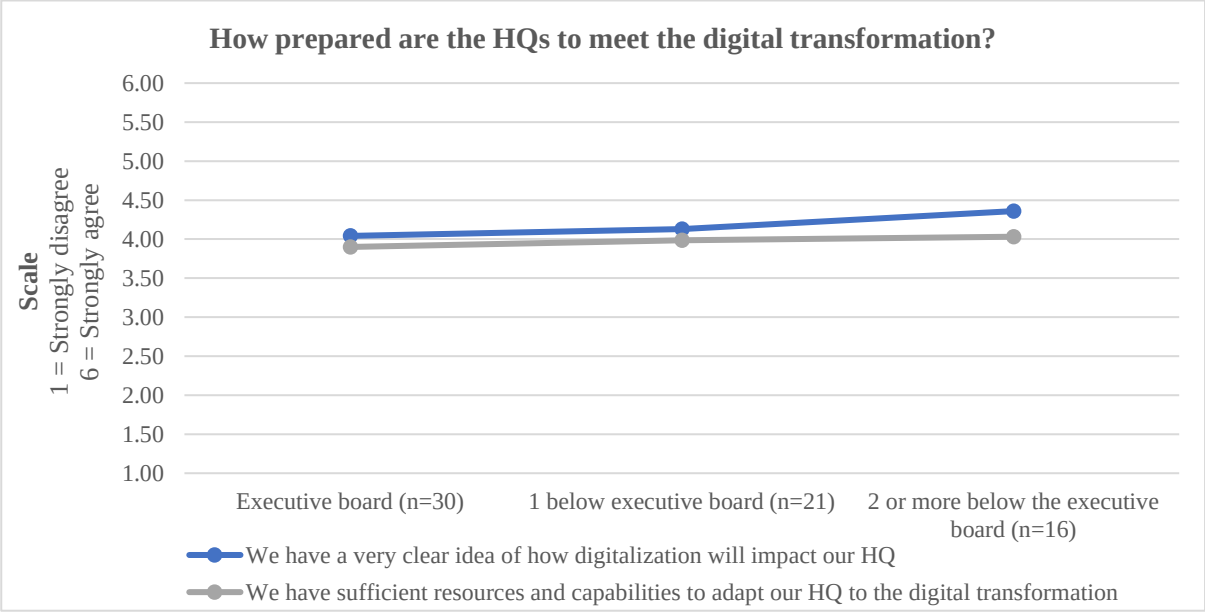

Figure 21: Average scores for *Understanding impact* and *Resources & capabilities* by organizational level

4.2.3.4 Differences across HQ type and size

Unlike the differences across organizational levels, the attitudes do seem to vary when compared across HQ size. Firstly, when examining HQs based on the number of FTEs under control, then only one out of three of the respondents from small and large HQs agree (or strongly agree) that they have sufficient resources and capabilities (See Figure 22). For medium HQs the share is 60%. When comparing the average scores of the three groups, then the small HQs with <500 FTEs are most trailing (See Figure 23). Their average score is 16% lower on average than that of Medium HQs. The main contributing factors to this difference appear to be *lack of required know-how* (Q1) and *shortage of well-qualified/skilled employees* (Q5) combined with *only a limited amount of in-house key functions* (Q4) and *less understanding of potential digitalization opportunities in the HQ* (Q3). On all of these items, small HQs score more than 20% lower than the medium HQs (See Appendix 9 for a full overview of the differences between the individual items). The average score for large HQs was 8% smaller than that of medium HQs.

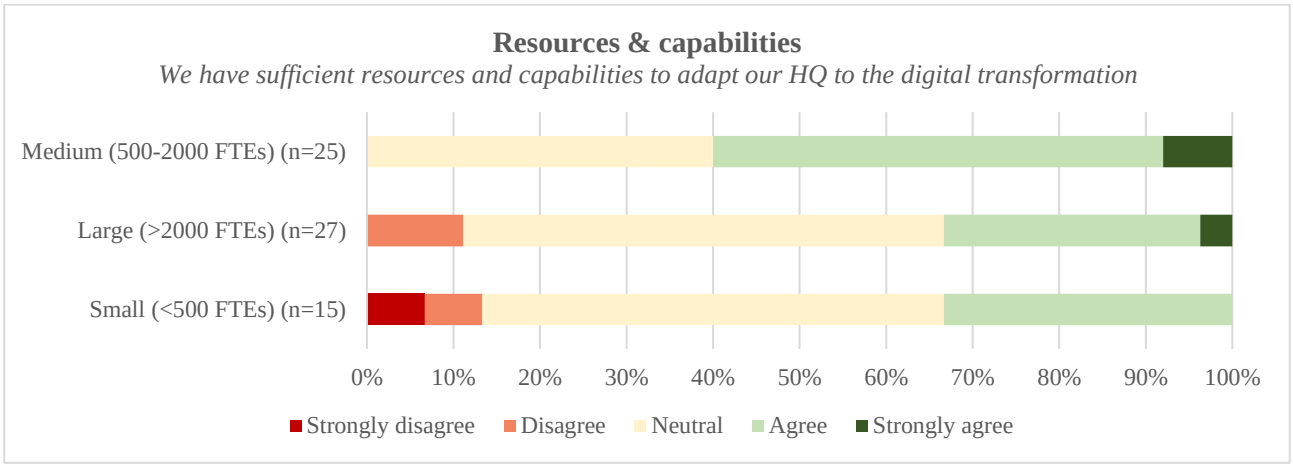

Figure 22: Response distribution for *Resources & capabilities* based on FTEs under control by the HQ

Despite the shortage in resources and capabilities, the small and large HQs appear to have a more clear idea about the impact of digitalization than the medium HQs based on their average response score. Hence, an almost inverse relationship exists where the medium HQs have the most sufficient resources and capabilities, but the least clear idea of how digitalization will impact compared to the other groups, and vice versa (See Figure 23). An overview of the response distribution for *Understanding impact* based on FTEs under control by the HQ can also be found in Appendix 10.

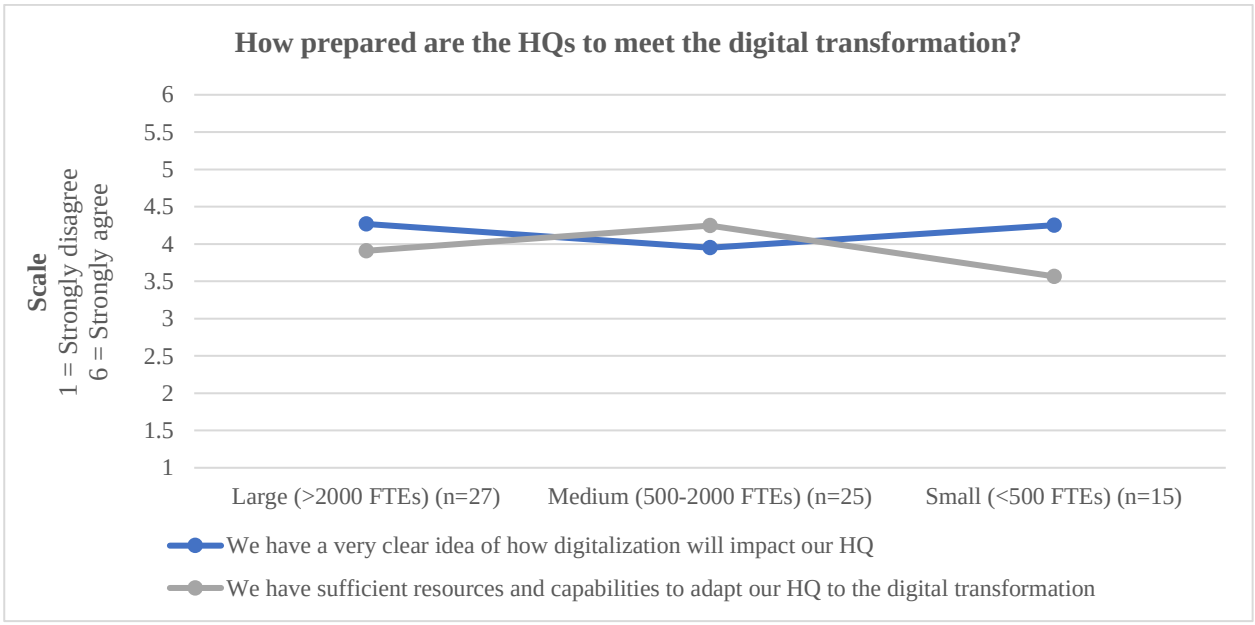

Figure 23: Average scores for *Understanding impact* and *Resources & capabilities* based on FTEs under control

For the different types of HQs, i.e. CHQs compared to DHQs and RHQs, differences were only minor (See Figure 24). CHQs had a 2% higher average score within the category *Resources & capabilities*, whereas DHQs/RHQs score 4% higher within *Understanding impact*.

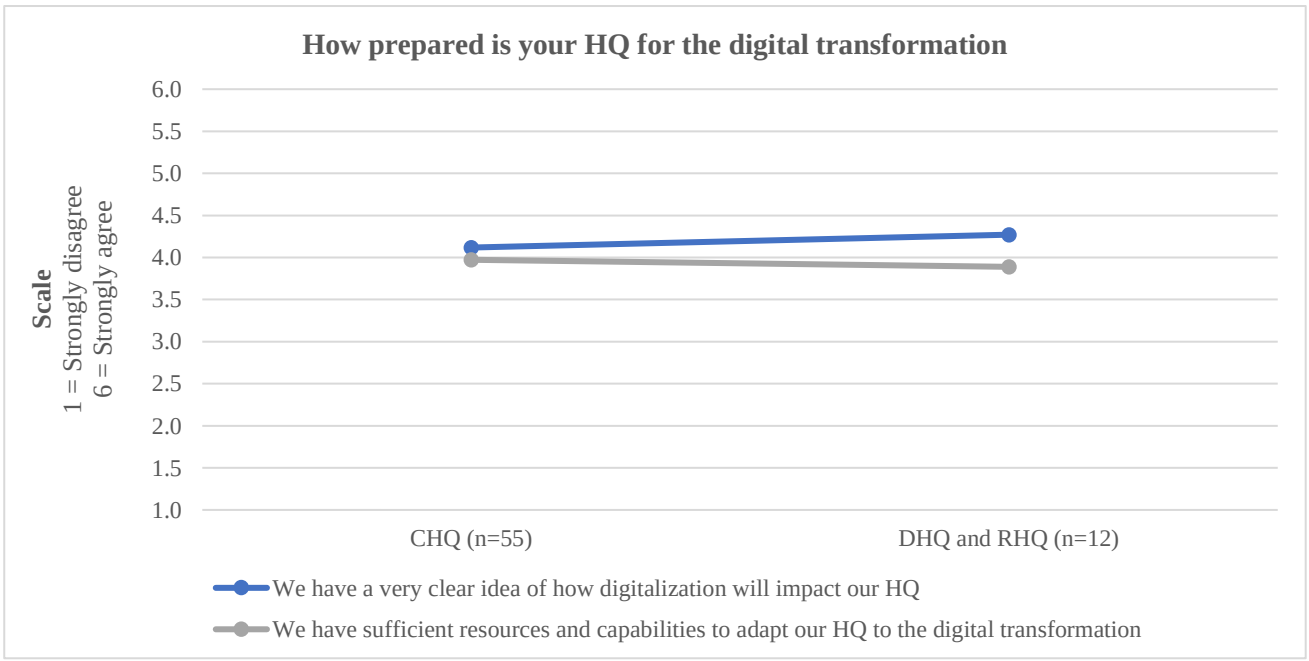

Figure 24: Average scores for *Understanding impact* and *Resources & capabilities* based on HQ type

4.2.3.5 Differences across industries

From the comparison across industries two observations are particularly interesting. First, across five of the six industry types, there are only small differences when comparing whether the respondents agree that their HQ has sufficient resources and capabilities (See Figure 25). However, for the *Finance and insurance* industry, the difference is quite substantial. Respondents within this industry on average scored 21% lower compared to respondents from the other industries on the *Resources and capabilities* category. The two items which this industry scores considerably lower on are *having the required know-how* (Q1) and *having well qualified/skilled employees* (Q5). On both items, the *Finance and insurance* industry averaged around 2.5 on the 6-point scale, and only one out of five respondents agree (or strongly agree) that they have the needed know-how or required employees to adapt to the digital transformation (See Appendix 11 for the comparison of individual items).

Second, the HQs operating within the *Wholesale and retail* industry appear to have a much better understanding of how digitalization will impact their HQ. On the 6-point scale, they have a 20% higher mean-score than what the average is across the other industries. The respondents from this industry were likewise some of the most enthusiastic in terms of how much digitalization could increase the value-added of the HQ, which could indicate one of two things. On the one hand, the respondents in this industry could be more biased (i.e. over-optimistic) towards their digitalization efforts and the potential value-added to be had from it. On the other hand, it could be the dynamics of the industry that generate these differences. On this latter point, the industry has recently started to make a large digital transition due to changing customer demands (Manyika et al., 2015; Sides & Furman, 2019). This might in turn have caused the HQs to start looking for different ways to make more use of the data that the subunits are going to supply. Regardless, any inferences from the results of both *Wholesale and retail* and *Finance and insurance* should be made with caution as both groups are made up of only six and eight observations, respectively. See Figure 25 below for the full comparison.

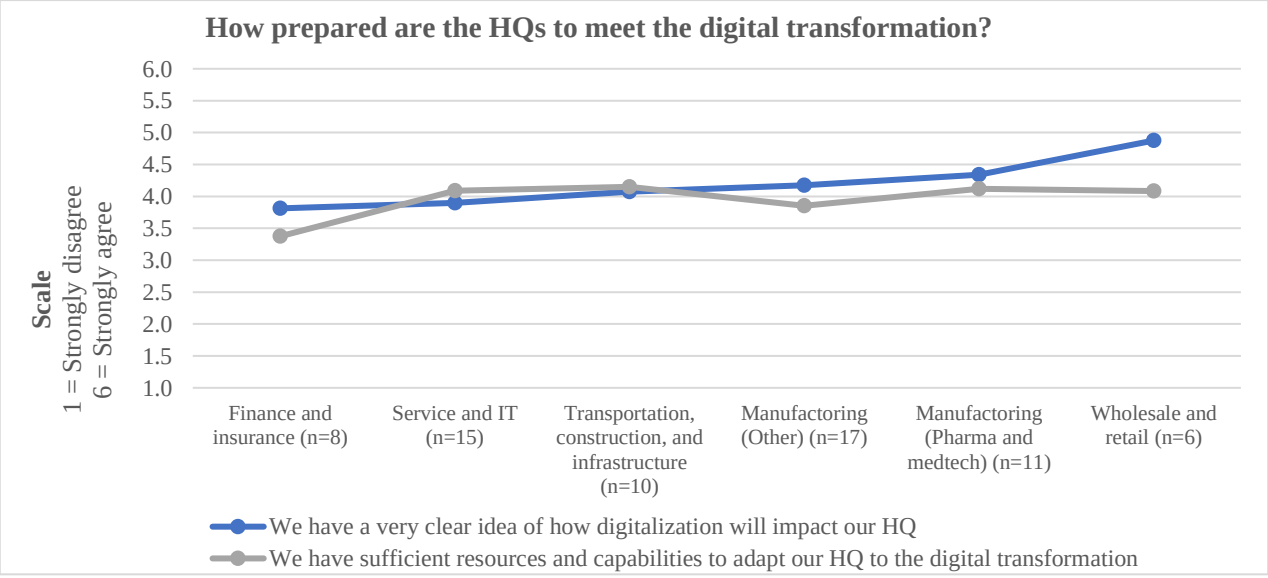

Figure 25: Average scores for *Understanding impact* and *Resources & capabilities* across industries

4.2.3.6 Conclusion: Are the HQs prepared?

Despite having high expectations for the increase in value-added for their HQ as a result of digitalization, the respondents seem to be less ensured about whether their HQs are prepared to meet the digital transformation. Less than six out of ten respondents agree (or strongly agree) that their HQ has a clear idea about the impact of digitalization. In addition, more than half of the HQ managers do not yet agree that their HQ has sufficient resources and capabilities to adapt to the digital transformation. It appears that the biggest constraints towards the latter is the lack of know-how and well-qualified/skilled employees. The problem with know-how and capable employees only seems to be aggravated in the industry of *Finance and insurance* and among the small HQs. The data only revealed minor differences in preparedness when grouping respondents based on their HQ type and organizational level. However, there appeared to be some differences when respondents were compared across number of FTEs under control. Here, the medium HQs were more likely to have the right resources and capabilities in place than small and large HQs. However, the medium HQs were trailing both the small and large HQs when it came to understanding how digitalization will impact their HQ. When compared across industries, the *Wholesale and retail* industry is by far the industry that indicates the best understanding of how digitalization would impact their HQ. At last, the data also showed that respondents who agree that their HQ is prepared to meet the digital transformation will on average have a more positive attitude towards whether digitalization will increase the value-added of their HQ.

4.2.4 How will digitalization impact the way HQs operate?

4.2.4.1 Overview

The third part of my problem statement was to examine the impact of digitalization on the way HQs operate in the future. From my factor analysis, I ended up with only one aggregated category, *Increasing involvement*, which investigated whether the HQ managers believe that their HQ will become more involved in its subunits' businesses as a result of digitalization. The distributions for the two items of the category show that 45% of the respondents agree (or strongly agree) that *the HQ will involve itself more in subunits businesses* (Q2) and that 31% agree (or strongly agree) that *the HQ will get much closer to the subunits* (Q3). See Figure 26 below.

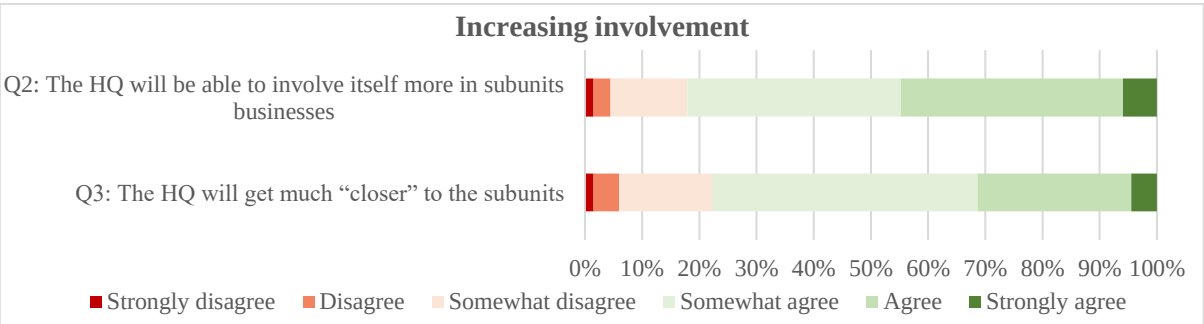

Figure 26: Response distribution for the individual items of the *Increasing involvement* category

The distribution patterns after averaging the scores of the individual items can be found in Figure 27. The results show that 49% of the respondents agree (or strongly agree) that their HQ will become more involved in its subunits' businesses as a result of digitalization, and that most of the other half remain neutral. Hence, only one of the 67 respondents disagree that digitalization will make their HQ more involved in its subunits' businesses. It therefore seems fair to say that even though digitalization might not per se make the HQ more involved, then it at least will not make the HQ less involved with only one respondent opposing the view.

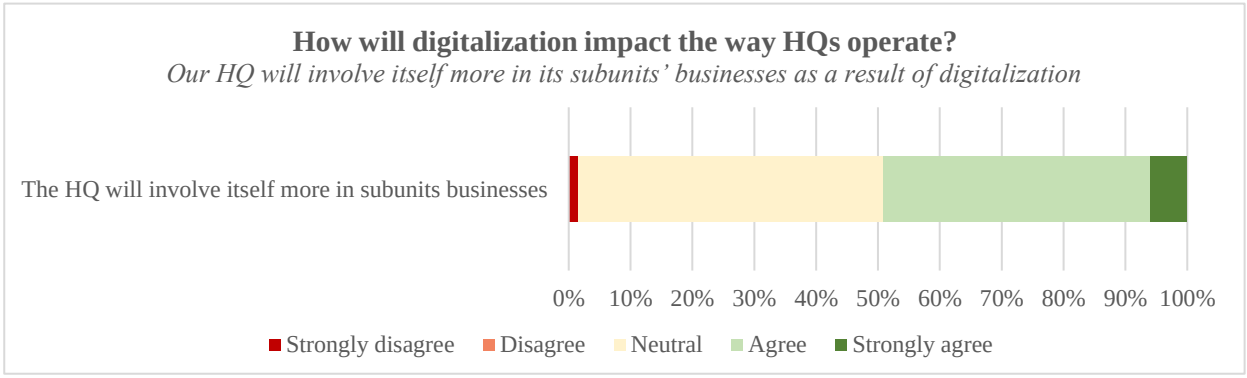

Figure 27: The average response distribution for *Increasing involvement*

Before analysing the results on *Increasing involvement* further, I will briefly comment on the eight items that were not grouped in the factor analysis (See Figure 28 for an overview). The first thing to notice from the individual items is that 87% of the respondents agree (or strongly agree) that digitalization will enable their HQ to become more data driven (Q10). The result imply that more data-driven decision making is likely to result from the increasing digitalization. This finding is not unexpected given the many opportunities digitalization offers in terms of increasing the interpretability of digitized data (e.g. Jarrahi, 2018). Second, the items; Q5, *the HQ will have more room for strategic thinking* and Q9, *the HQ will refocus on activities that machines and AI cannot do*, also have some support to them with 63% and 40% of respondents agreeing (or strongly agreeing), respectively. This could suggest that some respondents believe digitalization can relieve the HQ for some of its administrative tasks and instead make more room for strategic thinking. Hence, focus will be moved from the administrative role of the HQ and towards a more entrepreneurial role (Chandler, 1991; Foss, 1997). Third, there is only few (21%) respondents who disagree or somewhat disagree that the *HQ will become more powerful vis-á-vis its subunits* (Q4). Contrary, the remaining 79% of the respondents do at least somewhat agree that digitalization will make the HQ more powerful. Hence, although the extent of powerfulness is not quite clear (with 43% only "somewhat agreeing"), then there is some support to the notion that digitalization will make the HQ more powerful. However, this powerfulness might not be directly associated with the increased involvement of the HQ in its subunits' businesses as we shall see in the next sub-section.

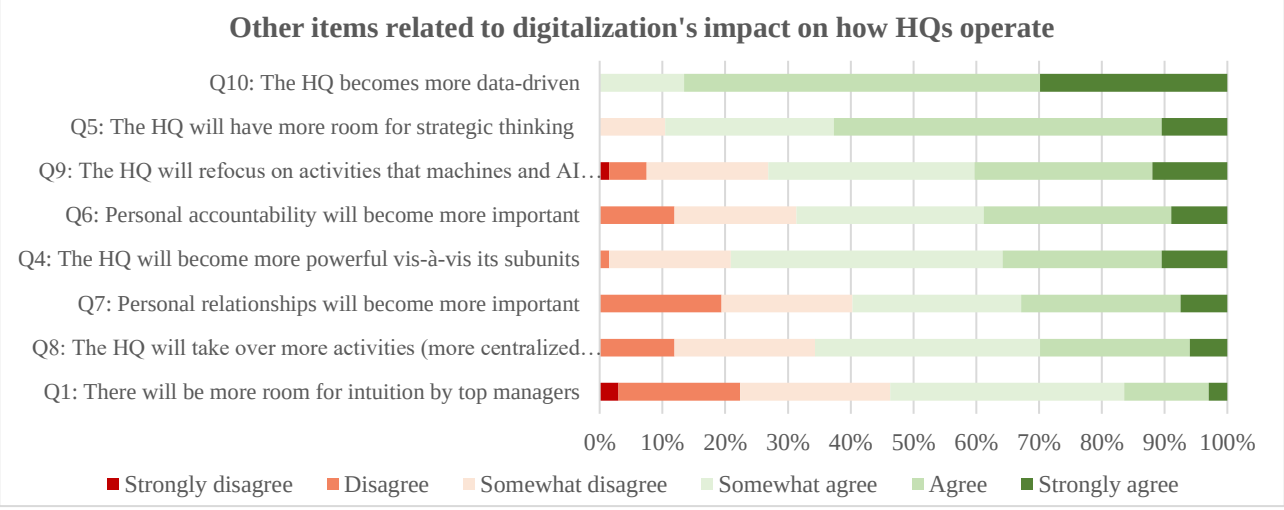

Figure 28: Response distribution for the items that were not aggregated into one category

4.2.4.2 More involvement does not equal more control and power of HQ

An important distinction remains in the academic literature around whether HQs should guide their subunits through strict control with their strategic initiatives, e.g. through approving strategic proposals, or whether the guidance is rather aimed towards strategic sparring by offering advice on new business opportunities etc. (Kaplan & Norton, 2005; Grant, 2016). From reading the formulations of the two questions (Q2 & Q3) within the category, *Increasing involvement*, little insight is offered as to which type of involvement the HQ will be engaged in. However, when examining the correlation with some of the items that were excluded in the factor analysis more nuances appear. Already, the respondents were asked whether they expect the *HQ will become more powerful vis-à-vis its subunits* (Q4) and *whether it will take over more activities (and become more centralized)* (Q8). These two questions are focused directly on the powerfulness and control of the HQ. But as the correlation matrix in Table 12 shows, then the correlations between these two questions and Q2 & Q3 are either negative or almost zero. This indicates that there is limited (and even negative) correlation between the HQ becoming more involved with its subunits' businesses and the HQ becoming more controlling and powerful. Hence, the HQ might get more involved, but it does not necessarily mean that the HQ will be more powerful and controlling simultaneously, and vice versa.

	Q2	Q3	Q8	Q4
Q2	1.00			
Q3	0.49	1.00		
Q8	***0.01***	***-0.11***	1.00	
Q4	***-0.08***	***-0.13***	0.06	1.00

Q2: The HQ will be able to involve itself more in subunits businesses
Q3: The HQ will get much "closer" to the subunits
Q8: The HQ will take over more activities (more centralized approach)
Q4: The HQ will become more powerful vis-à-vis its subunits

Table 12: Pearson's correlation matrix for Q2, Q3, Q8, and Q4 within the former *HQ operations* category

4.2.4.3 Organizational level

When investigating the different attitudes towards digitalization's impact on the increased involvement of the HQ, the views differ between respondents from different organizational levels. In particular, HQ managers from lower organizational levels were more than twice as likely to agree (or strongly agree) to this change than executives. Thus, managers working closer to the subunits are more likely to view digitalization as an enabler for more involvement with the HQs' subunits than the executives. The difference can be seen in Figure 29 below.

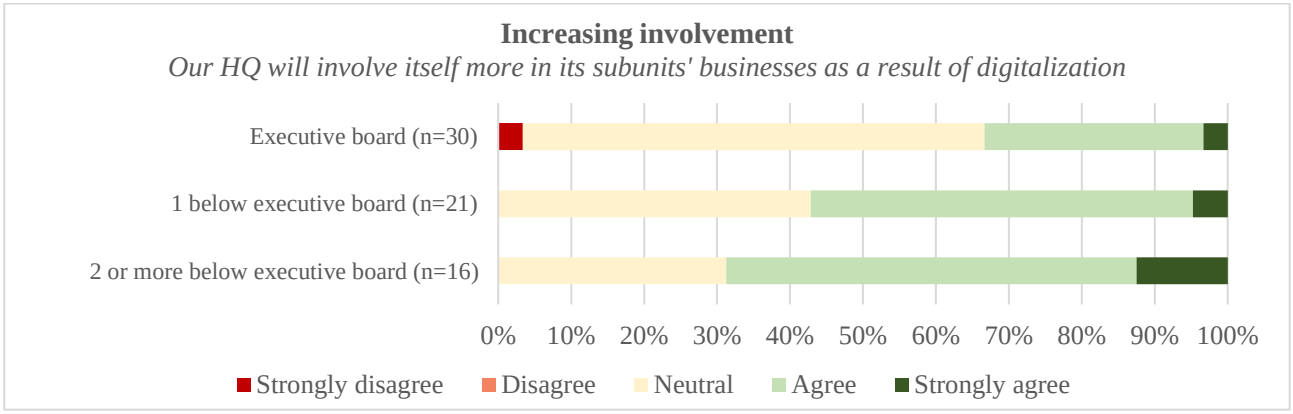

Figure 29: Response distribution for *Increasing involvement* based on the organizational level of the respondent

4.2.4.4 Differences across HQ type and size

Comparing across HQ types, there appears to be a considerable difference between how much the respondents believe digitalization will impact their HQ's involvement with their subunits' businesses. For the CHQs, only 44% of the respondents agree (or strongly agree) that the HQ's involvement will increase as a result of digitalization. For RHQs and DHQs, this number is 75%. Inferences from these numbers should be made with some caution, however, as the results only include twelve observations of respondents from RHQs and DHQs. Nevertheless, the differences between the attitudes from the CHQs and that of RHQs/DHQs seem quite substantial. An overview of the results can be found in Figure 30.

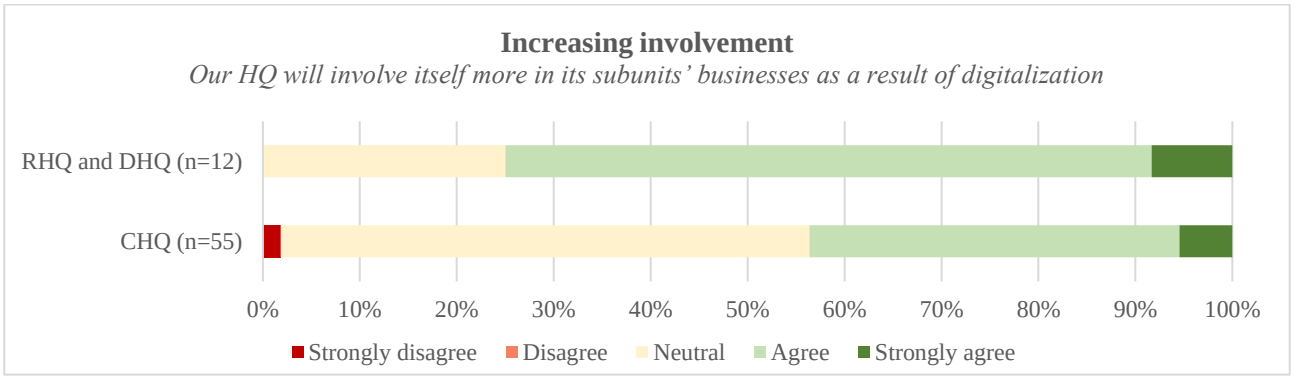

Figure 30: Response distribution for *Increasing involvement* based on HQ type

When comparing HQs based on number of FTEs under control, there are slight differences between the groups. For small and large HQs, around 60% of respondents agree (or strongly agree) that they will get more involved. For medium HQs only 32% of the respondents agree (or strongly agree) with the statement. Thus, as for the two previous categories, there appears to be some differences when comparing the HQs based on FTEs under control. The full overview can be found in Figure 31 below.

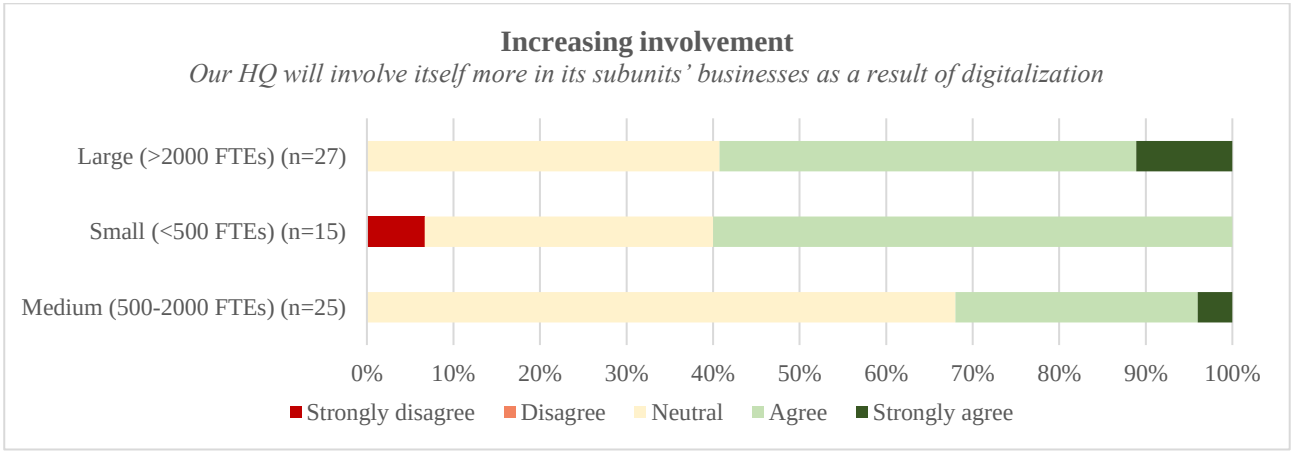

Figure 31: Response distribution for *Increasing involvement* based on FTEs under control by the HQs

4.2.4.5 Differences across industries

Contrary to respondent distributions for the previous categories, the differences between industries are quite small when comparing their attitudes towards whether the HQ will get more involved. Across all the industries the distributions of respondents agreeing (or strongly agreeing) to the statement remain within the range of 40% to 62%.

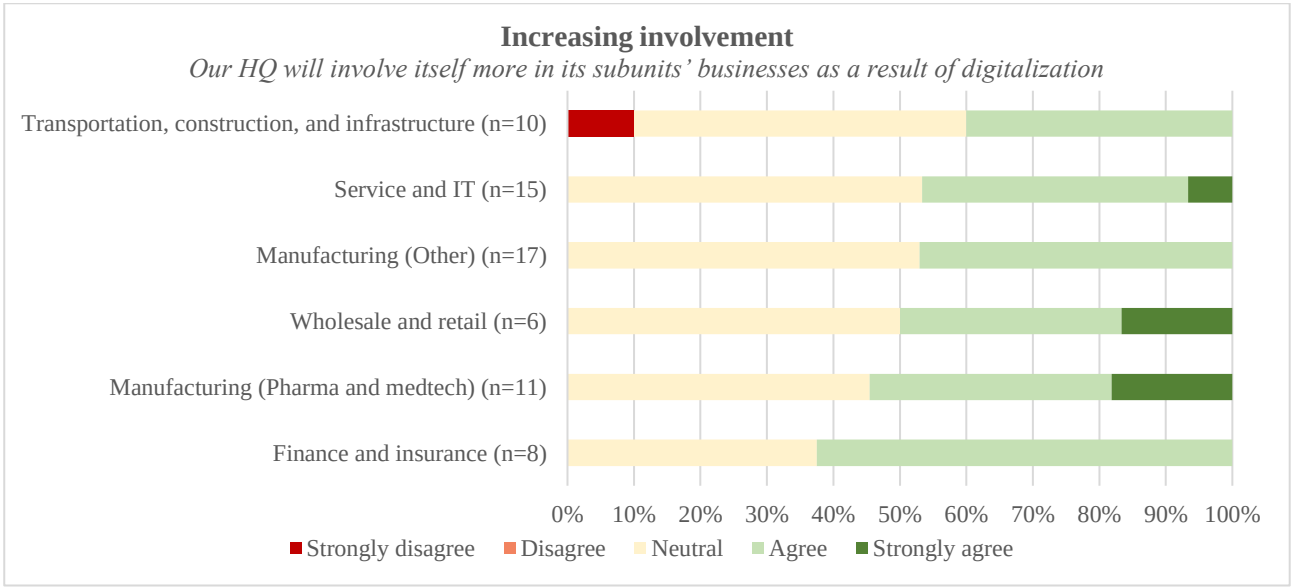

Figure 32: Response distribution for *Increasing involvement* across industries

4.2.4.6 Conclusion: How will digitalization impact the way HQs operate?

In conclusion, almost half of the respondents agree that digitalization will bring their HQ closer to its subunits through more involvement with its subunits' businesses. Particularly, managers at lower organizational levels, and managers working at RHQs and DHQs, seem more prone support this view. For the size of HQs variations were smaller, although respondents from medium HQs were the least likely to agree compared to respondents at larger and smaller HQs. At last it was found, that the respondents' opinions on whether their HQ will get more involved in their subunits' businesses do not correlate with their expectations towards whether the HQ will become more powerful, and vice versa. From the individual items that were not grouped into new categories we learned at least three things about the HQ managers' opinions; (1) the HQs are expected to become more data-driven, (2) digitalization is expected to make more room for strategic thinking and entrepreneurial activities, and (3) digitalization is not expected to make HQs less powerful, if anything, it might increase their power vis-à-vis its subunits.

4.3 Inferential statistics

In this third part of the analysis, I will use inferential statistics to test some of the results from my previous analysis. First, I will use the one sample t-test to see whether the average scores for the four categories are statistically significantly different from what is categorized as a "neutral" score. Second, I will test different trends found in the previous section using ANOVA and Tukey's HSD test.

4.3.1 Testing the main categories

4.3.1.1 The aim

As I found in my descriptive statistics, the respondents were on average more likely to agree than to disagree with the grouped statements of the four main categories. Subsequently, I want to test whether the respondents on average were also more likely to agree than to have a neutral/disagreeing attitude towards the main categories. That is, I will test whether the average scores for the categories *Increasing value-added, Understanding impact, Resources & capabilities*, and *Increasing involvement* are significantly higher than the 4.0 threshold for what is categorized as "agree" in the survey. Thus, I will test the following five questions with the test marked below them:

Do the respondents on average agree that digitalization will increase the value-added of their HQ?

Test: H_0: $\overline{Category1} \leq 4.0$

Test: H_A: $\overline{Category1} > 4.0$

Do the respondents on average agree that their HQ has the right resources and capabilities to adapt to the digital transformation?

Test: H_0: $\overline{Category2} \leq 4.0$

Test: H_A: $\overline{Category2} > 4.0$

Do the respondents on average agree that their HQ has developed a clear idea of how digitalization will impact their HQ?

Test: H_0: $\overline{Category3} \leq 4.0$

Test: H_A: $\overline{Category3} > 4.0$

Do the respondents on average agree that digitalization will enable their HQ to get more involved in its sub-units' businesses?

Test: H_0: $\overline{Category4} \leq 4.0$

Test: H_A: $\overline{Category4} > 4.0$

To test this, I will need to do a one sample t-test on the data from the respondents. Before undertaking this test, I will need to (1) correct for outliers in the data and (2) ensure that the data is not violating the normality assumption.

4.3.1.2 Testing for outliers

Field (2018) highlights that a frequent source of biases in many statistical tests is outliers. These are observations with scores substantially different from the rest of the data. It is common practice to also correct for outliers when using Likert type scales (Vaus, 2014). I will therefore apply the frequently used 1.5xIQR[9] rule to detect any outliers in my dataset. Using this rule, and as was also apparent from Figure 10, my data had a total of four outliers across all observations for the four categories, i.e. only 1.5% of the total observations were determined to be outliers. In accordance with the recommendations of Field (2018), I *winsorized* the outliers by replacing them with the next highest score in the data that is not an outlier.

4.3.1.3 Testing for normality

Before performing the t-test, I first tested whether the assumption of normality seemed to hold using the Shapiro-Wilk test and Q-Q plots (See Appendix 12 for an overview of the full test results and the Q-Q plots). Using the Shapiro-Wilk test, I will check whether the observations for any of the categories deviates significantly from a normal distribution using a significance level of 0.05. I found that none of the categories deviated significantly at a 0.05-level (See Table 13). Of the five categories, *Understanding impact* had the lowest p-value of 0.092. From examining the Q-Q plots it appears that the category has a slight left-skew. However, as the skew only appears to be minor, and because the deviation is not significant using the Shapiro-Wilk measure, I still choose to uphold the normality assumption for this category.

Category	Observations	W	V	z-score	p-value
1. Increasing value-added	67	0.99	0.39	-1.31	0.905
2. Resources & capabilities	67	0.99	1.06	-2.02	0.978
3. Understanding impact	67	0.97	1.63	1.33	0.092
4. Increasing involvement	67	0.98	1.11	0.39	0.348

Table 13: Shapiro-Wilk statistics for the four categories

[9] The 1.5xIQR rules determines that all observations that are not within 1 IQR ($IQR = Q_3 - Q_1$) range of either the 1st or 3rd quartile will be dropped (See also Schwertman, Owens, & Adnan, 2004)

4.3.1.4 T-test

As the assumption of normality seems to hold, I choose to use the t-test to find out whether the mean for each category could be determined to be statistically significantly different from 4.0. The results of the test can be found below in Table 14. An overview of the full Stata output can be found in Appendix 13.

Category	Mean	Std. err.	Std. dev.	t	df	p-value (one-sided)	95%-confidence interval	
							Lower	Upper
1. Increasing value-added	4.84	0.07	0.55	12.56	66	**0.000*** **	4.70	4.97
2. Resources & capabilities	3.96	0.09	0.74	-0.47	66	0.682	3.78	4.14
3. Understanding impact	4.16	0.11	0.88	1.50	66	0.069*	3.95	4.37
4. Increasing involvement	4.19	0.09	0.76	2.08	66	**0.021** **	4.01	4.38

***p < 0.01; **p < 0.05; *p < 0.1

Table 14: T-tests for the four categories against an expected mean of 4.0

The results show that there was a significant difference at a 0.05-level between the average score for *Increasing value-added* ($M = 4.8, SD = 0.55$) and the mean of 4.0; $t(66) = 12.56, p < 0.000$. Furthermore, the scores from *Increasing involvement* ($M = 4.2, SD = 0.76$) are also statistically significant on a 0.05-level; $t(66) = 2.08, p = 0.02$. Hence, the results show that a similar sample among HQ managers would with more than 95% probability find that the average respondent would at least agree (i.e. have a mean of above 4.0) that digitalization will increase the HQs value-added and that it will enable them to get more involved in their subunits' businesses. *Understanding impact* ($M = 4.2, SD = 0.88$) exhibits larger deviations in the responses and has a lower mean than the former two categories. Therefore, these results are only found to be significant on a 0.1-level; $t(66) = 1.5, p = 0.069$. The category *Resources & capabilities* ($M = 3.96, SD = 0.74$) has a mean below the hypothetical mean of 4.0 and therefore also a large p-value indicating that it is highly unlikely that we would find a mean above 4.0 even if we did a similar sample among HQ managers; $t(66) = -0.47, p = 0.682$. Hence, neither of the results from *Understanding impact* or *Resources & capabilities* are statistically significant on a 0.05-level. The results from these statistical tests will be discussed further in Section 5.1.

4.3.2 Testing trends

For this part of the analysis, I have selected five trends from the descriptive statistics that I would like to test for statistical significance. The five trends were selected based on their relevance in regard to my problem statement. In the following sub-sections, I will test the trends using the ANOVA test and Tukey's HSD test for the post-hoc procedure. The five trends are listed below:

1. *Do the respondents from different organizational levels on average have different perceptions of whether digitalization will increase the value-added of their HQ?*

2. *Do the respondents from HQs with different amount of FTEs under control on average have different perceptions of whether they have sufficient resources and capabilities to adapt the HQ to the digital transformation?*

3. *Do the respondents from different industries on average have different perceptions of whether digitalization will increase the value-added of their HQ?*

4. *Do the respondents from HQs with different amount of FTEs under control on average have different perceptions of whether their HQ will be more involved in their subunits' businesses as a result of digitalization?*

5. *Do the respondents from different organizational levels on average have different perceptions of whether their HQ will be more involved in their subunits' businesses as a result of digitalization?*

Trend 1: *Different believes about value-added across organizational levels*

One of the first findings from the data was that respondents' expectations to the increase in value-added differed across their organizational levels. To check whether the results from the different organizational level groupings are significantly different, I will therefore test:

Do the respondents from different organizational levels on average have different perceptions of whether digitalization will increase the value-added of their HQ?

Hence, I will use the ANOVA test to examine:

Test: H_0: $\overline{Category1}_{Exec.} = \overline{Category1}_{1\ below\ exec.} = \overline{Category1}_{>1\ below\ exec.}$

Test: H_A: The means are not equal

The summary statistics of *Increasing value-added* across organizational levels can be found below.

Group	N	Mean	Std. dev.	SE	Min	Max
>1 below executive board	16	5.15	0.35	0.18	4.50	5.88
1 below executive board	21	4.72	0.48	0.22	3.63	5.50
Executive board	30	4.75	0.62	0.16	3.63	6.00

Table 15: Descriptive statistics for *Increasing value-added* by organizational level

Tests of assumptions

Before moving further with the statistical analysis, I tested the assumptions of normality and homoskedasticity. An overview of Q-Q and residual plots along with the results from the Shaprio-Wilk test and Levene's test can be found in Appendix 14. Below is a summary of the results.

Test of normality: Using the Shapiro-Wilk test, I found that none of the mean distributions for *Increasing value-added* across organizational levels deviated significantly from the normal distribution at a significance level of 0.05. Of the three groups, the lowest p-value was found within the group *1-below executive board*, which still had a p-value of 0.813. When examining the Q-Q plots, the observations also appeared to be normally distributed without any substantial skew.

Test of homoskedasticity: Using Levene's test, I found that the variance of the means for the *Increasing value-added* groupings across organizational level were not significantly different on a 0.05-level, $F(2,64) = 2.83$ and $p = 0.066$. However, the low p-value does indicate that the groupings have some differences in their variance. By examining the residual plot, it can be seen that the residuals are on average narrower for respondents within the *>1 below executive board* group compared to the *Executive board* group. Despite of this, Levene's test still inform us that the differences are not significant. Furthermore, the ANOVA test is well-known for being robust to these type of small assumption deviations (Agresti & Finaly, 2013). Therefore, I choose to still use ANOVA test.

ANOVA and post hoc test

An overview of the results from my ANOVA test can be found below. The Stata output from the test is available in Appendix 15.

Source	Sum of squares	df	Mean square	F	Sig.
Between groups	2.04	2	1.02	3.71	**0.030****
Within groups	17.61	64	0.28		
Total	19.66	66	0.30		

***p < 0.01; **p < 0.05; *p < 0.1

Table 16: Results from ANOVA test for *Increasing value-added* by Organizational level

As Table 16 demonstrates, then there was a significant difference between the respondents' average scale score for *Increasing value-added* when compared across their organizational levels at a 0.05-significance level, $F(2,64) = 3.71, p = 0.03$. Hence, respondents from different organizational levels do seem to have different views of whether digitalization can increase the value-added of the HQ. To provide further insights around these results, I examined the differences using Tukey's HSD test. The results of this test can be found in Table 17 below.

Categories	Con-trast	SE	t	Sig.	95% confidence interval	
					Lower	Upper
>1 below executive board vs. 1 below executive board	0.43	0.17	2.46	**0.043****	0.01	0.85
Executive board vs. 1 below executive board	0.03	0.15	0.23	0.972	-0.32	0.39
Executive board vs. >1 below executive board	-0.39	0.16	-2.43	**0.047****	-0.78	0.00

***p < 0.01; **p < 0.05; *p < 0.1

Table 17: Results from Tukey's HSD test for *Increasing value-added* by *Organizational level*

The post hoc comparisons using the Tukey's HSD test shows that the difference of 0.43 between the mean score for respondents from *more than one level below the executive board* ($M = 5.15, SD = 0.35$) and respondents *one level below the executive board* ($M = 4.72, SD = 0.48$) is statistically significant at a 0.05-level. In addition, the 0.39 lower mean for respondents from the *executive board* ($M = 4.75, SD = 0.62$) compared to those *more than one level below the executive board* ($M = 5.15, SD = 0.35$) is likewise statistically significant on a 0.05-level. However, the differences between the means of respondents from the *executive board* ($M = 4.75, SD = 0.62$) and from *one level below the executive board* ($M = 4.72, SD = 0.48$) is minor ($Contrast = 0.03$) and non-significant. Before making a conclusion, it should be kept in mind that respondents from the executive board did exhibit a larger variance in their answers. This indicates that this group of respondents are less homogen as a group and that opinions are still dispersed across managers at this organizational level. Nonetheless, the results do indicate that we on average can expect managers at lower levels of the company to have more optimistic expectations towards whether digitalization can increase the value-added of the HQ than respondents who work within, or close to, the executive board.

Trend 2: *Medium sized HQs are most prepared in terms of resources and capabilities*

From my descriptive statistics, I found that respondents from medium HQs, with between 500-1500 FTEs under control, were more likely than those from smaller and larger HQs to agree that their HQ had sufficient resources and capabilities to adapt to the digital transformation. I will therefore check the results for statistical significance by testing:

> *Do the respondents from HQs with different amount of FTEs under control on average have different perceptions of whether they have sufficient resources and capabilities to adapt the HQ to the digital transformation?*

The statistical test will accordingly be:

Test: $H_{0:}\ \overline{Category2}_{>2000FTEs} = \overline{Category2}_{500-2000FTEs} = \overline{Category2}_{<500FTEs}$

Test: $H_{A:}$ The means are not equal

The summary statistics of the groups can be found below in Table 18.

Group	N	Mean	Std. dev.	SE	Min	Max
Small (<500 FTEs)	15	3.60	0.74	0.19	2.3	4.67
Medium (500-2000 FTEs)	25	4.25	0.66	0.13	3.17	5.5
Large (>2000 FTEs)	27	3.89	0.72	0.14	2.5	5.5

Table 18: Descriptive statistics for Resources & capabilities by FTEs under control

Tests of assumptions

See Appendix 16 for the full overview of the tests of assumptions. The results are summarized below.

Test of normality: Using the Shapiro-Wilk test, I found that none of the distributions for *Resources & capabilities* deviated significantly from the normal distribution at a 0.05-level across the three groupings. The lowest p-value for any of the groups was 0.39 for the medium HQs. The Q-Q plots only supported the test, as the observations appeared to be without skew or any substantial deviations.

Test of homoskedasticity: For the mean scores for *Resources & capabilities*, the variances across the three groupings were not significantly different on a 0.05-level. Using Levene's test, I got $F(2,64) = 0.08$ and $p = 0.926$. The high p-value indicates that it is fair to assume that the groupings have approximately the same variance on their mean scores for *Resources & capabilities*. The findings are supported by the residual plot which also shows a roughly equal variance across the groups.

ANOVA and post hoc test

As both the assumption about normality and homoskedasticity hold, I performed an ANOVA test. The summary result of this test can be found below.

Source	Sum of squares	df	Mean square	F	Sig.
Between groups	4.16	2	2.08	4.18	**0.020****
Within groups	31.80	64	0.50		
Total	35.96	66	0.54		

***p < 0.01; **p < 0.05; *p < 0.1

Table 19: Results from ANOVA test for Resources & capabilities by FTEs under control

As can be seen in Table 19, then there was a significant difference between the respondents' mean scale score for *Resources and capabilities* across the three groupings at a 0.05-significance level, $F(2,64) = 4.18, p =$

0.02. Thus, the opinions about whether the HQ has sufficient resources and capabilities to undertake the digital transformation do differ depending on how many FTEs the HQ has under control. I examined the differences between the three HQ size categories using Tukey's HSD test. An overview of the test results can be found in Table 20, and the full results of the test can be found in Appendix 17.

Categories	Con-trast	SE	t	Sig.	95% confidence interval	
					Lower	Upper
Medium (500-2000 FTEs) vs. Large (>2000 FTEs)	0.36	0.20	1.83	0.168	-0.11	0.83
Small (<500 FTEs) vs. Large (>2000 FTEs)	-0.29	0.23	-1.28	0.410	-0.84	0.25
Small (<500 FTEs) vs. Medium (500-2000 FTEs)	-0.65	0.23	-2.82	**0.017****	-1.20	-0.10

***p < 0.01; **p < 0.05; *p < 0.1

Table 20: Results from Tukey's HSD test for *Resources & capabilities* by *FTEs under control*

The comparisons using the Tukey's HSD test indicated that the (negative) 0.65 mean difference between respondents from small HQs ($M = 3.6, SD = 0.74$) and respondents from medium HQs ($M = 4.25, SD = 0.66$) is statistically significant on a 0.05-level. Although the results show that the small HQs ($M = 3.6, SD = 0.74$) on average are slightly less prepared in terms of resources and capabilities ($contrast = -0.29$) than large HQs ($M = 3.89, SD = 0.72$), then this difference is not statistically significant. In sum, the results indicate that on average the medium sized HQs are better prepared than the small HQs in terms of resources and capabilities.

Trend 3: *Expectations towards the HQs increase in value-added depends on industry type*

From the earlier analysis, it was apparent that the perceptions of whether digitalization can increase the value-added of the HQ varied across different industry types. To check whether this difference is statistically significant, I will therefore test:

> *Do the respondents from different industries on average have different perceptions of whether digitalization will increase the value-added of their HQ?*

The statistical test will accordingly be:

> Test: H_0: $\overline{Category1}_{Finance\ \&\ insurance} = \overline{Category1}_{Service\ \&\ IT} = \overline{Category1}_{Manu.\ (Other)} = \overline{Category1}_{Retail\ \&\ wholesale} = \overline{Category1}_{Manu.\ (Pharma\ \&\ Medtech)} = \overline{Category1}_{Transp.,\ constr.,\ \&\ infra.}$
>
> Test: H_A: The means are not equal

The summary statistics of the Industry groupings can be found in Table 21.

Group	N	Mean	Std. dev.	SE	Min	Max
Finance and Insurance	8	4.80	0.53	0.19	3.88	5.5
Manufacturing (Other)	17	4.60	0.55	0.13	3.63	5.25
Manufacturing (Pharma & MedTech)	11	4.90	0.46	0.14	4.13	5.5
Service and IT	15	5.04	0.41	0.11	4.25	5.63
Transportation, construction, and infrastructure	10	4.55	0.47	0.15	3.63	5.13
Wholesale and retail	6	5.42	0.63	0.26	4.5	6.0

Table 21: Descriptive statistics for *Increasing value-added* by *Industry type*

Tests of assumptions

See Appendix 18 for the full overview of the tests of assumptions. The results are summarized below.

Test of normality: Using the Shapiro-Wilk test, I found that none of the distributions for *Increasing value-added* deviated significantly from the normal distribution at a 0.05-level across the industry types. The two industries with the lowest p-values were *Transportation, construction, and infrastructure* ($p = 0.25$) and *Wholesale and retail* ($p = 0.35$). When examining the Q-Q plots, the former grouping did appear to have two outliers which are likely to result in the lower score, whereas the latter had only six observations, but a larger spread between the expected and observed quantiles. Nonetheless, the observations for both groupings did not seem to diverge substantially from the observations that would be expected under a normal distribution.

Test of homoskedasticity: For the *Increasing value-added* scale scores, the variance between the industries were not significantly different on a 0.05-level. Using Levene's test, I got $F(5,61) = 0.78$ and $p = 0.57$. The high p-value indicates that the industries have approximately equal variance. The conclusion was only supported by the residual plots.

ANOVA and post hoc test

As both the assumption about normality and homoskedasticity appear to hold, I moved forward with the ANOVA test. The summary result of the test can be found below, and the statistical test behind it can be found in Appendix 19.

Source	Sum of squares	df	Mean square	F	Sig.
Between groups	4.45	5	0.89	3.57	**0.007*** **
Within groups	15.20	61	0.25		
Total	19.66	66	0.30		

***p < 0.01; **p < 0.05; *p < 0.1

Table 22: Results from ANOVA test for *Increasing value-added* by *Industry type*

As Table 22 shows, then at least one of the mean scores for *Increasing value-added* from the six industry groupings were significantly different from the others at a 0.05-level, $F(5,61) = 3.57, p = 0.007$. This means that the respondents from the different industry groupings do have different views of whether digitalization will increase the value-added of the HQ. I examined the difference among the groupings using Tukey's HSD test. An overview of the results from the test can be found in Table 23 below.

Categories	Contrast	SE	t	Sig.	95% conf. interval	
					Lower	Upper
Manufacturing (Other) vs. Finance and insurance	-0.19	0.21	-0.91	0.944	-0.82	0.44
Manufacturing (Pharma and MedTech) vs. Finance and insurance	0.10	0.23	0.43	0.998	-0.58	0.78
Service and IT vs. Finance and insurance	0.24	0.22	1.12	0.871	-0.40	0.89
Transp., construc., and infrastructure vs. Finance and insurance	-0.25	0.24	-1.04	0.902	-0.94	0.45
Wholesale and retail vs. Finance and insurance	0.62	0.27	2.30	0.210	-0.17	1.41
Manufacturing (Pharma and MedTech) vs. Manufacturing (Other)	0.29	0.19	1.53	0.649	-0.27	0.86
Service and IT vs. Manufacturing (Other)	0.44	0.18	2.48	0.146	-0.08	0.96
Transp., construc., and infrastructure vs. Manufacturing (Other)	-0.05	0.20	-0.27	1.000	-0.64	0.53
Wholesale and retail vs. Manufacturing (Other)	0.81	0.24	3.43	**0.013****	0.12	1.51
Service and IT vs. Manufacturing (Pharma and MedTech)	0.14	0.20	0.73	0.978	-0.44	0.73
Transp., construc., and infrastructure vs. Manufacturing (Pharma and MedTech)	-0.35	0.22	-1.59	0.606	-0.99	0.29
Wholesale and retail vs. Manufacturing (Pharma and MedTech)	0.52	0.25	2.05	0.328	-0.23	1.26
Transp., construc., and infrastructure vs. Service and IT	-0.49	0.20	-2.41	0.168	-1.09	0.11
Wholesale and retail vs. Service and IT	0.38	0.24	1.56	0.631	-0.33	1.08
Wholesale and retail vs. Transp., construc., and infrastructure	0.87	0.26	3.36	**0.016****	0.11	1.63

***p < 0.01; **p < 0.05; *p < 0.1

Table 23: Results from Tukey's HSD test for *Increasing value-added* by *Organizational level*

The Tukey's HSD test showed two interesting findings. First, the differences between the mean scores from respondents within the *Wholesale and retail* ($M = 5.42, SD = 0.63$) were significantly different from those of respondents from the *Manufacturing (Other)* ($M = 4.6, SD = 0.55$) grouping on a significance level of 0.05. The *Manufacturing (Other)* category consist of HQs associated with manufacturing businesses within e.g. electronics, FMCG, heavy machinery, etc. The test likewise shows that the 0.87 difference between *Wholesale and retail* ($M = 5.42, SD = 0.63$) and *Transportation, construction, and infrastructure* ($M = 4.55, SD = 0.47$) is also significant on a 0.05-level. None of the other comparisons were statistically significant. Thus, it can be concluded that the differences in the perceptions of whether digitalization can increase the value-added are statistically significant for respondents from the *Wholesale and retail* industry in comparison to respondents within the industries *Transportation, construction, and infrastructure* together with *Manufacturing (Other)*.

Trend 4: *Larger HQs will be more involved in their subunits' businesses*

From the descriptive statistics it was evident that across HQ sizes, the large HQs with more than >2000 FTEs were most likely to agree that digitalization would enable them to get more involved in their subunits' businesses. I will therefore test the following:

> *Do the respondents from HQs with different amount of FTEs under control on average have different perceptions of whether their HQ will be more involved in their subunits' businesses as a result of digitalization?*

The statistical test will accordingly be:

> Test: H_0: $\overline{Category4}_{>2000FTEs} = \overline{Category4}_{500-2000FTEs} = \overline{Category4}_{<500FTEs}$
>
> Test: H_A: The means are not equal

The summary statistics of the three groupings for *Increasing involvement* can be found below in Table 24.

Group	N	Mean	Std. dev.	SE	Min	Max
Small (<500 FTEs)	15	4.20	0.75	0.19	3	5.0
Medium (500-2000 FTEs)	25	3.94	0.73	0.15	3	5.5
Large (>2000 FTEs)	27	4.43	0.76	0.15	3	6.0

Table 24: Descriptive statistics for *Increasing involvement* by *FTEs under control*

Tests of assumptions

See Appendix 20 for the full overview of the tests of assumptions. The results are summarized below.

Test of normality: Using the Shapiro-Wilk test, I found that none of the distributions for *Increasing involvement* deviated significantly from the normal distribution at a 0.05-level across the size categories. Of the three groupings, the lowest p-value was for the grouping small HQs ($p = 0.33$). However, the distribution did seem to exhibit a high degree of normality when examined via a Q-Q plot. The two other groupings both had a slight skew in opposite directions due to a few small outliers, but the divergences did not appear to be substantial. Hence, the assumption of normality did seem to hold.

Test of homoskedasticity: Using Levene's test, I found that the variance for the *Increasing involvement* scores were significantly different on a 0.05-level, $F(2,64) = 0.08$ and $p = 0.92$. The residual plots only supported this conclusion.

ANOVA analysis and post hoc test

As the assumptions hold, I performed the ANOVA analysis. The summary results can be found below.

Source	Sum of squares	df	Mean square	F	Sig.
Between groups	3.07	2	1.53	2.77	0.070*
Within groups	35.41	64	0.55		
Total	38.48	66	0.54		

***p < 0.01; **p < 0.05; *p < 0.1

Table 25: Results from ANOVA test for *Increasing involvement* by *FTEs under control*

As shown in Table 25, then the differences were ***non***-significant on a 0.05-level, $F(2,64) = 2.77, p = 0.07$. Hence, the respondents' view of whether digitalization will enable their HQ to get more involved in their subunits' businesses do not appear to vary significantly across the three groupings. Despite the lack of significance on a 0.05-significance level, then the results are statistically significant on a 0.1-level. Consequently, I did still find it interesting to see how the individual groups compare using Tukey's HSD test. The results of this test can be found in Table 26 below, and the full results of the test are available in Appendix 21.

Categories	Contrast	SE	t	Sig.	95% confidence interval	
					Lower	Upper
Medium (500-2000 FTEs) vs. Large (>2000 FTEs)	-0.49	0.21	-2.35	0.056*	-0.98	0.01
Small (<500 FTEs) vs. Large (>2000 FTEs)	-0.23	0.23	-0.94	0.615	-0.80	0.35
Small (<500 FTEs) vs. Medium (500-2000 FTEs)	0.26	0.24	1.07	0.536	-0.32	0.84

***p < 0.01; **p < 0.05; *p < 0.1

Table 26: Results from Tukey's HSD test for *Increasing involvement* by *FTEs under control*

The post hoc comparisons using the Tukey's HSD test indicated that the -0.49 difference between the mean score for respondents from medium HQs with ($M = 3.9, SD = 0.73$) and respondents from large HQs ($M = 4.4, SD = 0.76$) is *not* statistically significant on a 0.05-level with a p-value of 0.056. Nevertheless, the 95% CIs of [-0.98,0.01] indicate that the difference is not close from.

***Trend 5:** Different believes about increasing involvement across organizational levels*

Although the differences in believes about increasing involvement did not appear to be statistically significant (on a 0.05-level) across HQ sizes, then previous descriptive statistics did indicate, that there were different opinions about the topic across organizational level of the respondents. I will therefore test the below proposition:

> *Do the respondents from different organizational levels on average have different perceptions of whether their HQ will be more involved in their subunits' businesses as a result of digitalization?*

The statistical test will accordingly be:

Test: H_0: $\overline{Category4}_{Exec.} = \overline{Category4}_{1\ below\ exec.} = \overline{Category4}_{>1\ below\ exec.}$

Test: H_A: The means are not equal

The summary statistics of the groups can be found below.

Group	N	Mean	Std. dev.	SE	Min	Max
>1 below executive board	16	4.47	0.90	0.23	3.0	6.0
1 below executive board	21	4.43	0.66	0.14	3.0	6.0
Executive board	30	3.88	0.65	0.12	3.0	5.5

Table 27: Descriptive statistics for *Increasing involvement* by Organizational level

Tests of assumptions

See Appendix 22 for the full overview of the tests of assumptions. The results are summarized below.

Test of normality: Using the Shapiro-Wilk test, I found that none of the distributions for *Increasing involvement* deviated significantly from the normal distribution at a 0.05-level across Organizational level groupings. The lowest p-value across the groups was found for the respondents from the *executive board* ($p = 0.2$), but this distribution seemed to be approximately normally distributed when using a Q-Q plot. The Q-Q plots likewise appeared approximately normally distributed for the other groupings, and thus I do not expect the normality assumption to be violated for these groupings.

Test of homoskedasticity: The variances of the three organizational level groupings were not significantly different on a 0.05-level. Using Levene's test, I got $F(2,64) = 1.56$ and $p = 0.21$. Although the difference was not significant, then the low p-value does indicate that there might be small deviations in the variance. However, from examining the residual plots the residuals appear to be quite evenly distributed. Hence, the homoskedasticity assumption is assumed to hold.

ANOVA analysis and post hoc test

As both the assumption about normality and homoskedasticity hold, I performed an ANOVA test. The summary result of this test can be found below.

Source	Sum of squares	df	Mean square	F	Sig.
Between groups	5.26	2	2.63	5.07	**0.009*** **
Within groups	33.22	64	0.52		
Total	38.48	66	0.58		

***p < 0.01; **p < 0.05; *p < 0.1

Table 28: Results from ANOVA test for *Increasing involvement* by Organizational level

As shown in Table 28, then there was a significant difference between the respondents' average scale score for *Increasing involvement* when compared across their organizational levels on a 0.05-significance level, $F(2,64) = 5.07, p = 0.009$. Hence, the respondents from different organizational levels do seem to have different views of whether digitalization will enable the HQ to get more involved in its subunits' businesses. I examined the differences between the different organizational levels using Tukey's HSD test. The results of this test can be found in Table 29, and the full results of the test are available in Appendix 23.

Categories	Contrast	SE	t	Sig.	95% confidence interval	
					Lower	Upper
>1 below executive board vs. 1 below executive board	0.04	0.24	0.17	0.985	-0.53	0.61
Executive board vs. 1 below executive board	-0.55	0.20	-2.66	**0.026****	-1+04	-0.53
Executive board vs. >1 below executive board	-0.59	0.22	-2.62	**0.029****	-1.12	-0.05

***p < 0.01; **p < 0.05; *p < 0.1

Table 29: Results from Tukey's HSD test for *Increasing involvement* by *Organizational level*

The post hoc comparisons using the Tukey's HSD test revealed two interesting findings. First, it shows that the (negative) 0.55 difference between the mean scores for respondents from *one level below the executive board* ($M = 4.4, SD = 0.66$) and respondents from the *executive board* ($M = 3.9, SD = 0.65$) is statistically

significant on a 0.05-level. Second, the 0.59 lower mean for respondents from the *executive board* ($M = 3.9, SD = 0.65$) compared to those *more than one level below the executive board* ($M = 4.5, SD = 0.9$) is likewise statistically significant on a 0.05-level. The differences between the mean of respondents from the *executive board* ($M = 3.9, SD = 0.65$) and from *one level below the executive board* ($M = 4.4, SD = 0.66$) is small ($contrast = 0.04$) and non-significant. Thus, it appears that respondents from lower organizational levels are a significantly more prone to agree that digitalization will bring HQ closer to its subunits' businesses than respondents from the executive board.

4.3.3 Conclusion on the inferential statistics

In conclusion, the inferential statistics provided at least five interesting takeaways. First, the one sample t-test showed that the scores for *Increasing value-added* and *Increasing involvement* were significantly higher (on a 0.05-level) than the threshold value for agreeing. Thus, a similar sample among HQ managers would with more than 95% probability find that the average respondent would at least agree that digitalization will increase the HQs value-added and that it will enable them to get more involved in their subunits' businesses. The scores for *resources & capabilities* and *Understanding impact* were both insignificant on a 0.05-level. Second, the ANOVA and HSD test showed that HQ managers at lower organizational levels are significantly more likely to believe that digitalization will increase the value-added of the HQ than managers working within, or one-level below, the executive board. Third, it was found that HQ managers from medium sized HQs believe that their HQ is significantly better prepared for the digital transformation than HQ managers at smaller HQs. Four, the results showed that HQ managers from the *Wholesale and retail* industry are significantly more likely to agree that digitalization will increase the value-added of the HQ compared to respondents from the industries *Transportation, construction, and infrastructure* and *Manufacturing (Other)*. Five, the respondents from the executive board appeared to be significantly less likely to agree that digitalization will enable the HQ to get more involved in their subunits' businesses in comparison to managers at lower levels of the organization.

5. Discussion

In this section, I will first discuss the findings from the analysis in regard to the three sub-questions from my overall research question. Next, I will discuss the assumptions, limitations, and biases related to the study. At last, I will discuss the implications of the study's result for future research and business practice.

5.1 Discussion of the study's findings

5.1.1 Can digitalization be expected to increase the value-added of the HQ?

Previous research has suggested that the rise of digitalization presents many opportunities for firms to operate, organize, and communicate better (e.g. Davenport, 2014). The findings of this study show, that HQ managers likewise believe that the benefits of digitalization can be extended to also support the HQ in its value creation for its subunits. By aggregating the responses of eight individual items it was showed that 91% of the HQ managers agreed that they expect digitalization to increase the value-added of their HQ. The opinions appeared to be statistically significant even on a 1%-significance level. Specifically, digital technologies can assist the HQs in activities related to what Chandler (1991) describes as the entrepreneurial role of the HQ. Investigating the individual items, the respondents seemed particularly confident that new digital technologies would enable them to have better and more timely data for decision making. This could for instance help the HQ in making better decisions when doing business portfolio planning (e.g. Campbell et al., 1995). Other benefits that the respondents recognized were improved performance feedback for the overall corporation combined with a better ability to predict relevant factors such as sales forecast. These improvements can be useful for the HQ when providing strategic guidance to the subunits, e.g. by enabling them to better predict new business opportunities or threats (e.g. Kaplan & Norton, 2005). Furthermore, the improved ability to both strategically guide, and transfer best practices to, subunits also scored high. Both traits that are valuable, e.g. when trying to create synergies across the businesses (Foss, 1997). Thus, in a similar manner as Schmitt et al. (2019), this study finds that HQ managers expect digitalization to support them in the HQs value creating activities.

Although consensus was widely shared among the study participants, differences did emerge when comparing the opinions across different characteristics of the respondents and their HQ. One of the most interesting differences was between the opinions of HQ managers at higher organizational levels (i.e. those either in the executive board or one level below it) compared to HQ managers >1 level below the executive board. The data showed that the managers from lower organizational levels were significantly (on a 5%-significance level) more optimistic about whether digitalization could increase the value-added of the HQ. The results are peculiar because they contradict the findings of several other studies which often find senior managers and executives to be more optimistic and supportive towards digitalization opportunities than managers from lower levels. For instance, Ransbotham et al. (2016) find that lower-level managers, as opposed to senior managers, generally have lower expectations to the potential benefits of business analytics. In the same way, Bughin, Holley,

& Mellbye (2015) find that CEOs are twice as likely to act as direct sponsors of digital initiatives compared to the heads of local subunits. Similar findings have been made by Kane et al. (2017). One possible explanation could be, that the managers at the lower levels already cooperate closely with the subunits. Therefore, they might be more prone to see the benefits of digitalization than the executives that are not directly involved in the day-to-day collaboration with the subunits. However, more research is needed to clearly uncover the reasons behind this pattern.

Respondents' opinion did not only differ across organizational levels. The analysis likewise showed that respondents' scores for the *Increasing value-added* category were significantly different across industry groupings (on a 1%-significance level). Using pairwise comparison, it was shown that the differences of *Wholesale and retail* industry compared to the industries *Transportation, construction, and infrastructure* and *Manufacturing (Other)* were significantly different (on a 5%-significance level). The respondents from the *Wholesale and retail* also had mean scores that were 16-19% higher than the average of the other industries across items related to different parenting activities. The differences in expectations could indicate that digitalization offers more prosperous opportunities for HQs operating within the *Wholesale and Retail* industry. This could be explained by the rapid digitalization of the industry (e.g. Sides & Furman, 2019), which in turn will make more digitized data available for the HQs to leverage when supporting its subunits. Despite this tempting narrative, it is not yet clear whether general tendencies of digitalization of industries likewise translate into intraorganizational value in the horizontal relationships between HQs and their subunits. Furthermore, it does not explain why the optimism around digitalization appear to be larger for *Wholesale & retail* than for HQs associated with e.g. the manufacturing industry, which has likewise been highly affected by digitalization in recent years (Rolandsson et al., 2019). More research would therefore need to be made to understand the underlying reasons behind these observations.

5.1.2 How prepared are the HQs to realize the potential value-added?

Although expectations towards the value-adding effects of digitalization might be high, then the results also suggest that challenges still remain for HQs in realizing this potential. As found in the analysis, only 43% of the HQ managers agreed (or strongly agreed) that their HQ has sufficient resources and capabilities to adapt to the digital transformation. The inferential statistics likewise implied that the average score for the category was not significantly different from what is categorized as a neutral score. These findings are in line with several other studies that have found firms and organizations to frequently struggle when trying to realize the value potential of digitalization (e.g. Randbotham et al., 2016; Dhasarathy et al., 2018). Furthermore, the finding is also interesting in relation to the research by Schmitt et al. (2019). They propose that a challenge for CHQs in realizing the potential of digital technologies can be the lack of capabilities to develop insights from the data of subunits. This study brings empirical support to this claim. Indeed, the analysis of the individual

survey items revealed that HQ managers believed that the lack of well-qualified/skilled employees combined with lack of know-how in the HQ were the main obstacles HQs faced in having sufficient resources and capabilities to adapt.

As part of investigating whether the HQs were prepared to realize the potential value-added of digitalization, I also examined to what extent the respondents believed that their HQs had a clear idea about how digitalization would impact them. To this, only 54% of the HQ managers agreed (or strongly agreed), and the score for this category was not significantly different from a neutral score. Hence, HQs are on average also struggling in obtaining a clear understanding of how digitalization will affect their operations. As for resources and capabilities, the problem is not exclusively a problem that HQs are facing. Other studies have found, that most companies struggle to have a clear and coherent digital strategy across the organization (Kane et al., 2017). Nonetheless, this is still an important concern for HQs as research has shown that identifying and understanding the organizational changes that digitalization require is an important first step in integrating new digital initiatives (Yeow et al., 2018; Matt et al., 2015). The limited clarity around digitalization's impact on the HQs should also be viewed as an opening for future research. With the results of this study, it is apparent that only few (16%) of the HQ managers strongly agreed that their HQ has developed a clear idea about the impact of digitalization. To this end, it could be particularly interesting to understand how these prepared HQs view the impact, and whether there is anything to be learned for the many HQs that have yet to develop this clear understanding.

From the analysis it was also apparent that managers from medium HQs, with between 500-2000 FTEs under control, on average believed that their HQs were better equipped to adopt to the digital transformation than their smaller and larger counterparts. Particularly, the medium HQs' average score for *Resources & capabilities* was significantly higher (on a 5%-significance level) than that of small HQs with <500 FTEs under control. This difference was primarily driven by the small HQs lack of required know-how and skilled employees combined with a tendency for small HQs to have outsourced more of their key functions such as IT. Interestingly, the small HQs appeared to score almost 8% higher than the medium HQs on the items related to whether they had developed a clear idea of how digitalization will impact their HQ. Hence, small HQs might lack the resources and capabilities to adapt to the digital transformation, but they appear to have a better grasp around the potential impact of digitalization, and vice versa for the medium HQs. The finding indicates that the challenges HQs face in adapting to the digital transformation are not uniform in nature nor necessarily static across HQ types. Having the appropriate resources and capabilities to make use of more digital technology does not automatically translate into a clear understanding of how to use the technologies to the benefit of the HQ, and vice versa. This finding underlines the complexity for HQs in leveraging digital technologies to their benefit. As such, successfully overcoming the challenges of digitalization appear to be a no less complex task for HQs

than it is for many other parts of the organization (Günther et al., 2017; Dhasarathy et al., 2018; Bughin et al., 2017).

5.1.3 How will digitalization impact the way HQs operate in the future?

When examining how digitalization would impact the way HQs operate, it was found that almost half of the respondents agreed (or strongly agreed) that their HQ will get more involved in their subunits' businesses as a result of digitalization. The inferential statistics also showed that the results were statistically significant on a 0.05-level. The increased involvement is probably directly attributable to the better understanding HQs will obtain of the context of their subunits through digitalization. As previously found, HQ managers expect digitalization to give them better and more timely data around their subunits, e.g. through enhancements in the overall performance feedback of the corporation. These insights might in turn be used by the HQ to get a more thorough understanding of the contexts of individual subunits allowing them to increase their direct involvement in their businesses. These inferences are supported by some of the qualitative findings by Schmitt et al. (2019) who found that CHQ managers used data insights to get a quicker and more educated dialogue with local managers. However, in contrast to Schmitt et al. (2019), this study did not find any direct link between the increased involvement of the HQ and the expectation that the HQ would become more powerful vis-à-vis its subunits. As the analysis showed, the items for these questions instead exhibited small to negative correlations. Thus, in the context of Denmark, this increased involvement might not strictly come in the form of a more dominant HQ. This will in turn counteract one of the potential pitfalls of digitalization suggested by Schmitt et al. (2019), namely that the HQ will centralize decision-making processes and remove decision-making power from the local subunit managers with superior contextualized knowledge.

It was also found in the analysis that there were significant (on a 0.05-level) differences when the opinions of executives were compared to that of managers below the executive board on the topic of how digitalization would enable them to get more involved in their subunits' businesses. Compared to the executives, around twice as many of the respondents below the executive board agreed (or strongly agreed) that digitalization would increase the involvement of the HQ. On the one hand, the result is interesting because it demonstrates that executives clearly are not as keen to view digital technologies as a potential enabler for the HQ to get better integration with its subunits, even though past research has found such involvement to increase the value creation of the HQ (Nell & Ambos, 2013). On the other hand, the differences in opinions might result from executives working within different organizational contexts than the managers at lower levels. As previously described, the executives are not expected to be as close in their daily work to the subunits as managers working 1-2 levels below the executive board. Consequently, it might not be as clear for executives to see how digital technology can bring them closer to what they might already perceive as the somewhat distant subunits.

Besides the *Increasing involvement* category, several single item constructs were analysed regarding HQs operations in the future. Specifically, the data supported that the HQ is expected to make increased use of data in its support and control of its subunits as almost nine out of ten respondents agreed (or strongly agreed) that the HQ will become more data driven. Furthermore, there was a slight tendency among the respondents to agree that digitalization can give the HQ more time for strategic tasks related to the entrepreneurial role of the HQ (Chandler, 1991). These two tendencies could potentially have reinforcing effects on each other. With more time for strategic decisions and more data to support them, it is likely that the HQ will expand its current strategic responsibility. Furthermore, the strategic decision making is expected to be even more data-. With an extended focus on data, this might in turn make the HQs less reliable on the intuition of their managers which the data showed some support towards (See Figure 28). Such tendencies are already seen in leading digital companies such as Amazon where they base important HQ decisions, for instance deciding their geographical location of their CHQ, on algorithms rather than opinions of HQ managers (Bond, 2018). Thus, digitalization can be an enabler of an intensified focus towards the strategic responsibility of the HQ followed by more data-driven decision making. It should be noted, that the findings for these single items were not tested for statistical significance.

5.2 Assumptions, limitations, and biases related to the study

5.2.1 Limitations of the research method

The sampling for this study was made using a survey method which can make the study subject to several possible common method biases, i.e. biased methods which make the variance for the items attributable to the measurement method rather than to the constructs the measures represent (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). An important bias to consider when relying strongly on the personal opinions of the respondents is the *social desirability bias*. This bias refers to a tendency of some respondents to let their responses to certain questions be guided by whether they think their answer is socially desirable or not (Ibid.). The implications for this study could be, that some respondents would find it more socially desirable, or righteous, to express a positive opinion about their HQ digitalization efforts because they do not want to be disloyal to their HQ. Another associated bias is the *non-response bias* which refers to the potential bias, that those people who choose not to respond to a survey might differ in some systematic way (Hill, Roberts, Ewings, & Gunnell, 1997). The implication with this bias could be, that some employees who feel too loyal to their HQ would be reluctant to participate if they felt their answers would be exposing their HQ negatively. Both biases could make the overall sample more prone to agreeing towards the items in the survey. I tried to counter the biases by informing the respondents up-front that their responses would be treated as anonymous and strictly confidential. This ensured that they knew the responses would not be directly traceable to them nor to their

HQ/company. Furthermore, the questionnaire was opened with a statement telling the respondents that all HQs differ in their structure and approaches, thus indicating that all answers are fine.

Strong inferences from the inferential statistics used in this study should also be made with some caution, as the results could be improved using more rigours and advanced statistical models that would be better at determining cause-and-effect relationships. For instance, I used a simple ANOVA test to examine some of the findings from the descriptive statistics. Although this test is fine to compare different means across groups, then it is not able to control for other covariate factors that might co-vary with the dependent variable which could have been appropriate. For instance, it might have been relevant to control for the respondents' *organizational level* when testing whether there were differences across *Industry groupings* towards *Increasing value-added*, as *Organizational level* was known to have an effect on *Increasing value-added*. Furthermore, new control variables could also have been included such as checking for the HQs' existing embeddedness with their subunits when determining whether technology would let them get closer to the businesses of their subunits. Taking these factors into account would have enhanced our understanding of the cause-and-effect relationships for the different variables. Future studies should therefore seek to control for these types of interacting variables using ANCOVA tests which allows one to control for other continuous variables (Field, 2018). In a similar manner, confirmatory factor analysis could be used to test the validity of the factor items used in the survey of this study (Sharma, 1996).

5.2.2 Can we trust the judgements of HQ managers?

Perhaps one of the most critical assumptions that the findings of this study rely on is that HQ managers are able to critically and somewhat accurately assess the opportunities, changes, and challenges that digitalization foster for their HQ. Although their perceptions are quite possibly the best available indicators of what the future has in store, then there is no guarantee of whether their predictions are right. A similar concern was raised by Schmitt et al. (2019) around whether the positive perceptions of HQ managers towards the benefits of digitalization would be able to materialize. For instance, they raised concerns about whether better and more timely data would in fact directly translate into more relevant insights for the HQ, or whether these insights would even increase involvement of the HQ, as HQ managers will still lack the deeply contextualized understanding of the subunits activities to be more involved. These concerns are indeed justified, and previous research has shown that digital technologies do not always manage to contribute with the value they were originally expected to (Günther et al., 2017; Ransbotham et al., 2016). In a similar manner, is it not evident whether a strategically oriented HQ manager will be able to assess to what extent the right resources and capabilities are in place to support a digital transformation. Indeed, they might be overly optimistic on behalf of the HQs current digitalization efforts due to an inherent optimism bias (Sharot, 2011). Because of these caveats, one

should be careful not to treat the perception of managers directly as objective facts. Rather they should be treated as relevant indicators for the existing expectations towards digitalization's impact on HQs.

5.3 The implication of this study on future research and business practice

5.3.1 Potential implications for future research

Being an exploratory study, the research and findings within this thesis should be used to direct future research (Zikmund et al., 2013). To this end, this study opens several interesting opportunities for future research agendas, and I would like to highlight at least two of these important areas. First, the results show that a lot of HQs are yet to obtain a clear understanding of the of how digitalization will impact their operations. This could make it interesting for future research to make more in-depth qualitative studies of the HQs that have managed to already get a clear understanding of how digitalization will impact their operations. This will allow for a more thorough understanding of what technologies they expect to employ, and how they have planned to use them to support their HQ activities within their daily operations. In turn, this could serve as inspiration for other HQs in their future digitalization efforts. Second, the findings in this study suggest that HQs in Denmark are not a homogenous group in terms of their future expectations and challenges. Instead, respondents across different HQ types and industries differ in their views of these topics. Even across organizational levels do different perceptions appear to be present. Hence, the results of this study do support a contingency argument indicating that the use and challenges when dealing with digital technologies at the HQ-level depends on the context of the individual HQ. These findings fit well with existing literature in the area which have demonstrated that HQ activities often depend on the firm's environmental and organizational contexts (Menz et al., 2015). In this regard, future research should examine these contextual factors even further and seek to explore how other different organizational or environmental contexts might influence HQs' expectations and challenges towards digitalization. Similarly, qualitative studies could focus on explaining why perceptions in this study differed across HQ types, industries, and organizational levels of the respondents.

5.3.2 Implications for business practice

The conclusions and findings from this study are relevant beyond their contribution to an area of sparse research in the existing academic literature. They are likewise relevant for managers in HQs and subunits at multidivisional corporations. First, the results indicate that it is widely recognized among HQ managers that digitalization in some way can assist HQs in their support and control of their subunits. Consequently, the topic of how to leverage digital technologies at the HQ-level is relevant to consider and discuss for managers both working within the subunits of HQs and those sitting directly at the HQ. In this regard, the results show that views tend to vary across organizational levels, and it is therefore important to consider these different

perceptions when trying to align on expectations towards the digital possibilities. Second, HQ managers need to recognize that realizing the opportunities of digitalization might not be easy even in a digitally mature country as Denmark. Adapting to the digital transformation requires a large commitment in terms of both resources and capabilities. Especially having the required know-how and ensuring that the HQ has well-qualified employees to support the digital transformation appear to be central challenges for most HQs. Thus, it will be important for HQ managers to consider whether their HQs in fact have the right capabilities in place before adopting a more digital approach at the HQ-level. Third, the results of this study bring more clarity as to how HQs can expect digitalization to assist them in their parenting activities. For instance, it is expected that digitalization will allow the HQ to get more involved in their subunits' businesses and that it will enable the HQ to make more use of data-driven decision making. These considerations could be valuable for HQ managers in deciding whether it is interesting for them to implement and use more digital technology in their daily operations.

6. Conclusion

The results of this study suggest that Danish HQ managers expect digitalization to enable the HQ to add more value to the corporation by allowing the HQ to better support and involve in its subunits' businesses. This is enabled by better and more timely data improving the HQs to ability to understand the contexts of their subunits and making it easier for HQs to strategically guide and implement synergies in-between them. The expectations towards the increased involvement and value-added were found to be significantly larger among managers at lower organizational levels. Across industries, HQ managers from the wholesale and retail industry also appeared to be significantly more positive towards the potential of digitalization. Despite the positive outlook, the findings also suggest that many HQs are not yet ready to realize the potential of the digital opportunities due to: (1) a lack of resources and capabilities and (2) a lack of a clear understanding of how digitalization will impact the activities of the HQ. The former challenge was primarily the result of inadequate know-how and a shortage of employees with the appropriate capabilities within the HQs. This problem was only aggravated among smaller HQs, with <500 FTEs under control, as opposed to the medium HQs, with 500-2000 FTEs under control, which were better prepared in terms of resources and capabilities. The study built its conclusion on an analysis of 67 Danish HQ managers' opinions on the impact of digitalization on their HQs. The findings of this study add several important contributions to the sparsely explored area of digitalization and headquarters within the academic literature. On an aggregate level, the results suggest that digitalization is expected to support HQs in their entrepreneurial (i.e. value creating) activities, but that several challenges lay ahead for HQs in realizing this potential. On a granular level, the findings reveal the complexities of the believes about these opportunities and challenges which appear to be contingent on HQ types, industries, and organizational levels of the respondents. Hence, much is still to be learned about the effect of digitalization on HQs, and subsequent research should seek to investigate these contextual factors in more depth and seek to clarify how the best prepared HQs expect to be impacted by digitalization.

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8. Appendix

Overview of Appendix

Appendix 1 – Overview of tables and figures

The overview of figures in this thesis can be found below. An overview of the tables can be found on the next page.

Overview of Figures

Overview of tables

Appendix 2 – The survey

Have you developed a clear idea of what digitalization means to your HQ?

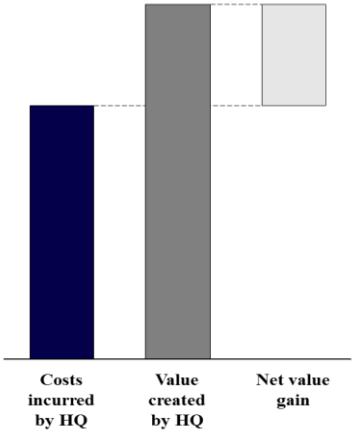
Firms have very different HQ setups: Some HQs add a lot of value to their corporations, some struggle to justify their existence. Some are larger, some very lean. Some work more top-down, some follow more cooperative models. Some increasingly internationalize or outsource activities – some stay integrated.

	Strongly disagree	*Disagree*	*Somewhat disagree*	*Somewhat agree*	*Agree*	*Strongly agree*
We have developed a very clear idea of digitalization's impact on:						
- how our **HQ functions**	☐	☐	☐	☐	☐	☐
- how our **HQ adds value** to the firm in the future	☐	☐	☐	☐	☐	☐
- what **resources and capabilities** our HQ needs	☐	☐	☐	☐	☐	☐
- what the **organizational setup** of our HQ shall be	☐	☐	☐	☐	☐	☐

--- The survey is continued on next page ---

What do you think: What is the effect of digitalization on HQ Performance?

HQ performance can be understood as the difference between the value added that the HQ generates vs. the costs incurred by the HQ and its activities.



Please do not hesitate to provide your estimates – we are interested in your personal judgement!

Value-Creation for Subunits
The digital transformation will …

	Strongly disagree	*Disagree*	*Somewhat disagree*	*Somewhat agree*	*Agree*	*Strongly agree*
allow our HQ to **have more information and data** for decision making (e.g. through more sophisticated data mining tools)	☐	☐	☐	☐	☐	☐
allow our HQ to **have more timely information and data** for decision making (e.g. through real-time dashboards)	☐	☐	☐	☐	☐	☐
enable us to **better predict relevant factors** (e.g. better sales forecasts via predictive analytics)	☐	☐	☐	☐	☐	☐
improve **performance feedback** for the overall corporation	☐	☐	☐	☐	☐	☐
improve our ability to **strategically guide** our subunits (e.g. communicating new insights of how customer benefits can be achieved)	☐	☐	☐	☐	☐	☐
improve our ability to **transfer best practices to our subunits** (e.g. through advanced gaps analysis and process mining)	☐	☐	☐	☐	☐	☐
improve our ability to identify and implement **synergies between subunits** (e.g. due to more and better information about the subunits' contexts)	☐	☐	☐	☐	☐	☐
allow us to better **allocate our attention** to real issues in our subunits (e.g. through AI-driven alert systems)	☐	☐	☐	☐	☐	☐

What do you think: What is the effect of digitalization on the way HQ managers operate?

	Strongly disagree	*Disagree*	*Somewhat disagree*	*Somewhat agree*	*Agree*	*Strongly agree*
There will be more **room for intuition** by top managers	☐	☐	☐	☐	☐	☐
Our HQ will be able to **involve itself more in subunits businesses**	☐	☐	☐	☐	☐	☐
Our HQ will get much **"closer"** to the subunits	☐	☐	☐	☐	☐	☐
Our HQ will become **more powerful** vis-à-vis its subunits	☐	☐	☐	☐	☐	☐
Our HQ will have more room for **strategic thinking**	☐	☐	☐	☐	☐	☐
Personal accountability will become more important	☐	☐	☐	☐	☐	☐
Personal relationships will become more important	☐	☐	☐	☐	☐	☐
Our HQ will take over **more activities** (more centralized approach)	☐	☐	☐	☐	☐	☐
Our HQ will **refocus on activities** that machines and AI cannot do	☐	☐	☐	☐	☐	☐
Our HQ becomes **more data-driven**	☐	☐	☐	☐	☐	☐

To what extent does your HQ have sufficient resources & capabilities to adapt your HQ to the digital transformation?

	Strongly disagree	*Disagree*	*Somewhat disagree*	*Somewhat agree*	*Agree*	*Strongly agree*
Our HQ has the **required know-how** to drive digitalization	☐	☐	☐	☐	☐	☐
Our HQ has sufficient **financial resources**	☐	☐	☐	☐	☐	☐
We are well **aware** of **digitalization opportunities** for the HQ	☐	☐	☐	☐	☐	☐
All **key functions** of our HQ are **in-house** and not outsourced (e.g. IT)	☐	☐	☐	☐	☐	☐
We have enough **well-qualified/skilled employees** in our HQ	☐	☐	☐	☐	☐	☐
Our HQ is the **technology scout** for digitalization within the organization	☐	☐	☐	☐	☐	☐
We have already established **a good set of external partners** (e.g. with consultants) that help our with digitalization	☐	☐	☐	☐	☐	☐

Additional Information

Management level
Please indicate **your management level** within your company.

☐ Executive board ☐ 1 below board level ☐ 2 below board level ☐ <2 below board level

Please indicate the "**center of gravity" for digitalization** within your corporation.

☐ The center of gravity is the Executive board ☐ 1 below board level ☐ 2 below board level ☐ <2 below board level

Organizational affiliation
Please specify the type of HQ in which you are working.

☐ Corporate Headquarters ☐ Regional Headquarters ☐ Divisional Headquarters ☐ Other (please specify): _____

Corporate function
Please indicate your current function within your company *(multiple answers possible)*.

☐ Gen. mgmt. ☐ Strategy ☐ Corp. de-velop. ☐ M&A ☐ Finance & Control-ling ☐ HR ☐ IT ☐ Marketing & Sales ☐ R&D ☐ Other

Industry
Which industry does your company belong to (e.g. pharmaceuticals, food products)?_____

Sales volume
Please indicate the approximate sales volume (2018) in EUR that is under the control of your HQ: _____

Number of employees
Please indicate the number of employees (2018) in FTEs that is under the control of your HQ:_____

Follow-up process and contact details

Please indicate whether you are interested in receiving a summary report of the study's findings

☐ Yes, I would like you to send a summary report ☐ No, I am not interested in a summary report

Company:_____
E-Mail:_____
Thank you very much for your participation!

Appendix 3 – Industry classifications in this thesis

Below is an overview of how the different industry groupings (in **bold**) were made based on their respective classifications (in *italic*) under the Danish industry classification, DB07 (In Danish: Dansk Branchekode, 2007). For more details see Torma et al. (2015).

Finance and insurance
Financial intermediaries, banks, and insurance

Service and IT
Information and communication
Culture, theme parks, and sport
Hospitality and food services
Other services

Transportation, construction, and infrastructure
Building and construction
Electricity and gas
Transportation and handling of good
Real estate

Manufacturing (Other)
Manufacturing; all types of manufacturing except pharma and MedTech (e.g. manufactures of electronics, FMCG, heavy machinery, etc.)

Manufacturing (Pharma and medtech)
Manufacturing; only pharmaceutical and MedTech companies

Wholesale and retail
Wholesale and retail

Appendix 4 – Reason for not choosing the Bonferroni method

One of the most common post hoc methods used to control for the familywise error rate is the *Bonferroni method* which is used to adjust the minimum required significance level when using pairwise comparison (Kim, 2015; Field, 2018). The method simply requires one to take the pre-determined significance level, alpha, and divide it by the number of pairwise comparisons in the test to get an alpha that controls for the familywise error rate (Field, 2018). The Bonferroni method is, however, also known to be quite conservative with only limited statistical power which increases the probability of Type 2 errors (Lee & Lee, 2018). For the same reason, the Bonferroni method is seldomly recommended unless it is critical to avoid Type-1 errors, e.g. in a clinical setting (Ibid.). Consequently, I choose to use the HSD test as the adjustments made to the required significance is smaller than for the Bonferroni method (Lee & Lee, 2018).

Appendix 5 – Pearson's correlation coefficients for the four categories

Increasing value-added								
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Q1	1.00							
Q2	0.69	1.00						
Q3	0.32	0.36	1.00					
Q4	0.25	0.30	0.53	1.00				
Q5	0.33	0.32	0.46	0.49	1.00			
Q6	0.30	0.16	0.23	0.15	0.43	1.00		
Q7	0.15	0.16	0.28	0.19	0.27	0.60	1.00	
Q8	0.19	0.25	0.26	0.26	0.34	0.38	0.49	1.00

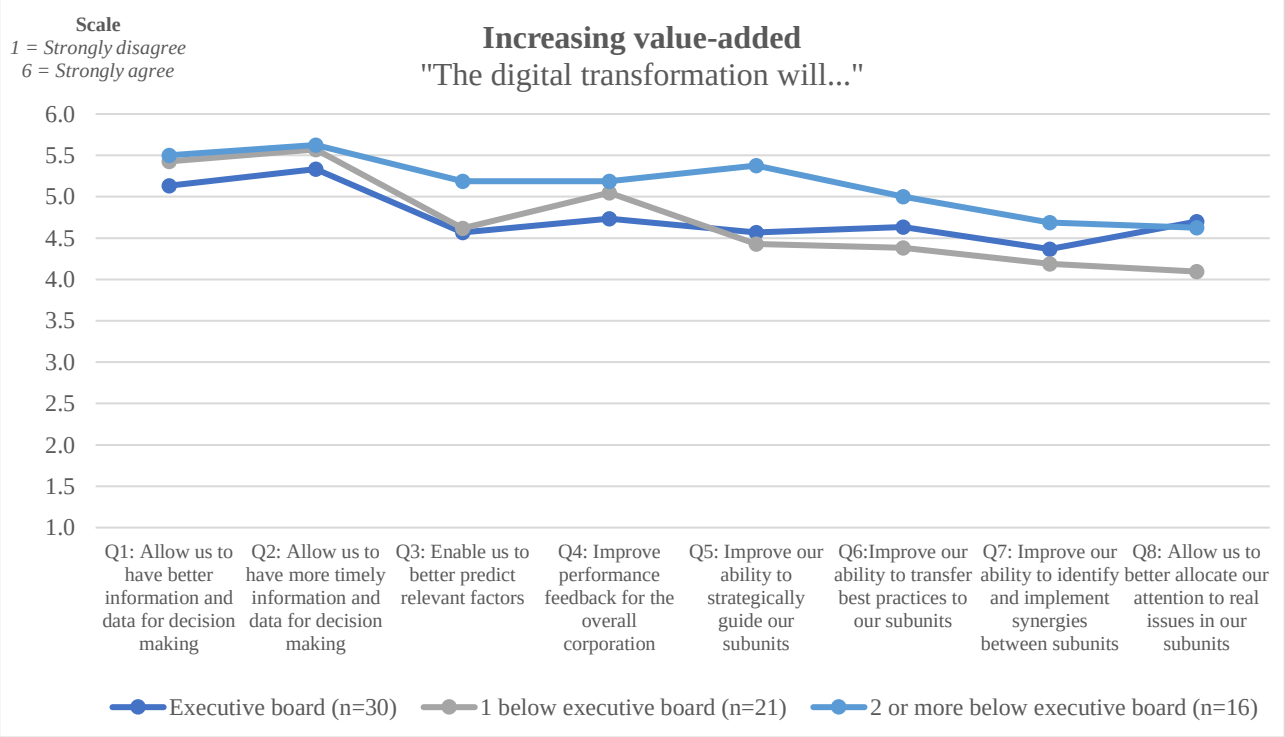
Resources & capabilities							
	Q1	Q2	Q3	Q4	Q5	Q6	Q7
Q1	1.00						
Q2	0.27	1.00					
Q3	0.61	0.34	1.00				
Q4	0.27	0.07	0.30	1.00			
Q5	0.43	0.26	0.30	0.35	1.00		
Q6	0.30	0.25	0.27	0.23	0.18	1.00	
Q7	0.26	0.02	0.31	0.12	0.05	0.32	1.00

Understanding impact				
	Q1	Q2	Q3	Q4
Q1	1.00			
Q2	0.75	1.00		
Q3	0.55	0.49	1.00	
Q4	0.50	0.53	0.82	1.00

HQ operations										
	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Q1	1.00									
Q2	0.05	1.00								
Q3	0.28	0.49	1.00							
Q4	-0.16	0.01	-0.11	1.00						
Q5	-0.08	0.26	0.04	0.25	1.00					
Q6	0.18	0.17	0.11	0.13	0.14	1.00				
Q7	0.26	-0.32	-0.26	0.02	0.05	0.26	1.00			
Q8	-0.06	-0.08	-0.13	0.06	-0.08	0.17	0.30	1.00		
Q9	0.38	0.21	0.04	-0.10	0.19	0.02	0.22	0.13	1.00	
Q10	0.05	0.25	0.08	-0.01	0.27	0.01	-0.04	-0.12	0.22	1.00

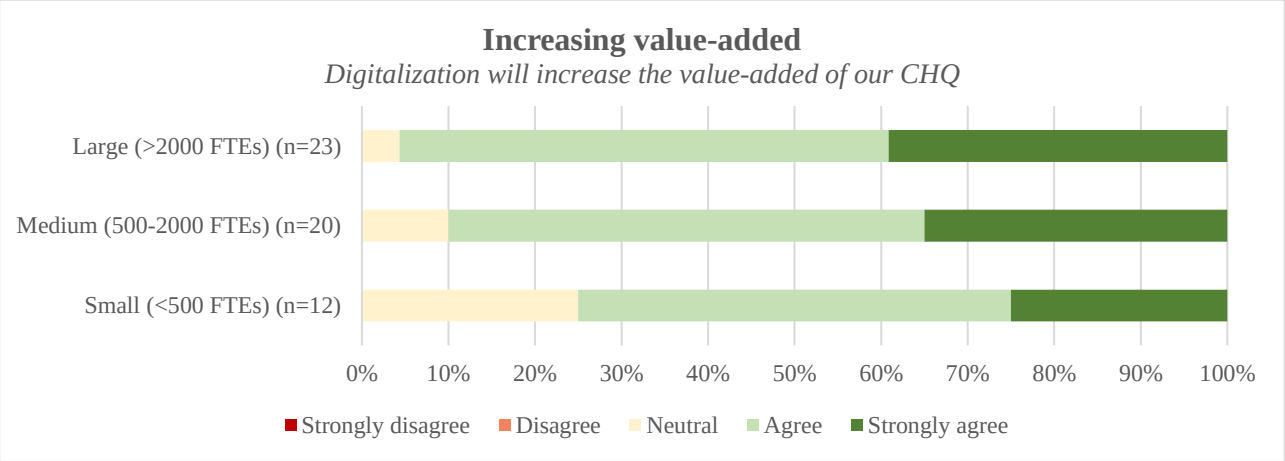
Appendix 6 – Mean scores for *Increasing value-added* by organizational level

The figure below shows the different scores for each item within *Increasing value-added* based on the respondents' organizational level.



Appendix 7 – Responses for *Increasing value-added* by FTEs under control

The below figure shows response distributions solely for CHQs for the category *Increasing value-added* based on FTEs under control by the HQ.



Appendix 8 – Mean scores for *Increasing value-added* by industry type

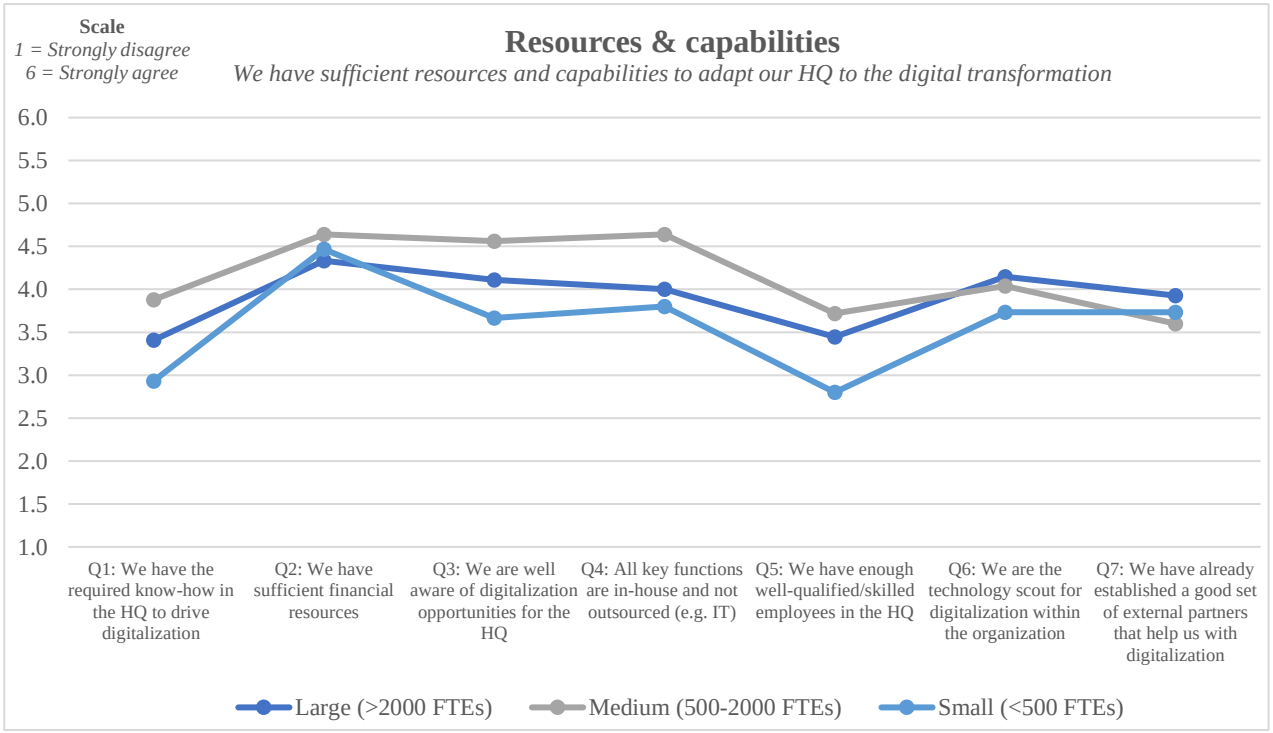
The table below shows the different scores for each item within *Increasing value-added* based on industry type of the respondent.

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Transportation, construction, and infrastructure (n=10)	4.9	5.1	4.3	4.3	3.9	4.6	4.6	4.7
Manufacturing (Other) (n=17)	5.0	5.2	4.4	4.9	4.5	4.5	4.2	4.1
Finance and insurance (n=8)	5.1	5.4	4.6	5.3	4.6	4.8	4.3	4.4
Manufacturing (Pharma and medtech) (n=11)	5.7	5.7	4.7	4.8	5.1	4.5	4.4	4.3
Service and IT (n=15)	5.5	5.8	5.3	5.0	5.0	4.7	4.3	4.7
Wholesale and retail (n=6)	5.8	5.8	5.0	5.7	5.5	5.2	5.2	5.2
Average without Wholesale & retail	5.3	5.4	4.7	4.9	4.6	4.6	4.3	4.4
Difference in average from *Wholesale & retail* and average across the other industries	11%	7%	7%	17%	19%	12%	19%	16%

Q1: Allow us to have better information and data for decision making
Q2: Allow us to have more timely information and data for decision making
Q3: Enable us to better predict relevant factors
Q4: Improve performance feedback for the overall corporation
Q5: Improve our ability to strategically guide our subunits
Q6: Improve our ability to transfer best practices to our subunits
Q7: Improve our ability to identify and implement synergies between subunits
Q8: Allow us to better allocate our attention to real issues in our subunits

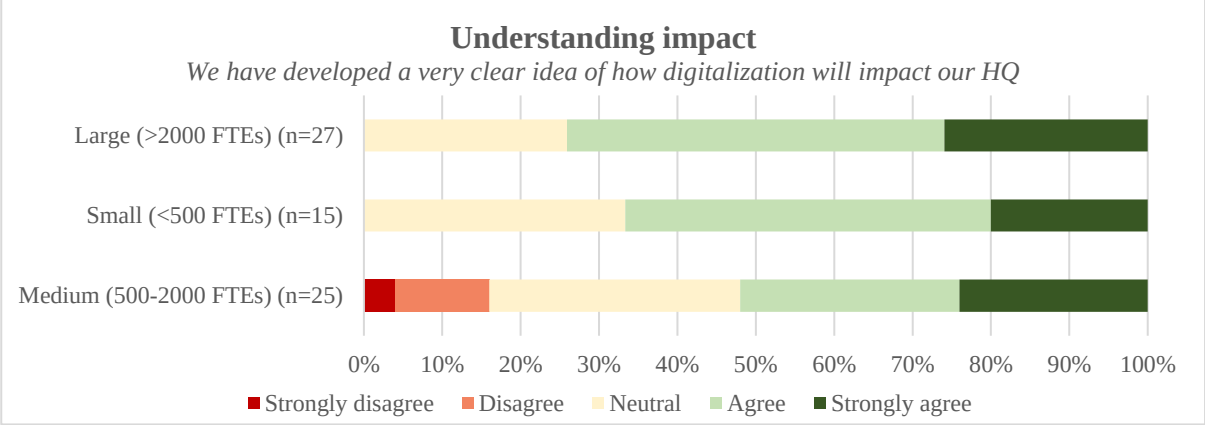
Appendix 9 – Mean scores for *Resources & capabilities* by FTEs under control

The figure below shows the different scores for each item within *Resources & capabilities* based on FTEs under control by the HQ.



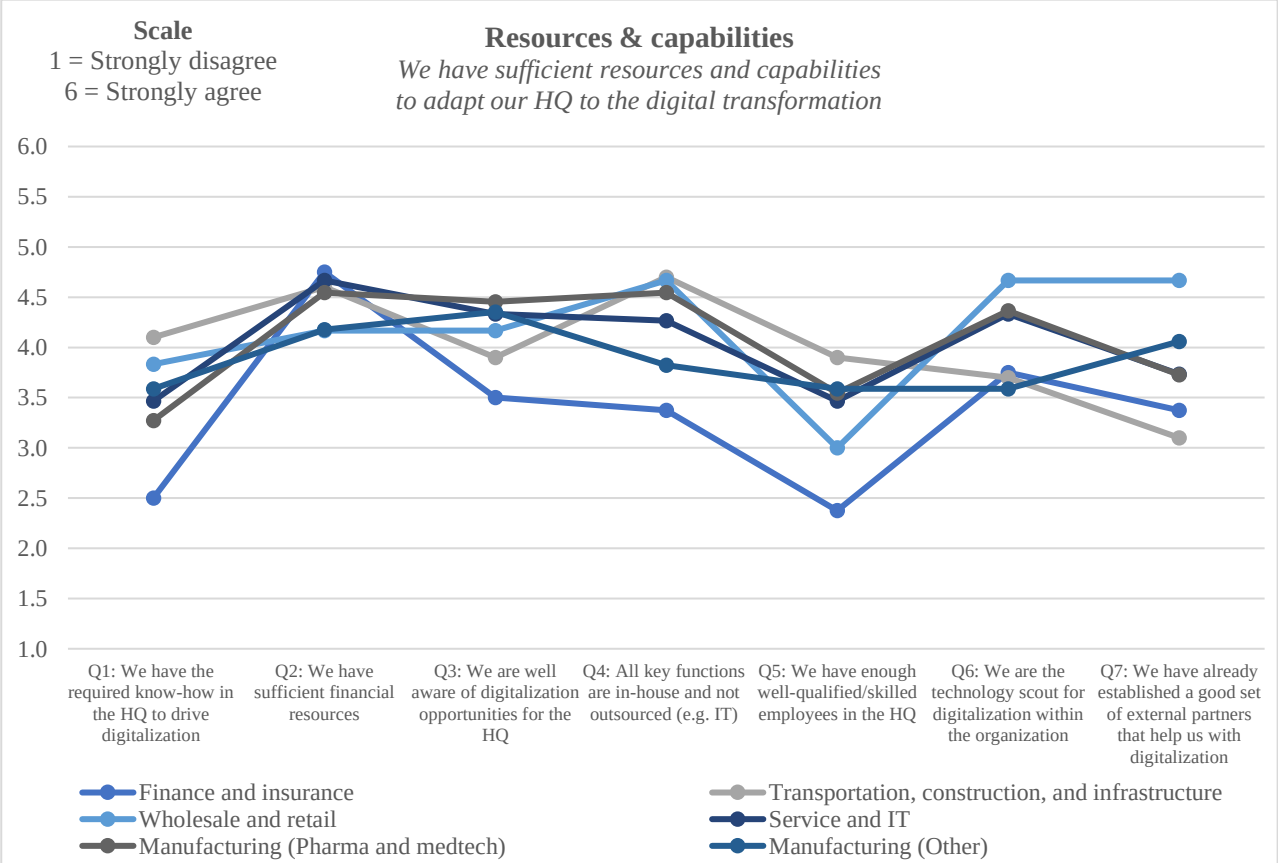
Appendix 10 – Responses for *Understanding impact* by FTEs under control

The figure below shows the response distributions for the category *Understanding impact* based on FTEs under control by the HQ.



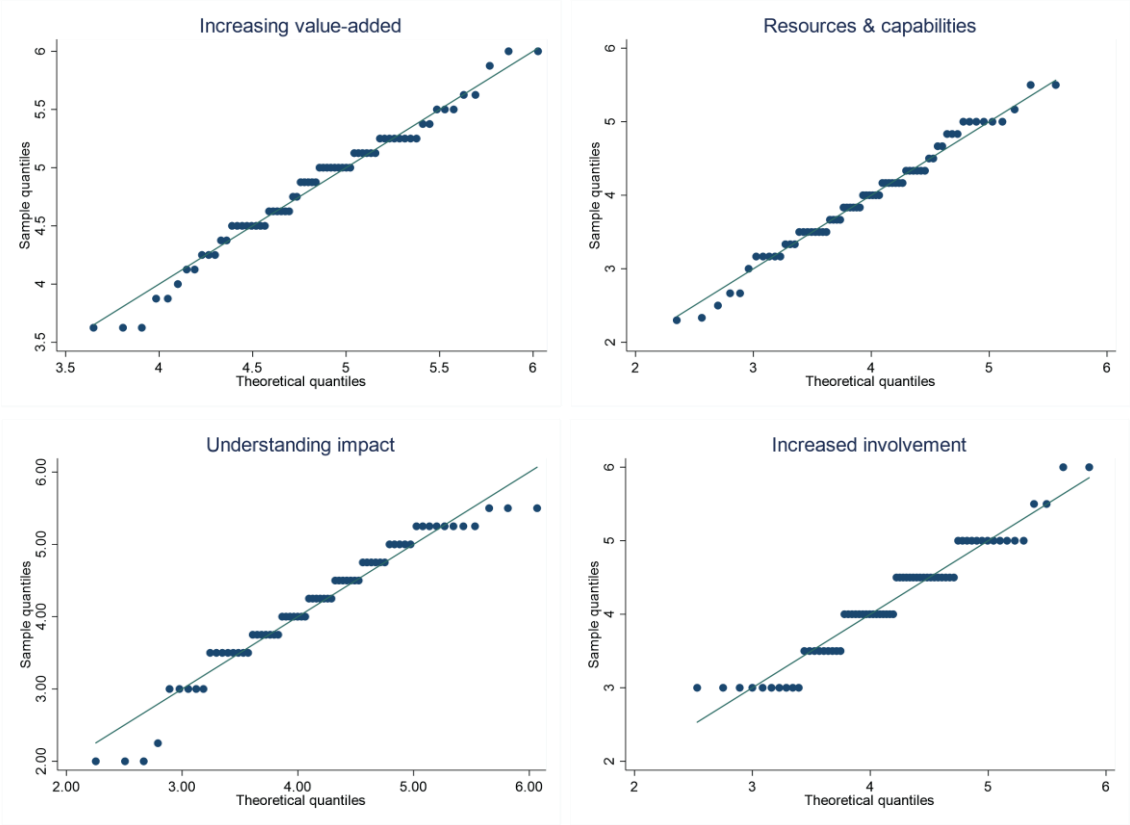
Appendix 11 – Responses for *Resources & capabilities* by industry

The figure below shows the different average scale score for each item within *Resources & capabilities* based on the industry of the respondent.



Appendix 12 – Tests of normality assumption for the four main categories

Below is an illustration of the Q-Q plots from the five categories obtained using Stata.



Below are the results from my Shapiro-Wilk test for normality obtained using Stata. Please note that I use different category numbers from what was presented in Section 4.1.

Shapiro-Wilk W test for normal data

Variable	Obs	W	V	z	Prob>z
Category1	67	0.99079	0.547	-1.308	0.90453
Category2	67	0.99336	0.395	-2.017	0.97816
Category3	67	0.96897	1.844	1.327	0.09226
Category4	67	0.97985	1.197	0.391	0.34804

Category1 = Increasing value-add
Category2 = Resources & capabilities
Category3 = Understanding impact
Category4 = Increasing involvement

Appendix 13 – T-test for average scores for the four main categories

Below is the Stata output and the results from my t-test for the average scale scores of the respondent across the five categories.

Increasing value-add

```
One-sample t test

------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
Catego~1 |      67    4.837687    .0666724    .5457371    4.704571    4.970802
------------------------------------------------------------------------------
    mean = mean(Category1)                                        t =  12.5642
Ho: mean = 4.0                                 degrees of freedom =       66

   Ha: mean < 4.0               Ha: mean != 4.0                 Ha: mean > 4.0
 Pr(T < t) = 1.0000         Pr(|T| > |t|) = 0.0000          Pr(T > t) = 0.0000

.
```

Resources & capabilities

```
One-sample t test

------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
Catego~2 |      67    3.957214    .0901802    .7381569    3.777163    4.137265
------------------------------------------------------------------------------
    mean = mean(Category2)                                        t =  -0.4745
Ho: mean = 4.0                                 degrees of freedom =       66

   Ha: mean < 4.0               Ha: mean != 4.0                 Ha: mean > 4.0
 Pr(T < t) = 0.3184         Pr(|T| > |t|) = 0.6367          Pr(T > t) = 0.6816
```

Understanding impact

```
One-sample t test

------------------------------------------------------------------------------
Variable |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
Catego~3 |      67    4.160448    .1069579    .8754885    3.946899    4.373996
------------------------------------------------------------------------------
    mean = mean(Category3)                                        t =   1.5001
Ho: mean = 4.0                                 degrees of freedom =       66

   Ha: mean < 4.0               Ha: mean != 4.0                 Ha: mean > 4.0
 Pr(T < t) = 0.9308         Pr(|T| > |t|) = 0.1384          Pr(T > t) = 0.0692
```

Increasing involvement

One-sample t test

Variable	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
Catego~4	67	4.19403	.0932813	.7635405	4.007788	4.380272

mean = mean(Category4) t = 2.0801
Ho: mean = 4.0 degrees of freedom = 66

Ha: mean < 4.0 Ha: mean != 4.0 Ha: mean > 4.0
Pr(T < t) = 0.9793 Pr(|T| > |t|) = 0.0414 Pr(T > t) = 0.0207

Appendix 14 – Trend 1: Tests of assumptions

Test of normality assumption

Shapiro-Wilk test for normality

-> Mangtlevel2 = 1 below exec. board

Shapiro-Wilk W test for normal data

Variable	Obs	W	V	z	Prob>z
Category1	21	0.97370	0.644	-0.888	0.81286

-> Mangtlevel2 = 2 or more below exec. board

Shapiro-Wilk W test for normal data

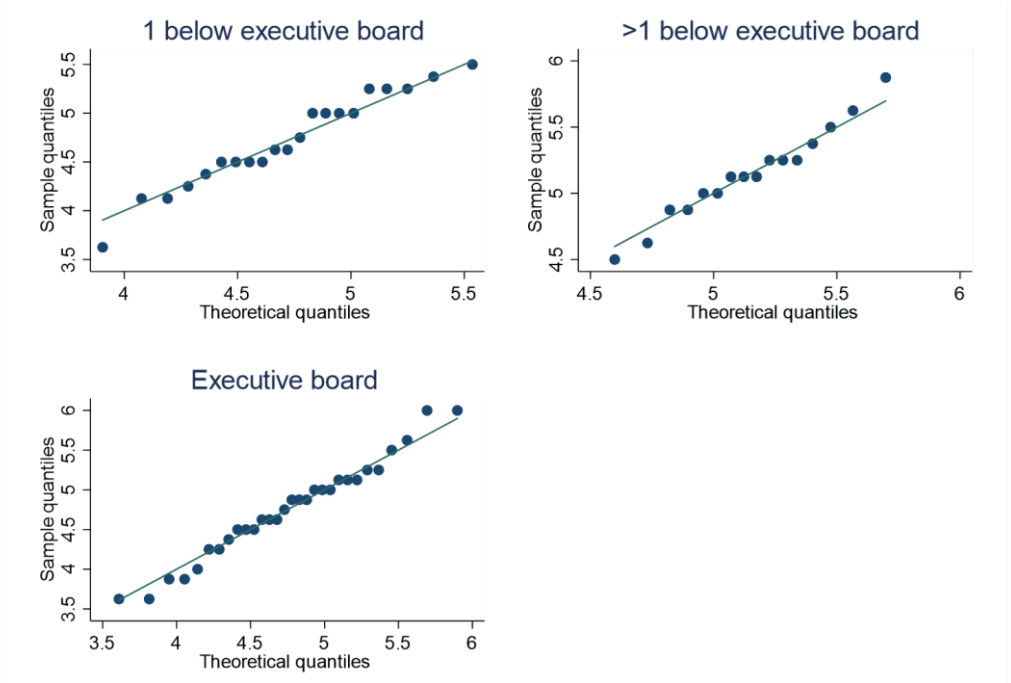
Variable	Obs	W	V	z	Prob>z
Category1	16	0.99097	0.183	-3.374	0.99963

-> Mangtlevel2 = Exec. board

Shapiro-Wilk W test for normal data

Variable	Obs	W	V	z	Prob>z
Category1	30	0.99128	0.277	-2.653	0.99601

Q-Q plots



Test of homoscedasticity assumption

Levene's test for homoscedasticity

Mngt level (STATA)	Summary of Q3_avg Mean	Std. Dev.	Freq.
1 below e	4.7202381	.48235225	21
2 or more	5.1484375	.35124407	16
Exec. boa	4.7541667	.61892159	30
Total	4.8376866	.54573715	67

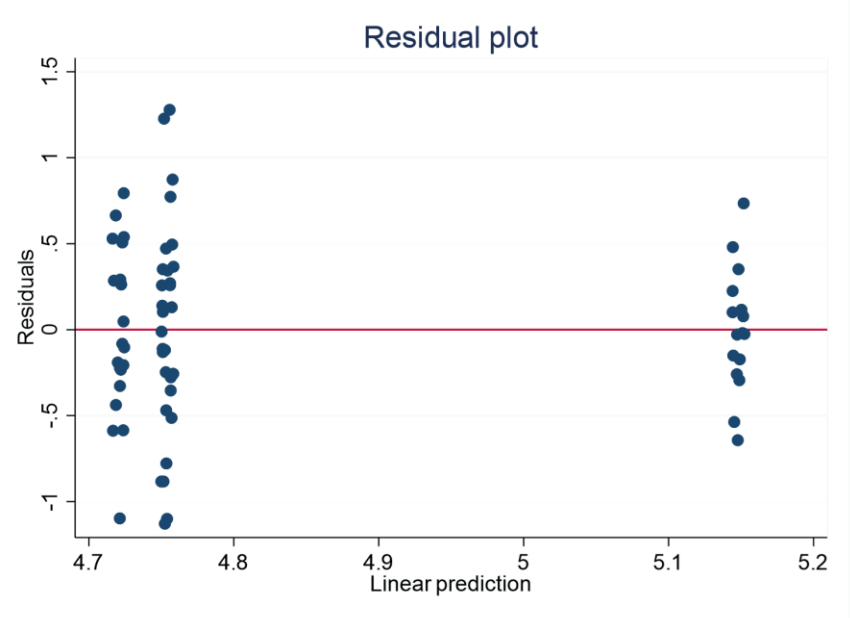
W0 = 2.8340201 df(2, 64) Pr > F = 0.06617351

W50 = 2.7340902 df(2, 64) Pr > F = 0.07254536

W10 = 2.9186255 df(2, 64) Pr > F = 0.06123092

Note: W0 refers to the mean-centred test used in this study (W50 refers to the median-centred test).

Residual plot



Note: First residual plot is *1 below executive board*; second plot is *Executive board*; Third plot is *>1 below executive board*.

Appendix 15 – Trend 1: Results of ANOVA and post hoc test

ANOVA test

Analysis of Variance

Source	SS	df	MS	F	Prob > F
Between groups	2.0440025	2	1.02200125	3.71	0.0298
Within groups	17.6127139	64	.275198655		
Total	19.6567164	66	.297829037		

Bartlett's test for equal variances: chi2(2) = 5.6736 Prob>chi2 = 0.059

Tukey's pairwise comparison test

Pairwise comparisons of marginal linear predictions

Margins : asbalanced

	Number of Comparisons
Mangtlevel2	3

	Contrast	Std. Err.	Tukey t	Tukey P>|t|	Tukey [95% Conf.	Interval]
Mangtlevel2						
2 or more below exec. board vs 1 below exec. board	.4281994	.1740822	2.46	0.043	.0105025	.8458963
Exec. board vs 1 below exec. board	.0339286	.1492581	0.23	0.972	-.3242049	.392062
Exec. board vs 2 or more below exec. board	-.3942708	.1623983	-2.43	0.047	-.7839331	-.0046086

Appendix 16 – Trend 2: Tests of assumptions

Test of normality assumption

Shapiro-Wilk test for normality

-> Sizecategory2 = Large (>2000 FTEs)

Shapiro-Wilk W test for normal data

Variable	Obs	W	V	z	Prob>z
Category2	27	0.98221	0.523	-1.332	0.90853

-> Sizecategory2 = Medium (500-2000 FTEs)

Shapiro-Wilk W test for normal data

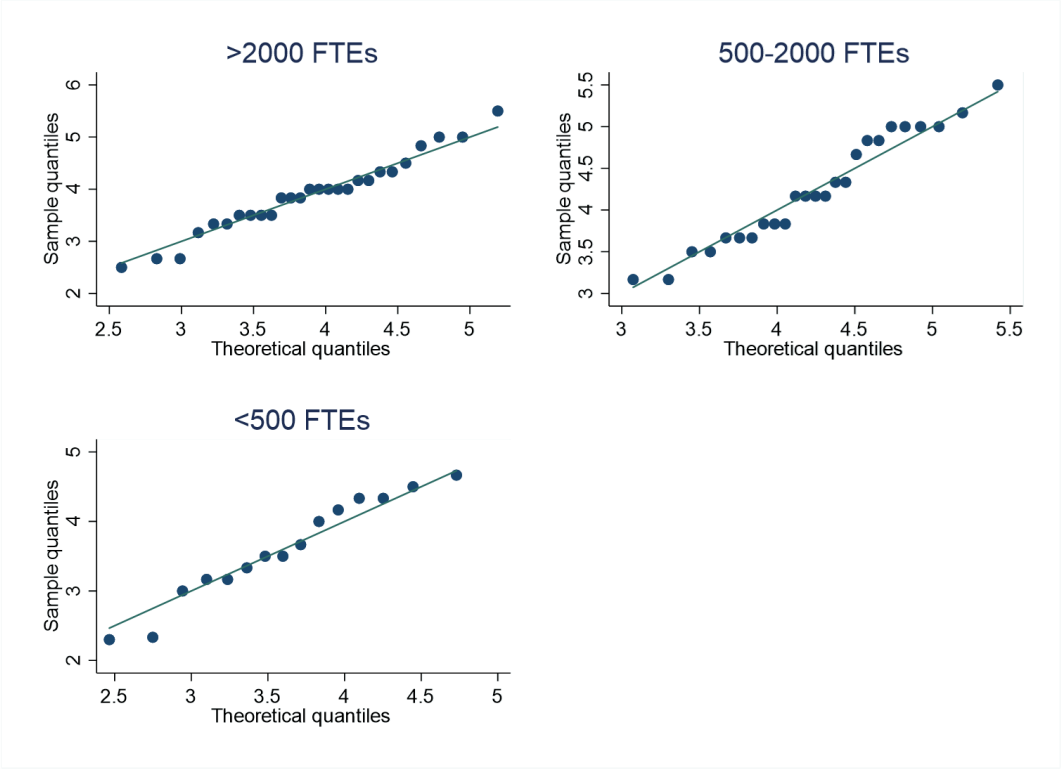
Variable	Obs	W	V	z	Prob>z
Category2	25	0.95880	1.145	0.277	0.39105

-> Sizecategory2 = Small (<500 FTEs)

Shapiro-Wilk W test for normal data

Variable	Obs	W	V	z	Prob>z
Category2	15	0.95090	0.952	-0.097	0.53866

Q-Q plots



Test of homoscedasticity assumption

Levene's test for homoscedasticity

Size category	Summary of Q6_avg Mean	Std. Dev.	Freq.
Large (>2	3.8888889	.72353595	27
Medium (5	4.2466667	.66339475	25
Small (<5	3.5977778	.73823757	15
Total	3.9572139	.73815691	67

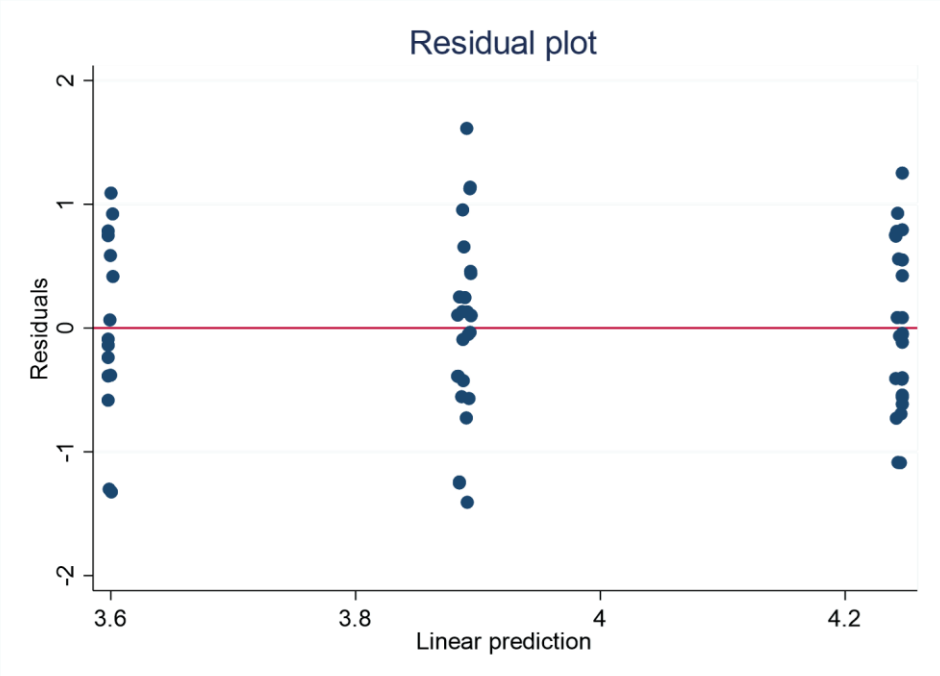
W0 = 0.07735945 df(2, 64) Pr > F = 0.92564351

W50 = 0.06814907 df(2, 64) Pr > F = 0.93418891

W10 = 0.08064093 df(2, 64) Pr > F = 0.92261847

Note: W0 refers to the mean-centred test used in this study (W50 refers to the median-centred test).

Residual plot



Note: First residual plot is *<500 FTEs*; second plot is *>2000 FTEs*; Third plot is *500-2000 FTEs*

Appendix 17 – Trend 2: Results of ANOVA and post hoc test

ANOVA test

Analysis of Variance

Source	SS	df	MS	F	Prob > F
Between groups	4.15853179	2	2.07926589	4.18	0.0196
Within groups	31.8032593	64	.496925926		
Total	35.961791	66	.544875622		

Bartlett's test for equal variances: chi2(2) = 0.2616 Prob>chi2 = 0.877

Tukey's pairwise comparison test

Pairwise comparisons of marginal linear predictions

Margins : asbalanced

	Number of Comparisons
Sizecategory2	3

	Contrast	Std. Err.	Tukey t	Tukey P>|t|	Tukey [95% Conf.	Interval]
Sizecategory2						
Medium (500-2000 FTEs) vs Large (>2000 FTEs)	.3577778	.1956571	1.83	0.168	-.1116865	.827242
Small (<500 FTEs) vs Large (>2000 FTEs)	-.2911111	.2270089	-1.28	0.410	-.8358017	.2535795
Small (<500 FTEs) vs Medium (500-2000 FTEs)	-.6488889	.2302291	-2.82	0.017	-1.201306	-.0964718

Appendix 18 – Trend 3: Tests of assumptions

Test of normality assumption

Shapiro-Wilk test for normality

Shapiro-Wilk W test for normal data

Variable	Obs	W	V	z	Prob>z
Category1	8	0.93844	0.858	-0.243	0.59584

-> IndustryFNAL2 = Manufactoring (Other)

Shapiro-Wilk W test for normal data

Variable	Obs	W	V	z	Prob>z
Category1	17	0.96013	0.842	-0.342	0.63392

-> IndustryFNAL2 = Manufactoring (Pharma and medtech)

Shapiro-Wilk W test for normal data

Variable	Obs	W	V	z	Prob>z
Category1	11	0.93896	0.988	-0.021	0.50839

-> IndustryFNAL2 = Service and IT

Shapiro-Wilk W test for normal data

Variable	Obs	W	V	z	Prob>z
Category1	15	0.98057	0.377	-1.931	0.97323

-> IndustryFNAL2 = Transportation, construction, and infrastructure

Shapiro-Wilk W test for normal data

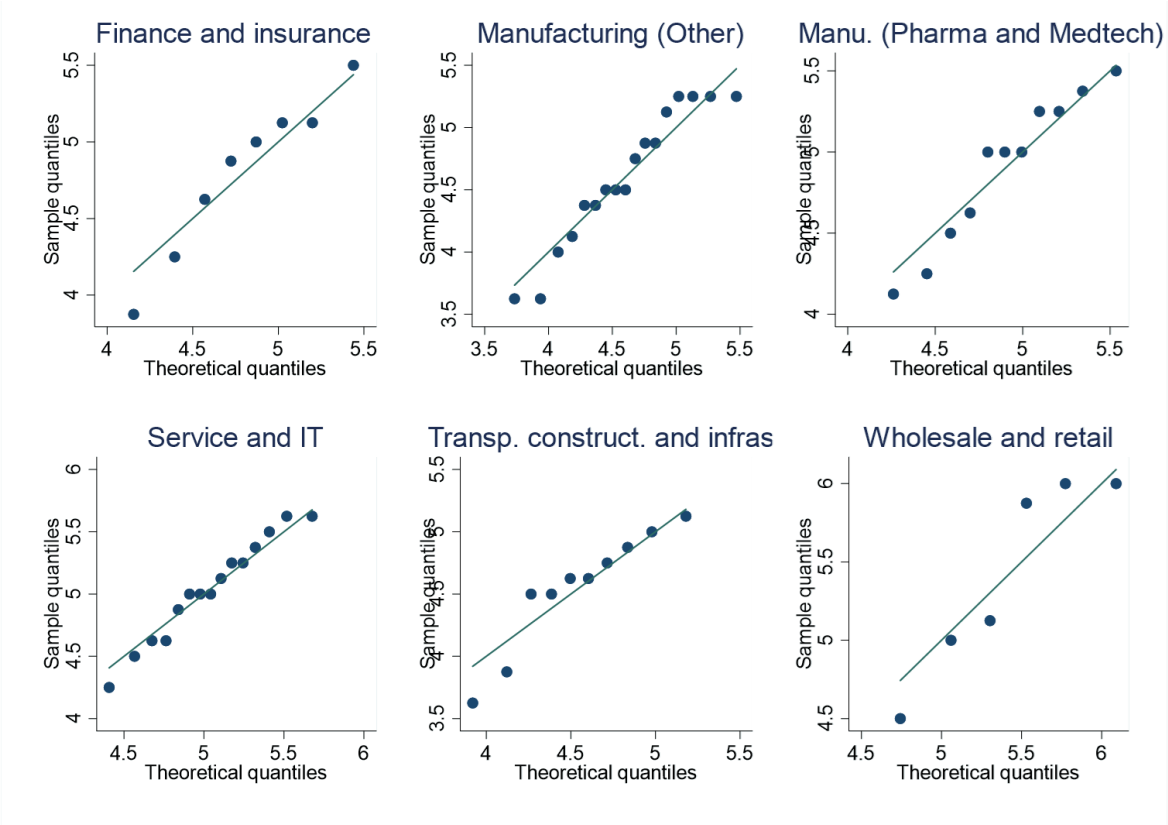
Variable	Obs	W	V	z	Prob>z
Category1	10	0.90523	1.460	0.675	0.24981

-> IndustryFNAL2 = Wholesale and retail

Shapiro-Wilk W test for normal data

Variable	Obs	W	V	z	Prob>z
Category1	6	0.89518	1.298	0.396	0.34623

Q-Q plots



Test of homoscedasticity assumption

Levene's test for homoscedasticity

Industry FNAL	Summary of Q3_avg Mean	Std. Dev.	Freq.
Finance a	4.796875	.52583904	8
Manufacto	4.6029412	.54528392	17
Manufacto	4.8977273	.46036053	11
Service a	5.0416667	.41367977	15
Transport	4.55	.47214052	10
Wholesale	5.4166667	.63080636	6
Total	4.8376866	.54573715	67

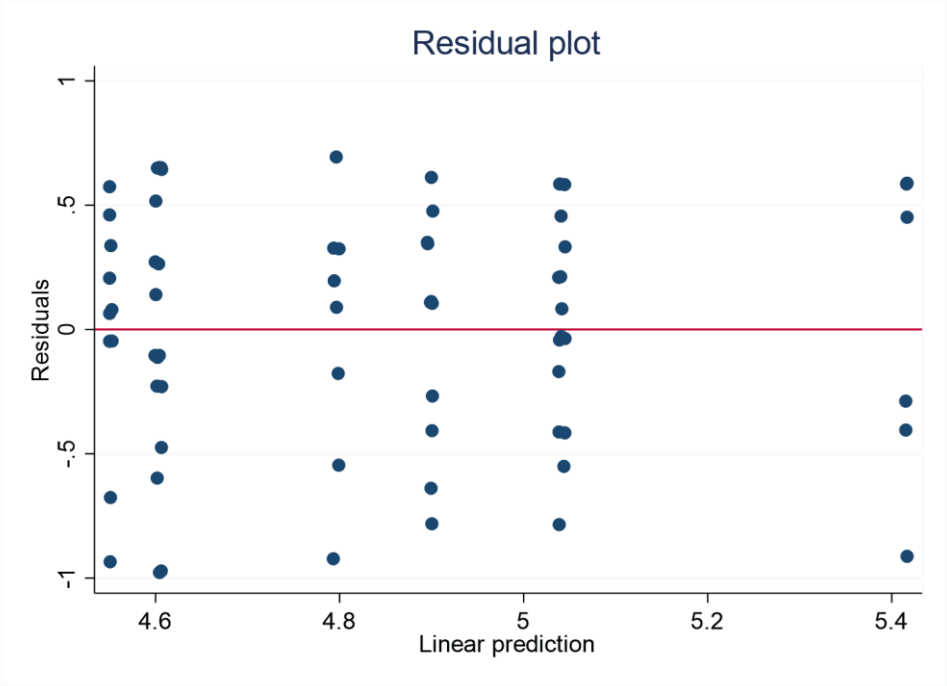
W0 = 0.77955216 df(5, 61) Pr > F = 0.56830158

W50 = 0.67354703 df(5, 61) Pr > F = 0.64504278

W10 = 0.77042697 df(5, 61) Pr > F = 0.57474137

Note: W0 refers to the mean-centred test used in this study (W50 refers to the median-centred test).

Residual plot



Note: First residual plot is *Transportation, construction, and infrastructure*; second plot is *Manufacturing (Other)*; third plot is *Finance and insurance*; fourth plot is *Manufacturing (Pharma and Medtech)*; fifth plot is *Service and IT*; sixth plot is *Wholesale and retail*.

Appendix 19 – Trend 3: Results of ANOVA and post hoc test

ANOVA test

Analysis of Variance

Source	SS	df	MS	F	Prob > F
Between groups	4.45283175	5	.890566351	3.57	0.0067
Within groups	15.2038847	61	.249244011		
Total	19.6567164	66	.297829037		

Bartlett's test for equal variances: chi2(5) = 1.9162 Prob>chi2 = 0.861

Tukey's pairwise comparison test

Pairwise comparisons of marginal linear predictions

Margins : asbalanced

	Number of Comparisons
IndustryFNAL2	15

	Contrast	Std. Err.	Tukey t	Tukey P>|t|	Tukey [95% Conf.	Interval]
IndustryFNAL2						
Manufactoring (Other) vs Finance and insurance	-.1939338	.2140489	-0.91	0.944	-.8237142	.4358466
Manufactoring (Pharma and medtech) vs Finance and insurance	.1008523	.2319786	0.43	0.998	-.5816814	.7833859
Service and IT vs Finance and insurance	.2447917	.2185675	1.12	0.871	-.3982837	.887867
Transportation, construction, and infrastructure vs Finance and insurance	-.246875	.236812	-1.04	0.902	-.9436296	.4498796
Wholesale and retail vs Finance and insurance	.6197917	.2696223	2.30	0.210	-.1734983	1.413082
Manufactoring (Pharma and medtech) vs Manufactoring (Other)	.2947861	.1931837	1.53	0.649	-.2736044	.8631766
Service and IT vs Manufactoring (Other)	.4387255	.176855	2.48	0.146	-.081622	.959073
Transportation, construction, and infrastructure vs Manufactoring (Other)	-.0529412	.1989618	-0.27	1.000	-.6383321	.5324498
Wholesale and retail vs Manufactoring (Other)	.8137255	.2370698	3.43	0.013	.1162123	1.511239
Service and IT vs Manufactoring (Pharma and medtech)	.1439394	.1981787	0.73	0.978	-.4391475	.7270263
Transportation, construction, and infrastructure vs Manufactoring (Pharma and medtech)	-.3477273	.2181352	-1.59	0.606	-.9895305	.294076
Wholesale and retail vs Manufactoring (Pharma and medtech)	.5189394	.2533756	2.05	0.328	-.2265493	1.264428
Transportation, construction, and infrastructure vs Service and IT	-.4916667	.2038153	-2.41	0.168	-1.091338	.1080042
Wholesale and retail vs Service and IT	.375	.2411575	1.56	0.631	-.3345402	1.08454
Wholesale and retail vs Transportation, construction, and infrastructure	.8666667	.2578082	3.36	0.016	.1081363	1.625197

Appendix 20 – Trend 4: Tests of assumptions

Test of normality assumption

Shapiro-Wilk test for normality

-> Sizecategory2 = Large (>2000 FTEs)

Shapiro-Wilk W test for normal data

Variable	Obs	W	V	z	Prob>z
Category4	27	0.99353	0.190	-3.410	0.99967

-> Sizecategory2 = Medium (500-2000 FTEs)

Shapiro-Wilk W test for normal data

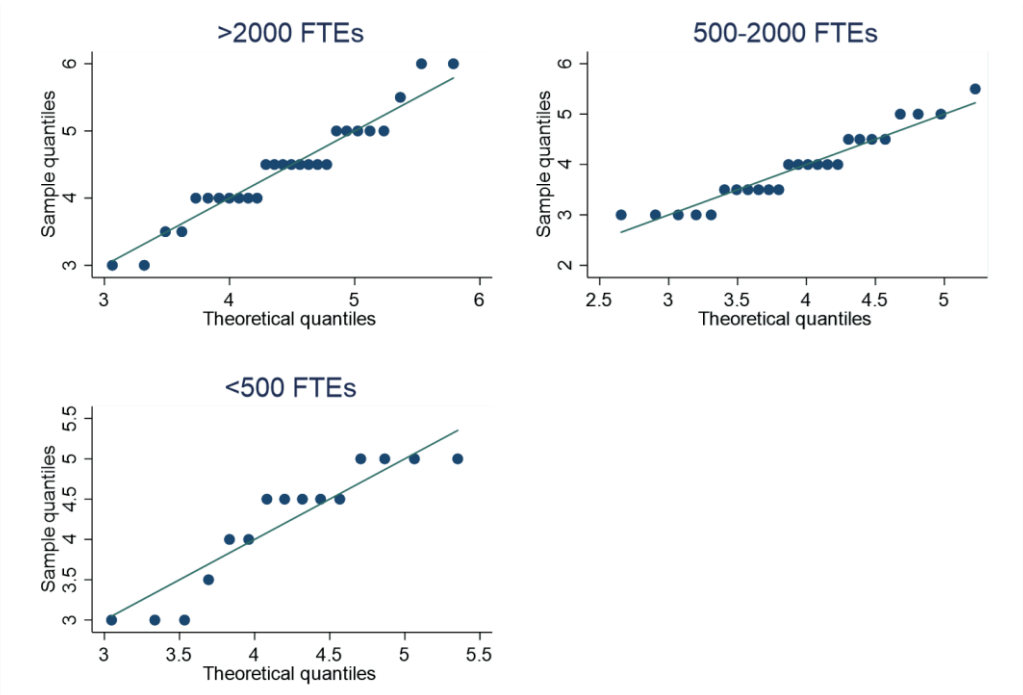
Variable	Obs	W	V	z	Prob>z
Category4	25	0.95537	1.240	0.440	0.33000

-> Sizecategory2 = Small (<500 FTEs)

Shapiro-Wilk W test for normal data

Variable	Obs	W	V	z	Prob>z
Category4	15	0.94716	1.025	0.048	0.48086

Q-Q plots



Test of homoscedasticity assumption

Levene's test for homoscedasticity

Size category	Summary of Q5_avg (More involved) Mean	Std. Dev.	Freq.
Large (>2	4.4259259	.75579433	27
Medium (5	3.94	.72629195	25
Small (<5	4.2	.75118953	15
Total	4.1940299	.76354052	67

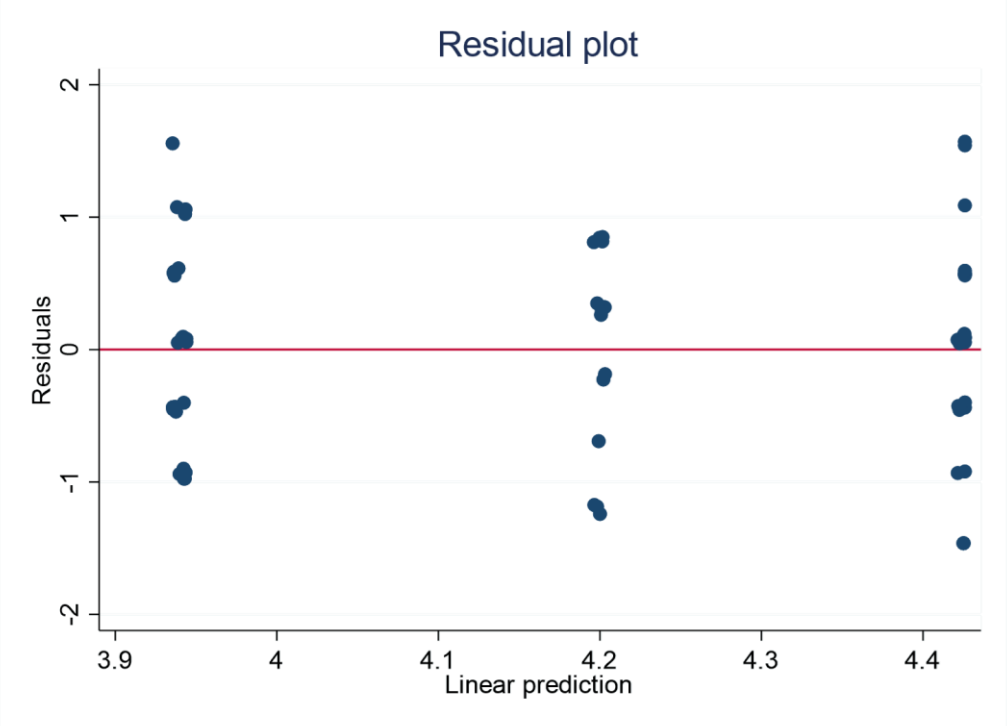
W0 = 0.08392286 df(2, 64) Pr > F = 0.9196032

W50 = 0.01608538 df(2, 64) Pr > F = 0.98404728

W10 = 0.07865956 df(2, 64) Pr > F = 0.92444378

Note: W0 refers to the mean-centred test used in this study (W50 refers to the median-centred test).

Residual plot



Note: First residual plot is *500-2000 FTEs*; second plot is *<500 FTEs*; Third plot is *>2000 FTEs*.

Appendix 21 – Trend 4: Results of ANOVA and post hoc test

ANOVA test

Analysis of Variance

Source	SS	df	MS	F	Prob > F
Between groups	3.06576009	2	1.53288004	2.77	0.0702
Within groups	35.4118519	64	.553310185		
Total	38.4776119	66	.58299412		

Bartlett's test for equal variances: chi2(2) = 0.0421 Prob>chi2 = 0.979

Tukey's pairwise comparison test

Pairwise comparisons of marginal linear predictions

Margins : asbalanced

	Number of Comparisons
Sizecategory2	3

	Contrast	Std. Err.	Tukey t	Tukey P>|t|	Tukey [95% Conf.	Interval]
Sizecategory2						
Medium (500-2000 FTEs) vs Large (>2000 FTEs)	-.4859259	.2064591	-2.35	0.056	-.9813088	.009457
Small (<500 FTEs) vs Large (>2000 FTEs)	-.2259259	.2395419	-0.94	0.615	-.8006884	.3488365
Small (<500 FTEs) vs Medium (500-2000 FTEs)	.26	.2429398	1.07	0.536	-.3229155	.8429155

Appendix 22 – Trend 5: Tests of assumptions

Test of normality assumption

Shapiro-Wilk test for normality

-> Mangtlevel2 = 1 below exec. board

Shapiro-Wilk W test for normal data

Variable	Obs	W	V	z	Prob>z
Category4	21	0.98615	0.339	-2.185	0.98554

-> Mangtlevel2 = 2 or more below exec. board

Shapiro-Wilk W test for normal data

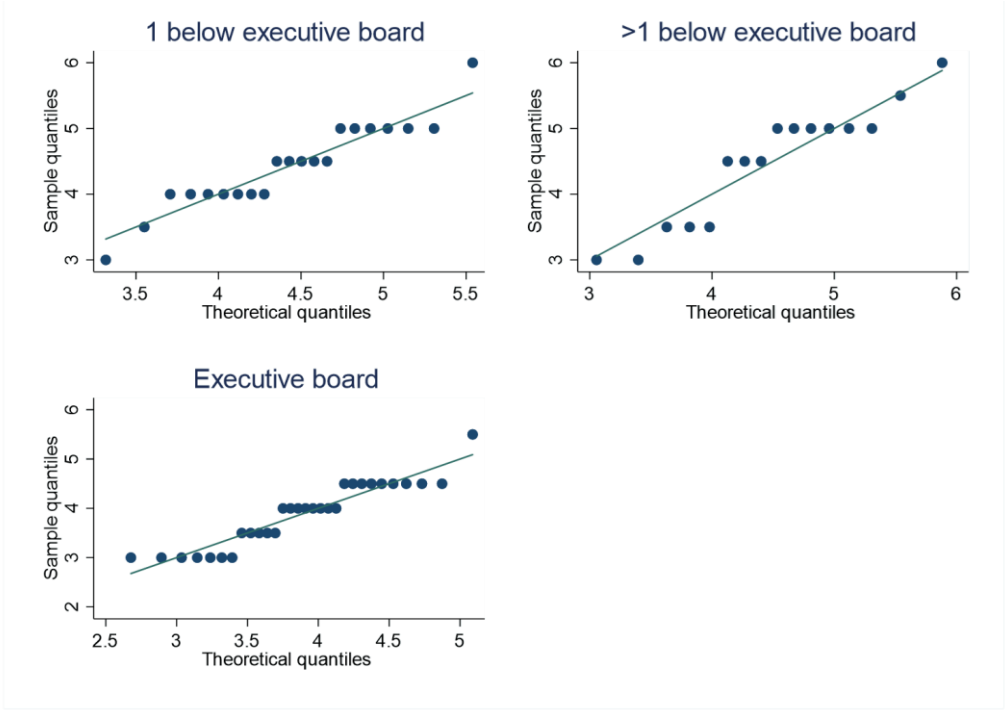
Variable	Obs	W	V	z	Prob>z
Category4	16	0.93646	1.287	0.502	0.30789

-> Mangtlevel2 = Exec. board

Shapiro-Wilk W test for normal data

Variable	Obs	W	V	z	Prob>z
Category4	30	0.95254	1.509	0.850	0.19764

Q-Q plots



Test of homoscedasticity assumption

Levene's test for homoscedasticity

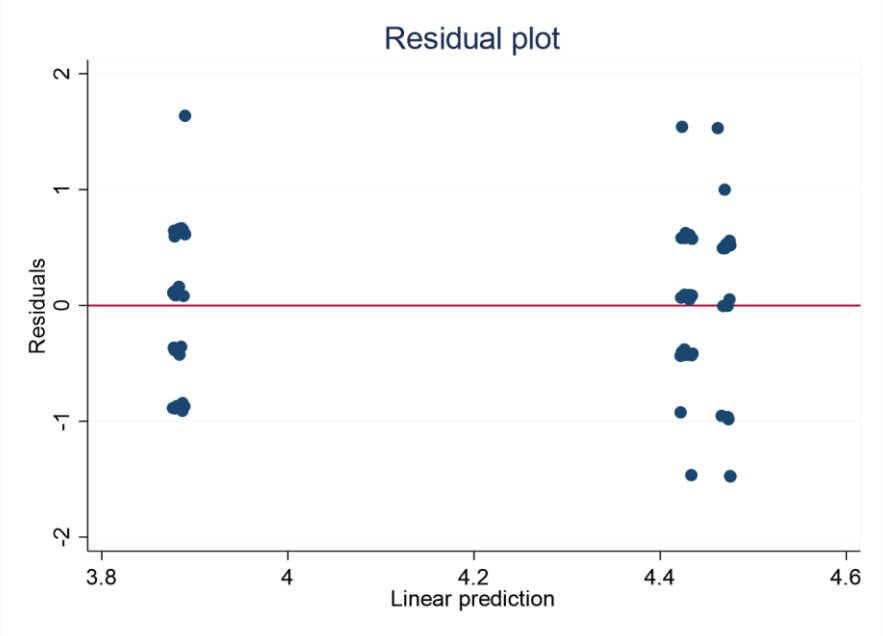
Mngt level (STATA)	Summary of Q5_avg (More involved) Mean	Std. Dev.	Freq.
1 below e	4.4285714	.65737574	21
2 or more	4.46875	.90311959	16
Exec. boa	3.8833333	.65236088	30
Total	4.1940299	.76354052	67

```
W0   =   1.5639421   df(2, 64)      Pr > F = 0.21720234

W50  =   1.2707645   df(2, 64)      Pr > F = 0.28760096

W10  =   2.3683957   df(2, 64)      Pr > F = 0.1017895
```

```
. by Mangtlevel2, sort : swilk Category4
```

Note: W0 refers to the mean-centred test used in this study (W50 refers to the median-centred test).

Residual plot



Note: First residual plot is *Executive board*; second plot is *1 below executive board;* Third plot is *>1 below executive board*.

Appendix 23 – Trend 5: Results of ANOVA and post hoc test

ANOVA test

Analysis of Variance

Source	SS	df	MS	F	Prob > F
Between groups	5.25871313	2	2.62935657	5.07	0.0091
Within groups	33.2188988	64	.519045294		
Total	38.4776119	66	.58299412		

Bartlett's test for equal variances: chi2(2) = 2.5848 Prob>chi2 = 0.275

Tukey's pairwise comparison test

Pairwise comparisons of marginal linear predictions

Margins : asbalanced

	Number of Comparisons
Mangtlevel2	3

	Contrast	Std. Err.	Tukey t	Tukey P>|t|	Tukey [95% Conf.	Interval]
Mangtlevel2						
2 or more below exec. board vs 1 below exec. board	.0401786	.2390748	0.17	0.985	-.5334632	.6138203
Exec. board vs 1 below exec. board	-.5452381	.2049828	-2.66	0.026	-1.037079	-.0533975
Exec. board vs 2 or more below exec. board	-.5854167	.2230288	-2.62	0.029	-1.120557	-.0502762