Mari Helen Svenkerud

Decision-Making Logics and Firm Performance in Companies with Different Levels of Sustainability and Digitalization

A Cluster Analysis of Norwegian Manufacturers

Master's thesis in Industrial Economics and Technology Management
Supervisor: Arild Aspelund
January 2023

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Thesis Statement

It is getting increasingly complex for companies to navigate a rapidly changing and uncertain business environment while at the same time meeting sustainability performance expectations. Sustainability and digitalization are today's dominating "megatrends" among companies. However, it remains unclear in the literature as to whether these growth paths are harmonious with a competitive advantage. This thesis seeks to contribute to theory, policymakers, and practitioners by studying how Norwegian manufacturers' firm performance is affected by different sustainability and digitalization performance levels and what decision-making logic patterns they apply.

Summary

Sustainability and digitalization are strategic imperatives expected to speed up the major transformations needed to solve the current environmental crisis. However, the related research field is highly fragmented. Scholars are particularly interested in exploring the potential synergies of the two growth strategies. This study seeks to contribute by first partaking in the unresolved discussions of the impact of sustainability and digitalization on firm performance. Secondly, it will approach the until now largely unexplored topic of the decision-making logic patterns in sustainable and digitalized companies.

A quantitative analysis was conducted based on survey data from 461 Norwegian manufacturing companies and data from the official registers *Proff Forvalt*. The companies were clustered through the K-Means cluster method based on their sustainability and digitalization performance. The clustering returned the four groups: Green Digitals, Sustainables, Digitals, and Laggards. Then, they were compared on the level of market performance, knowledge acquisition, effectuation and causation by using analysis of variance (ANOVA).

The analysis detects no difference between the companies in terms of market performance, but they are distinct in the level of knowledge acquisition. The Green Digitals outperform the others by far, followed by the Sustainables and Digitals. These findings contribute to practitioners by clearly demonstrating the competitive advantage of pursuing sustainability and digitalization simultaneously. For now, the advantage lies in knowledge acquisition. However, the Green Digitals will likely reap the benefits of their current ambition level in the future. Hence, this study challenges the effect of the double externality problem and the claims that sustainability and digitalization are conflicting growth paths. Furthermore, the results show that sustainability- and digitalization-oriented companies are concerned with gaining knowledge through stakeholders, which aligns with the ecosystem thinking within sustainability and circular economy.

Another key finding is that effectuation and causation are not mutually exclusive decision-making logics, and that clusters use a balanced combination of both. Thus, the following two dominating views in literature are contradicted. First, that companies apply more causation than effectuation, which has been the historical trend. Second, that companies tend to focus on one of them. A last principal finding is that the Green Digitals score the highest on all the decision-making logics. The Green Digitals' competitive advantage in knowledge acquisition and highest score on effectuation and causation can imply that companies are in a stronger position if they prioritize spending time and resources on a broad span of strategic approaches. The Laggards' lack of strategic commitment will likely make many of them irrelevant in the future. Further research can focus on potential synergies between effectuation and causation and similarly between sustainability and digitalization. Additionally, longitudinal studies are required to monitor the impact of sustainability and digitalization.

Sammendrag

Bærekraft og digitalisering er strategiske trender som er forventet å fremskynde de store omveltningene som kreves i det grønne skiftet. Forskningsfeltet er svært fragmentert. Forskere er spesielt interessert i å utforske de potensielle synergiene mellom vekststrategiene. Denne studien bidrar ved å først ta del i den uavklarte diskusjonen om virkningen av bærekraft og digitalisering på selskapers resultater. Deretter vil den tilnærme seg det nesten uutforskede temaet om beslutningslogikkmønstre i bærekraftige og digitaliserte selskaper.

En kvantitativ analyse ble gjort basert på undersøkelsesdata fra 461 norske industriselskaper og data fra de offisielle registrene Proff Forvalt. Selskapene ble gruppert gjennom K-Means-klyngemetoden basert på deres resultater på bærekraft og digitalisering. Klyngingen returnerte de fire gruppene: "Green Digitals", "Sustainables", "Digitals" og "Laggards". En variansanalyse (ANOVA) ble brukt til å sammenligne gruppene på markedsprestasjon, nivå av kunnskapsinnhenting og bruk av beslutningslogikkene "effectuation" og "causation".

Analysen fant ingen forskjell mellom gruppene når det gjelder markedsprestasjoner, men de skiller seg betraktelig fra hverandre på nivået av kunnskapsinnhenting. "Green Digitals" utmerker seg, etterfulgt av "Sustainables" og "Digitals". Disse funnene er et bidrag til bedriftsledere ved å tydelig demonstrere konkurransefortrinnet ved å strebe etter bærekraft og digitalisering samtidig. Foreløpig ligger fordelen innen kunnskapsinnhenting. Imidlertid vil "Green Digitals" sannsynligvis høste fordeler av deres nåværende høye ambisjonsnivå i fremtiden. Derfor utfordrer denne studien effekten av det doble eksternalitetsproblemet og påstandene om at bærekraft og digitalisering er motstridende vekststrategier. Videre viser resultatene at bærekraft- og digitaliseringsorienterte selskaper er opptatt av å få kunnskap gjennom interessenter, noe som stemmer overens med økosystemtenkningen innenfor bærekraft og sirkulær økonomi.

Et annet nøkkelfunn er at "effectuation" og "causation" ikke er gjensidig utelukkende beslutningslogikker, og at gruppene anvender dem omtrent like mye. Dermed blir to tidligere dominerende syn i litteraturen utfordret. For det første, at selskaper bruker mer "causation" enn "effectuation", som har vært den historiske trenden. For det andre, at selskaper har en tendens til å fokusere på én av dem. Videre fant denne studien at de mest bærekraftige og digitaliserte selskapene brukte alle beslutningslogikkene mest intensivt. "Green Digitals" sitt konkurransefortrinn på kunnskapsinnhenting og deres høye poengsummer på "effectuation" og "causation" kan antyde at selskaper setter seg i en sterkere posisjon hvis de prioriterer å bruke tid og ressurser på et bredt spekter av strategiske tilnærminger. Laggards' mangelende strategiske engasjement vil sannsynligvis gjøre mange av dem irrelevante i fremtiden. Videre forskning kan fokusere på å utforske potensielle synergier mellom "effectuation" og "causation" og tilsvarende mellom bærekraft og digitalisering. I tillegg kreves det langsiktige studier for å følge med på effekten av bærekraft og digitalisering.

Preface

This master's thesis was written as a part of the study program Industrial Economics and Technology Management (IØT) at the Norwegian University of Science and Technology (NTNU). The thesis was written during the autumn of 2022 and winter of 2023. The study is meant to contribute to the field of business development, strategy, sustainability, and digitalization. The goal was to explore the firm performance and decision-making style of companies with different sustainability and digitalization performance levels.

The data source for the statistical analyses, K-Means cluster analysis and analysis of variance, was the "NTNU's Industry Survey" questionnaire from 2022. The questionnaire was supplemented with information particular to the company that was obtained from Proff Forvalt's official registers.

I would like to thank my supervisor, Arild Aspelund, for his guidance and insight. His constructive feedback has been an invaluable contribution. Additionally, I would like to thank friends and family. All the advice and support have been much appreciated.

Mari Svenkerud

Mari H Svenkerud

Oslo, 23.01.2023

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1 Introduction

Resource depletion, environmental degradation, and climate change have generated a global environmental crisis due to years of increased consumption, economic growth, unsustainable business operations, and a lack of appropriate regulations (IPCC, 2014; Shrinkhal, 2019). As a result, companies are facing growing pressure from stakeholders to take action while simultaneously experiencing a snowball effect in the generation of new climate policies (del Río Castro et al., 2021).

The interaction between digitalization and sustainability in business presents promising avenues for developing a greener economy and society (Brenner & Hartl, 2021; del Río Castro et al., 2021; di Vaio et al., 2020). At the same time, companies are trying to navigate how to overcome manifold barriers and uncertainties related to the complex transitions in an already rapidly changing business environment (Markard et al., 2012). Unfortunately, companies are being pushed to strive for sustainability and digitalization without enough academic guidance (de Marco et al., 2020). The strategy, business development, and innovation research field suffers from discrepancy and outdatedness because of a delay in advanced academic production (Bos-Brouwers, 2010; del Río Castro et al., 2021; Guandalini, 2022; Lee & Falahat, 2019; Maksimov et al., 2019). Literature is divided on whether pursuing both sustainability and digitalization is too resource-demanding, raises costs, and can lead to competitive disadvantage, which causes confusion for decision-makers (Freeman et al., 1983; Porter & van der Linde, 1995; Rennings, 2000). Likewise, some authors are concerned that the growth paths end up competing with each other because of inherent tensions between them, while others locate them as complementary (Denicolai et al., 2021). Ultimately, scholars, policymakers, and practitioners want answers to how they affect firm performance.

Despite all the barriers to success with sustainability and digitalization innovation, many companies have successfully made the leap and pursued these growth paths. However, the best business development and decision-making process to get there remains disputed. Many scholars believe there is a need for updated research on appropriate innovation processes and tools in the sustainability context (Markard et al., 2012; Moeuf et al., 2019). In addition, there is a growing interest in the scientific literature about which decision-making logics promote sustainability (Coffay et al., 2022; Johnson & Hörisch, 2022; Long et al., 2021). The ongoing discussion concerns whether combining the goal-oriented decision-making logic of causation and the non-goal-oriented decision-making logic of effectuation increases competitive advantage and sustainability performance (Johnson & Hörisch, 2022; Sarasvathy, 2001).

There is an urgent need for transferrable theoretical frameworks and clarity in a fragmented research field to advance in sustainability and digitalization (del Río Castro et al., 2021). This thesis will contribute by comparing Norwegian manufacturing companies with different sustainability and digitalization performance scores to progress toward more unified perspectives in the field. They will be compared in terms of general characteristics, market performance, knowledge acquisition, and distribution of different decision-making logics. Additionally, the study aims to clarify whether effectuation and causation are mutually exclusive.

1.1 Research Question

This study seeks to add to the research field through the following research question:

> What characterizes Norwegian manufacturing companies with different levels of sustainability and digitalization performance in terms of decision-making logic style and firm performance?

The research question is investigated by testing hypotheses that will be developed in Chapter 2 based on relevant theory. This thesis aims to verify and challenge existing literature about disputed topics within the field, provide implications to practitioners and scholars, and give recommendations for future research.

1.2 Structure and Content

This thesis is divided into six chapters, starting with this introduction. Chapter 2 covers the theoretical background from which the hypotheses are developed. Chapter 3 describes the research methodology, followed by the findings from the quantitative analysis in Chapter 4. Chapter 5 discusses the key findings, implications for theory and practitioners, the limitations of this study, and the recommendations for future research. Finally, in Chapter 6, the thesis reaches its conclusion.

2 Theoretical Background

Chapter 2 introduces relevant background information and theory by describing and defining fundamental terms and discussions to enable a better understanding of the thesis and to develop the hypotheses needed to reach the research goals. Central terms such as sustainability, digitalization, effectuation, and causation will be defined.

2.1 Sustainability and Digitalization as Paths for Increased Firm Performance

2.1.1 Sustainability

Sustainability is attracting growing attention among practitioners, policymakers, and researchers (Denicolai et al., 2021). The Brundtland Commission introduced the term sustainable development in 1987. The original definition was: "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987, p. 35). Geissdoerfer et al. (2017) defined sustainability as the "balanced integration of economic performance, social inclusiveness, and environmental resilience to the benefit of current and future generations." Elkington (1998, p. 70) introduced the "triple bottom line" concept, which he describes as "focusing on economic prosperity, environmental quality, and - the element which business had preferred to overlook - social justice." Therefore, to adhere to sustainability principles, businesses must consider all three dimensions of sustainability (Dyllick & Hockerts, 2002). In a company context, sustainability refers to fulfilling the needs of a company's direct and indirect stakeholders while not compromising the needs of stakeholders in the future (Dyllick & Hockerts, 2002). Companies experience pressure from stakeholders and a stream of new laws and regulations forcing companies to change (Gadenne et al., 2009; Tomaževič et al., 2015). Furthermore, financial institutions and investors are allocating their investments to sustainable companies (Eccless & Klimenko, 2019).

2.1.2 Sustainability and Firm Performance

Research literature has investigated whether sustainability is harmonious with performance with conflicting results. Those who believe that sustainability increases performance claim that sustainable activities can lower cost and risk, increase market share and profits, and contribute to competitive advantage (Cai & Li, 2018; Porter & van der Linde, 1995). Gomes et al. (2011) add that a company's technological innovations must be committed to the environment to yield greater international success and competitive advantage. Furthermore, studies have shown that sustainable businesses are more innovative (Michelino et al., 2019). Kuzma et al. (2020) did a meta-study in 2020 that discovered a positive connection between innovation and sustainability in social, economic, and environmental aspects. Cai & Li (2018) demonstrate that eco-innovation can significantly improve a firm's environmental performance, indirectly improving its economic performance. These findings are supported by Bos-Brouwers (2010), who found that ecoefficiency lowers cost. An analysis by al Koliby et al. (2022) of 428 manufacturing companies from Malaysia showed a strong connection between knowledge acquisition and sustainable performance, indicating that sustainable companies can have a competitive advantage in knowledge possession. Likewise, Awan et al. (2021) and Abbas & Sağsan (2019) had similar findings about the positive relationship between knowledge acquisition, green innovation, and corporate sustainable development.

On the other hand, many authors point out that sustainability is coupled with uncertainty and risk, high initial investment costs, and the "double externality problem" (Rennings, 2000). The "double externality problem" occurs when environmental innovations provide both positive spillovers for the company based on R&D and simultaneously positive externalities with improved environmental quality. Environmental innovators enhance the environment, but although the company bears the expenses, society benefits from decreased pollution (Rennings, 2000). Moreover, companies face manifold barriers to implementing sustainability into their business, such as economic, legislative, collaborative, technological, and lack of stakeholder environmental awareness and knowledge (Urbinati et al., 2021). The transition is complex as no single transferable method will guarantee success (Reim et al., 2021), especially with the constant stream of new laws and regulations. Not enough understandable resources, support tools, and frameworks adapted to context are available to practitioners (Chen et al., 2021). This shortage can result in poor decisions making, which can have rebound effects and lead to solutions with lower environmental, economic, and social performance. A holistic perspective is required, which requires new capabilities in companies.

2.1.3 Digitalization

During the first decade of the 21st century, companies globally implemented a growing number of new technologies and digitalization processes. Currently, the most significant force behind innovation and entrepreneurship is digitalization (Berger et al., 2021). Gartner (2021) defines digitalization as "the use of digital technologies to change a business model and provide new revenue and value-producing opportunities; it is the process of moving to a digital business." Hanelt et al. (2021) describe "digital transformation" as "the organizational change that is triggered and shaped by the widespread diffusion of digital technologies." However, the concept is difficult to define because of its holistic character (Guandalini, 2022). Examples of digital technologies span from the internet, artificial intelligence (AI), virtual reality, blockchain technology, cloud services, and the internet of things (IoT). Digitalization is associated with higher product quality, increased productivity, flexibility, business model innovation, better user experience, new ways of interacting with consumers, and on some occasions, sustainability (Denicolai et al., 2021; Lacy & Rutqvist, 2016).

2.1.4 Digitalization and Firm Performance

Digitalization brings opportunities and challenges. Despite this, there is a high consensus in the scientific literature that digitalization is a source of increased competitive advantage and performance. Digital technologies are becoming less expensive and more accessible to smaller businesses (Denicolai et al., 2021). In line with Petkovski et al. (2022), digitalization is the linchpin of future growth. They claim that it is a powerful method of improving the long-term competitiveness of global economies. Ferreira et al. (2019) found that innovation and productivity are enhanced through digital transformation and that adopting innovative digital procedures increases competitiveness. According to Martincevic (2022), digital transformation is unavoidable and fundamental to organizations' continued growth in the current environment and market. Attaining and sustaining long-term competitiveness is more difficult today without new digital technologies that provide a prerequisite for accomplishing it (Martincevic, 2022). Digitization has the potential to have a long-lasting effect not only on the way people work, but also on accelerating the rate of change that businesses must adapt to (Velinov et al., 2020). Furthermore, Ordieres-Meré et al. (2020) found a correlation between knowledge creation and environmental performance when facilitated directly or indirectly by digitalization. Ordieres-Meré et al.'s (2020) findings can imply that companies with a high digitalization and sustainability performance benefit from more knowledge creation than less sustainable and digitalized companies. Others conclude that digitalization has fewer effects on performance. Lee & Falahat (2019) collected data from 143 exporting manufacturers from Malaysia. They found that digitalization has little direct influence on competitive advantage but has a significant indirect impact on advantages related to products and services.

2.1.5 Combining Sustainability and Digitalization for Increased Firm Performance

As written above, sustainability and digitalization can be sources of enhanced performance. How is performance affected when these two are combined? As Denicolai et al. (2021) point out, there is not enough empirical evidence in the research literature about the effect of the combination of sustainability and digitalization strategies on performance since they usually are studied individually. Academics are only recently starting to take notice of the subject (Bos-Brouwers, 2010; Denicolai et al., 2021; Maksimov et al., 2019). Up to this point, the conversation has been dominated by the complexity of combining the growth strategies.

Both digitalization and sustainability emerged to tackle different societal and business objectives that might be in conflict and fight for the same limited company resources (Ardito et al., 2021). Besides, they also have different drivers. Digitalization is mainly driven by increased efficiency through technological innovations, such as AI, machine learning, and IoT, which can reshape industry, manufacturing, and labor. The other is driven by climatic, environmental, and geopolitical deterioration, which needs a new strategy emphasizing resource preservation, environmental governance, and efforts to decarbonize the atmosphere (Ardito et al., 2021). Moreover, they can conflict with each other's objectives (Guandalini, 2022; Markman et al., 2016). Internationalization and technological advancement are often seen as potentially hazardous to the environment owing to pollution or excessive use of the planet's resources (Dewick et al., 2006; Rock et al., 2009). Ardito et al. (2021) claim that there is little proof that integrating digitization with sustainability improves business outcomes and that the combination can even be detrimental. Their research found that focusing on the two growth strategies hampered businesses' innovative performance.

Sustainability and digitalization are in competition from birth because companies can struggle if they must focus on both (Alsamhi et al., 2019; Denicolai et al., 2021). Ocasio (1997) refers to the "attention allocation problem" as a source of the conflict. According to the "attention allocation problem," decision-makers should "focus their energy, effort, and awareness on a lower number of concerns" to perform better. Managers tasked with acquiring, disseminating, and organizing resources within the organization will likely struggle to manage resource commitments toward both digital and environmental orientations because the resources needed to implement each are distinct and address different goals (Moeuf et al., 2019). Smaller companies can also be victims of the "liability of smallness," meaning that smaller companies have fewer resources and can perform better if they focus on either digitalization or sustainability (Freeman et al., 1983).

Other streams of literature conclude that the combination of sustainability and digitalization efforts is beneficiary for performance. Many contemporary sustainability initiatives depend on digital innovation (Martin et al., 2018). Bos-Brouwers (2010) found that though initial investment can be significant, these sustainability-oriented innovations boost productivity and reduce production costs. Conforming to Goodman et al. (2017), organizations that incorporate sustainability into their digital operations are better able to create value, collaborate and communicate with stakeholders, and manage the whole supply chain. Based on a large sample of companies listed on the main European Union financial markets, the financial markets encourage digitalization initiatives, with investors giving more money to businesses that digitize their operations and are more socially responsible (Ionaşcu et al., 2022).

Companies can advance their sustainability efforts with digitalization solutions (Agrawal et al., 2022; Guandalini, 2022). If sustainability alone contributes to greater performance, companies with sustainability efforts induced by digitalization can also increase their performance, which means that the combination can lead to greater performance. To illustrate, AI can be used to optimize logistics and therefore save fuel, waste management organizations can install sensors in their containers to be notified when they are full, and sensor technology can help farmers reduce the amount of water, fertilizer, and pesticides (Alsamhi et al., 2019).

The following hypothesis is developed based on the reviewed theory in section 2.1:

H1: Companies that excel in either or both sustainability and digitalization have greater firm performance.

2.2 Effectuation and Causation

An unpredictable and dynamic competitive environment is disrupting industries and companies at a high pace. Before, businesses needed to foresee the unknown and used standard venture development methods. Today, companies must act quickly to sustain their competitive advantage (Xu & Koivumäki, 2019). The need for more "agile actions" calls for a broadened span of decision-making logic in the business development process. Scientific literature reflects these changes in the business environment with more research about the decision-making logics effectuation and causation (Chandler et al., 2011; Johnson & Hörisch, 2022). Professor Saras Sarasvathy first invented these terms in 2001 (Sarasvathy, 2001). She defines causation as "the more conventional and rigid goal-oriented approach to entrepreneurship, in which entrepreneurs decide on a predetermined goal and then select between available means to achieve this goal." In contrast, "an effectuation approach implies that entrepreneurs focus on the means at hand, which they aim to materialize into one or more goals that were not necessarily predefined" (Sarasvathy, 2001). Effectuation has emerged as an important decision-making logic in an unpredictable business environment (Göbel et al., 2021). However, the combination is required to succeed, and Sarasvathy (2001) underline that they can coexist simultaneously. Nevertheless, there can be many tensions on the path to their synergy (Galkina et al., 2022).

This thesis' part about effectuation and causation aims to identify the decision-making logic pattern of sustainable and digitalized companies. This is a valuable contribution to literature, policymakers, and practitioners as it is essential to identify if certain actions negatively influence digitalization and sustainability (Ebrahim et al., 2014). According to Johnson & Hörisch (2022), especially effectuation's influence on sustainability has not been studied in the research literature. Additionally, many researchers contend that sustainability differs fundamentally from other innovation and business practices (Markard et al., 2012). The essence of sustainability creates a distinct set of challenges that businesses must overcome, leaving much of the conventional strategic thinking inadequate. Therefore, it is natural to believe that the decision-making logic pattern differs in sustainable business development. Furthermore, it is important to remember that different aspects of effectuation and causation affect digitalization and sustainability differently. In the following, effectuation and causation will be described in more detail.

2.2.1 Effectuation

The essence of effectuation lies in an experimental approach to business development where goals are defined later in the business development process. According to Reymen et al. (2017), effectuation is integral when the value proposition is developed. Examples of effectuation can be experimenting with options where even the worst-case losses are affordable, planning by making pre-commitments and forming strategic alliances to control the future, and maintaining flexibility to take advantage of unexpected opportunities as they arise (Chandler et al., 2011; York & Venkataraman, 2010). Effectuation can be divided into four subconstructs: experimentation, affordable loss, flexibility, and pre-commitments.

Experimentation involves regularly testing new business models before identifying a suitable one (Reymen et al., 2017). The chosen business model needs to be able to withstand changes in the market and competition. The affordable loss principle implies that companies should calculate what they can afford to lose if they follow the business idea in question (Futterer et al., 2018). The affordable loss logic is instrumental when companies experience a shortage of resources (Galkina et al., 2022). Flexibility occurs when a company embraces the unexpected and exploits contingencies rather than considering them as disadvantages or attempting to avoid them (Eyana et al., 2018; Stroe et al., 2018). The pre-commitments principle means that companies can increase available resources, decrease risk related to uncertainty, and receive valuable feedback by forming ties in an evolving network of strategic alliances and stakeholders such as suppliers and consumers (Frese et al., 2020; Mansoori & Lackéus, 2020; Sarasvathy, 2001; Smolka et al., 2018).

2.2.2 Causation

As mentioned, the causation decision-making logic is more plan- and goal-oriented, where companies start by identifying business opportunities and, after that, gather key resources and map key activities (Sarasvathy, 2001). Companies with a higher causation tendency often explore existing and less uncertain markets (Galkina et al., 2022; Xu & Koivumäki, 2019). As opposed to affordable loss, the causation approach would be to calculate the expected return and develop cost structures (Futterer et al., 2018; Galkina et al., 2022). In contrast to the pre-commitments logic, the approach in line with causation would be competitive analysis and more calculated partner selection (Reymen et al., 2017).

2.2.3 Effectuation Versus Causation

Before diving into comparing clusters, the general debate about effectuation versus causation will be elaborated. Historically, business model research has been dominated by the forward-looking and prediction-oriented causation logic (Chesbrough, 2010; Teece, 2010; Zott et al., 2011; Zott & Amit, 2010). Despite their tensions, research has proven that they naturally coexist and are not mutually exclusive (Chandler et al., 2011; Frese et al., 2020; Galkina et al., 2022; Perry et al., 2012; Smolka et al., 2018). Furthermore, several authors find that their interaction positively influences companies' performance (Braun & Sieger, 2021; Johnson & Hörisch, 2022; Smolka et al., 2018; Vanderstraeten et al., 2020). However, causation and effectuation are mostly considered as independent processes working in iterative shifts, meant for different tasks, phases, and development stages (Baber et al., 2019; Frese et al., 2020; Futterer et al., 2018; Mero et al., 2020; Reymen et al., 2015). To illustrate, effectuation has proved to work well in ideation processes and the early start-up stages during uncertainty. As the company grows, more causation decision-making logic is applied (Brown et al., 2021; Sarasvathy, 2001). Furthermore, different stakeholders can have different interests. For instance, investors tend to favor causation, while entrepreneurs use more effectuation (Appelhoff et al., 2016; Read & Sarasvathy, 2005).

2.2.4 Comparison of Clusters

As stated, one of the research goals in this thesis is to investigate the different clusters' decision-making logic patterns. In general, literature about effectuation and causation in either or both sustainable and digitalized companies is sparse. Most of the research discusses the decision-making logics in the context of entrepreneurship and start-ups, tendencies in different phases, which are more used in specific processes, their impact on performance, if one excludes the other, and their synergy and tensions.

Beginning with sustainable companies: the literature is split on whether it is effectuation or causation that positively influences the level of sustainability. Long et al.'s (2021) findings suggest that goal orientation, in other words, causation, negatively influences new venture sustainability. This is supported by Uzhegova & Torkkeli (2022), who found that the effectual logic can result in more sustainable activity in internationalized small and medium-sized enterprises (SMEs). Muhd Yusuf et al.'s (2018) results contradict these findings. Their studies indicate that causation is the deciding factor for the level of sustainability. On the other hand, Johnson & Hörisch (2022) found that effectual and causal behavior are equally important for increased sustainability. The conclusions in the literature about the influence of the flexibility logic also conflict with each other. In line with Martín-Tapia et al. (2010), flexibility is necessary to be environmentally proactive, overcome risks, innovate, and grow. This contrasts with (Long et al., 2021), who claim that one should avoid contingencies to promote new venture sustainability. Finally, a long line of authors, for instance, Konietzko et al. (2020), Long et al. (2021), Salvador et al. (2021), Santa-Maria et al. (2021), and Tura et al. (2019), all emphasize the importance of pre-commitments for success in sustainability. Furthermore, the road toward sustainability involves rearranging value chains into ecosystems and coopetition (Santa-Maria et al., 2021). Brown et al. (2021b) add that collaboration guides companies through circular-oriented innovation's complexity, uncertainty, and risk.

Continuing with the more digitalized companies: the established view is that they adhere to rational and planned adoption processes. However, current publications suggest that digitalization is also driven by effectual thinking, owing to technological and commercial uncertainties that need more agile and experimental methods in the digital era (Mero et al., 2020). Nevertheless, according to the papers from the literature search, the common view is that both are equally employed but for different processes. A multiple case study by Baber et al. (2019) found that digital business model development combines effectuation and causation. For instance, effectuation was used to adjust networks and product development, while causation was used for switching platforms. Finally, Anagnou et al. (2019) discovered that effectuation and causation are not mutually exclusive but rather complementary entrepreneurial strategies that are often used in combination when developing business models.

To the best of the author's knowledge, there does not exist much theory about effectuation and causation in companies that score high on both sustainability and digitalization. Followingly, it is difficult to propose a well-informed hypothesis. Furthermore, one cannot simply assume that the pattern will be a combination of the different findings above. On the other hand, it seems easier to hypothesize about the characteristics of companies that are neither sustainable nor digitalized. One could assume that there is a higher degree of innovation among companies that focus on sustainability and digitalization since these attributes are at the center of attention in today's business model development (Berger et al., 2021; Ferreira et al., 2019; Lacy & Rutqvist, 2016). Following this logic: since innovation requires both decision-making logics, one could argue that less sustainable and digitalized companies score lower on most subconstructs related to effectuation and causation (Berends et al., 2014; Sitoh et al., 2014). Consequently, these companies might experiment less as innovation is closely tied to experimentation. Additionally, they likely score lower on causation than the other clusters because sustainability and digitalization can enable long-term competitiveness and hence requires long-run business strategies and plans (Denicolai et al., 2021). However, on average, non-sustainable and non-digitalized companies probably experience their fair share of uncertainty due to rapid changes in the business environment. Thus, affordable loss and flexibility can be valuable strategies they prioritize (Frese et al., 2020; Lacy & Rutqvist, 2016). If the group with low levels of sustainability and digitalization scores low on all or most of the subconstruct, this could be the result of satisfactory performance. As pointed out before, sustainability and digitalization innovation can bear high initial investment costs; therefore, many companies might not find it attractive to follow these growth paths (Bos-Brouwers, 2010). It is natural that less sustainable and digitalized companies apply less pre-commitments as their operations might not require rearrangements in the value chain. Moreover, they might not experience the kind of uncertainty that can motivate companies to create closer and new bonds with different stakeholders (Goodman et al., 2017; Lacy & Rutqvist, 2016; Tura et al., 2019).

Based on the literature review in section 2.2, this paper sets the following hypotheses:

H2: Effectuation and causation are not mutually exclusive alternatives among the different clusters and for the entire sample.

H3: The non-sustainable non-digitalized companies score significantly lower on the decision-making logic constructs:

- H3a: Experimentation
- H3b: Affordable loss
- H3c: Flexibility
- H3d: Pre-commitments
- H3e: Causation

In short, sustainability and digitalization are becoming more and more important for companies. At the same time, the research gaps and lack of knowledge among practitioners and policymakers regarding how to successfully implement sustainability and digitalization while at the same time ensuring competitiveness and performance need to be addressed. Thus, it is useful to uncover the status of how sustainable and digitalized companies perform and what decision-making logics they apply. This is the target of the thesis. To reach this goal, the posited hypotheses will be tested through of a cluster analysis. With cluster analysis, one can unravel what distinguishes the different combinations of sustainable and digitalized companies from non-sustainable and non-digitalized companies.

3 Research Methodology

The following chapter presents the applied methodology of the thesis. First, the research design and data collection are described, followed by a presentation of the key factors and variables used in the analysis. Next, the process of data screening and assumption test for the multivariate analysis is described. Then, the statistical methods used in the main data analysis are explained. Finally, the research quality is discussed, and a summary of the dataset is provided.

3.1 Research Design

Research is generally categorized into quantitative and qualitative research. This study uses a deductive and quantitative research approach. A quantitative research approach involves collecting and analyzing numerical data with the use of statistical methods (Bryman, 2012). There are several benefits to choosing this research design to reach the goals set in this thesis.

Quantitative research aims to provide less biased results that can be generalized. Furthermore, the research design enables analyses of data from large samples. Based on a more extensive and randomly selected sample, it seeks to describe a whole population or a sub-population (Carr, 1994). This study's research objective is to test hypotheses with a high degree of generalizability and replicability so that the findings can be compared to prior and future research. The quantitative research method is considered the best alternative to reach that goal.

The data was retrieved by distributing a self-completion questionnaire. This approach has several advantages. First, it can reduce bias since the respondent is not interacting with the interviewer, which can contribute to more objective results (Sloan & Quan-Haase, 2017). Scholars can detect the frequency of the phenomenon they want to study with the questionnaire format. Moreover, one can analyze the connection between variables with the cross-sectional research method as it collects data at a single point in time (Bell et al., 2019). Finally, the final database consisted of the questionnaire answers and information about each company from official registers. By applying two data sources, the study's reliability increases.

The study applies three statistical techniques, Confirmatory Factor Analysis (CFA), the K-Means cluster method, and analysis of variance (ANOVA) with Bonferroni tests. In short, CFA creates factor structures by reducing several overlapping variables to a representative factor. The K-Means cluster method divides the sample into groups based on the factors in question, and ANOVA allows for comparison between the clusters.

3.2 Data Collection

The database comprises data from the self-completion questionnaire and information from the official register *Proff Forvalt*. The following sections address the data-gathering procedure and selection criteria.

3.2.1 The Questionnaire

The main data collection process used a cross-sectional self-completion questionnaire developed by the Department of Industrial Economics and Technology Management at the Norwegian University of Science and Technology (NTNU). This approach was chosen to reach a large number of Norwegian manufacturing companies in different locations while saving time and resources. The questionnaire was created with the data collection tool "Nettskjema." Three companies pre-tested the survey to enhance its quality. After, the final product, "*NTNU's Industry survey,"* was sent through Outlook's email merger in bulk. Participants completed it between February and April 2022.

The target companies had 5 to 500 employees, and the NACE codes in group "C-manufacturing" They have in common that they produce products such as textiles, metals, products of wood, and electronics. The screening process in *Proff Forvalt* resulted in 4839 companies. The following criteria were also included. Holding companies and companies without a registered email address were excluded. Additionally, the organizational costs had to exceed 1 547 000 to be included. The final sample comprised 2 325 companies. After one follow-up email, the final response rate was 19,8%, with 461 responses. The respondent's demographic consisted mainly of CEOs, with 86%, and the rest were other top management employees.

The survey covered topics such as sustainability, digitalization, internationalization, growth ambition and strategy, product and service description, and effectuation and causation. It was divided into 15 sections with a total of 87 questions. The answers included natural, ordinal, and nominal data. Subjective questions were answered on a Likert scale from 1: "strongly disagree" to 7: "strongly agree." General characteristics and facts about the firm were obtained through open-ended or yes and no questions. Appendix   contains a list of the questions from the survey that are applied in this thesis.

3.2.2 Data Retrieved from Proff Forvalt

Proff Forvalt provided data from official records. They hold accurate information about all Norwegian companies. Professor Arild Aspelund collected financial data and provided company-specific data, including the year of establishment and the number of employees in 2021.

3.2.3 Data Selection

Selection criteria were set to improve the quality of the data. Companies' first answer was removed if they answered the survey twice. This applied to 24 companies, and followingly 24 cases were removed. One company was removed because its financial data was not public. Another was removed since they did not answer questions from this study's essential categories, sustainability and digitalization. The information obtained from the survey and Proff Forvalt was then combined in a single SPSS file. After applying the selection criteria, the dataset was reduced from 461 to 435 cases.

3.3 Key Variables

Each question in the survey is defined as a variable in this study. By conducting a CFA, variables that measure similar phenomena are grouped into factors. This section will describe what the factors in the analysis represent. Furthermore, the factors can be divided into dependent and independent factors. Based on the dependent factors *Sustainability Performance* and *Digitalization Performance*, four clusters take form derived from their score on the factors. The level of the independent factors, *Market Performance, Knowledge Acquisition, Experimentation, Affordable Loss, Flexibility, Pre-commitments,* and *Causation,* are measured for every cluster. All of the factors are comprised of two or more variables.

Sustainability Performance is a factor consisting of six questions from the survey related to how the companies perceive their degree of sustainability. However, according to current literature, perceived sustainability is an objectively accurate measure of actual sustainability performance (Hermundsdottir & Aspelund, 2022). The factor measures how anchored sustainability is at the management and board level, in the business strategy and values, in product and production innovation, and finally, in profiling. *Digitalization Performance* measures to what degree digitalization is a part of the companies' sales and marketing, value creation and business model, product and service innovation and improvement, and channels to reach new customers and markets.

Firm Performance refers to two factors, namely *Market Performance* and *Knowledge Acquisition.* The first factor measures the companies' subjective opinion about their export activities regarding achieved market share, sales growth, sales growth compared to competitors, profitability, and overall export activities in recent years. These measures are based on research by Knight (1997), and further research has proved that they reflect the companies' actual market performance. The second measures satisfaction with export activities with respect to gaining new knowledge through contact with customers and partners and about alternative business models.

Experimentation, Affordable Loss, Flexibility, and *Pre-commitments* are subconstructs of effectuation. *Experimentation* expresses the company's level of experimentation with products, services, and solutions. Further, it seeks to identify whether the company tries different business models and often ends up with different product and service solutions than initially planned. *Affordable Loss* is determined by how careful the companies are to avoid committing more resources than they can afford to lose and not to risk more resources than they were willing to lose with their original concept. *Flexibility* measures to what degree companies use approaches that guarantee flexibility and adaptability, seize opportunities as they emerge, and adjust business development to the available resources. *Finally, pre-commitments* illustrate the strength of the relationships with stakeholders. More specifically, it measures how involved stakeholders are in business development. Stakeholders' involvement can lower uncertainty, help assess future business opportunities and improve strategic decision-making.

Lastly, *Causation* indicates how devoted a company is to making long-term business strategies and plans. Furthermore, it addresses to what degree they use control and monitoring systems to reach their objectives and whether they plan manufacturing and marketing before entering new markets. All the questions about effectuation and causation are based on the works of Frese et al. (2020).

Appendix   presents all the variables that have been applied in the study.

3.4 Assessing the Data

The statistical methods have some assumptions that must be met for them to provide valid results. Factor analysis and ANOVA's assumptions are related to sample size, outliers, missing values, level of measurement, independence of observation, normal distribution, and homogeneity of variance (Tabachnick & Fidell, 2007). This subchapter describes the process of assessing the assumptions.

3.4.1 Dealing with Outliers

A statistical outlier is a data point that deviates considerably from other observations and can potentially disrupt the dataset (Pallant, 2016). To identify outliers, scatterplots were generated. None was detected. Afterward, a manual screening was conducted to find potential levels of disengagement. One case was removed because the company had answered the same number on every Likert scale question. The dataset was then reduced from 435 to 434.

3.4.2 Dealing with Sample Size and Missing Values

For statistical reliability, it is essential to have a sufficiently large sample size (Tabachnick & Fidell, 2007). The dataset had 461 respondents, which is considered adequate in line with (MacCallum et al., 1999). Missing values can be another threat to the quality of the results. Little's Missing Completely at Random (MCAR) test was conducted to ensure that the potential missing values were missing at random. The test was not significant. However, one company answered none of the questions and was removed from the sample. The final number of cases in the dataset was followingly 433.

3.4.3 Assessing Multivariate Analysis Assumptions

Level of measurement refers to how ANOVA requires variables in the form of an interval or ratio (Pallant, 2016), which was satisfied since the dependent variables were answered on a Likert scale. Independence of observation was secured by ensuring that the respondents answered the questionnaire independently and could not see others' answers.

To determine the data's normality, the dataset was screened for skewness and kurtosis in SPSS. Skewness is an indicator of how symmetric the distribution is, and kurtosis is a measure of peakedness (Tabachnick & Fidell, 2007). There are no established standards for determining how high the level of skewness and kurtosis has to be before the distribution is regarded as non-normal. This thesis follows George & Mallery (2010), who consider a range between -2 and +2 adequate. The test showed kurtosis for the *Flexibility* factor with a value of 2,213. Therefore, a logarithmic transformation was performed to standardize the value. The results for all the variables and factors are presented in Appendix B.

Finally, ANOVA assumes homogeneity of variance, which is satisfied if the variances in the different groups are equal or similar (Pallant, 2016). To assess homogeneity of variance, Levene's test is performed in SPSS. If the test is violated, Welch's t-test is used instead of ANOVA as it does not require homogeneity of variance (Welch, 1938).

3.5 Establishing the Measurement Model

3.5.1 Factor Analysis

Several questions in this study's survey address the same issue for reasons of validity. The goal is to construct factors comprising variables where the questions are correlated. Confirmatory factor analysis (CFA) is a statistical method used to reduce the number of variables to underlying constructs (Kinnear & Gray, 2009). The analysis was conducted in SPSS with principal component analysis and the oblique rotation method direct oblimin. The eigenvalues were set to greater than 1.

The author saw it necessary to conduct two separate factor analyses. The first included *Sustainability Performance*, *Digitalization Performance*, *Experimentation, Affordable Loss, Flexibility, Pre-commitments,* and *Causation,* and the second included *Market Performance* and *Knowledge Acquisition.* The reason is that only exporting companies answered the firm performance questions, which include 182 companies. The first analysis could use the entire sample by dividing the factor analyses. Although the sample was reduced to 182 cases for the second factor analysis, this is still considered a sufficiently large sample size, according to MacCallum et al. (1999).

The questions in the survey are based on previous questionnaires; therefore, the mentioned factors were expected to appear. When running the first CFA in SPSS, *Affordable Loss* and *Flexibility* formed one factor instead of two separate ones. It seemed reasonable to divide them since they are logically separated in meaning and derived from a standardized template in effectuation and causation studies by Frese et al. (2020). Moreover, their factor loadings and Cronbach's alphas were satisfactory when separate.

To establish the final factors, the factor loadings from the CFA have to be examined. A factor loading is a measure of the extent to which the variable is a pure measure of a factor (Tabachnick & Fidell, 2007). There is no established minimum threshold for factor loading. When conducting the first factor analysis, thresholds of 0,5, 0,55, and 0,6 were tested to check the effect on the significance level of the ANOVA. There was no notable difference between the thresholds, so 0,6 was chosen. Two questions in total were removed in this process, from *Affordable Loss* and *Causation,* respectively. In the second factor analysis, one of the *Market Performance* variables loaded 0,49. According to (Hair et al., 1998), a threshold of 0,45 is adequate if the sample size is above 150. Thus, the threshold was set to 0,45 for the firm performance factors.

The results from the factor analyses are presented in Appendix C.

3.5.2 Measurement Assessment

To ensure a factor's internal consistency in the latent factor, internal reliability is tested by measuring Cronbach's alpha. Normally, a threshold of 0,7 is considered adequate, but 0,8 is preferred (Cortina, 1993; Taber, 2018). All the factors complied with the 0,8 threshold except *Knowledge Acquisition*. *Knowledge Acquisition* only scores 0,526. The author chose not to discard the factor despite its low Cronbach's alpha because the final results are considered illustrative of the company's level of Knowledge Acquisition. After all, the means and ANOVA follow the same pattern of the underlying variables. The results are reported in Appendix C.

3.5.3 Cluster Analysis

The study applied the K-Means cluster method to allocate cases based on their score on the defining factors: *Sustainability Performance* and *Digitalization*. K-Means clustering is an iterative process where the algorithm tries to partition a dataset into a collection of mutually exclusive clusters that are as dense and well-separated as the sample will allow (Khan & Ahmad, 2004). Clustering allows the analyst to reveal structures and compare groups which are essential to identify unique traits in groups quantitatively.

3.6 ANOVA

The one-way analysis of variance (ANOVA) is a regression technique that tests for statistically significant differences between two or more independent groups' means (Pallant, 2016). The method will be used to distinguish the clusters with respect to the independent factors. As mentioned in subchapter 3.4, Welch's t-test will be applied if Levene's test is violated.

A post hoc test is carried out afterward to identify which clusters have significant differences between them (Field, 2009). The test compares all the combinations of groups pairwise.
The post hoc test also reduces the chance of false positives. Bonferroni is the appropriate test if the ANOVA analysis is conducted, while the Games-Howell test is appropriate after Welch's t-test.

3.7 Quality of Study

This subchapter will assess the quality and limitations of the methodology. Some common measures of quality in social research are reliability and validity (Bryman, 2012).

Reliability reflects the degree of replicability and consistency. The study has a high degree of replicability if the research method yields the same results when repeated (Bryman, 2012). The author has attempted to provide a thorough and detailed description of all the procedures to ensure replicability. Moreover, most questions in the survey are given in the form of a 7-point Likert scale to provide consistency. However, the reliability can have been affected because the respondents' exact environment and context when the survey was completed cannot be replicated. The participant can be affected by distractions, and their knowledge level will change over time (Cooper & Schindler, 2011).

Validity refers to the precision with which a research method measures what it is designed to measure. Several professors and three manufacturing companies reviewed the questions to ensure they reflected what they intended to measure. The pre-testing helped increase comprehension and reduced the limitations related to the self-completion questionnaire. One limitation is that respondents are limited by not being able to ask questions while they complete the survey.

Several questions overlapped to improve the factor analysis and to assure sampling validity. Furthermore, the questions are based on surveys in previous research. Thus, comparing the thesis' findings with prior and future research is more accessible, and the study's generalizability is improved. Meanwhile, the validity can have suffered because of the lack of description of some of the concepts in the questions. As mentioned, sustainability and digitalization are broad terms. Therefore, the respondent's interpretation of and level of knowledge about the concepts will vary.

Multiple data sources were applied to increase construct validity and data robustness further. The Proff Forvalt register provided measures such as firm age and size measures, which could then be compared to the respondents' answers. This also reduced social desirability bias and increased reliability (Jakobsen & Jensen, 2015). Social-desirability bias is one of the most prevalent kinds of bias affecting survey validity. It refers to the inclination of respondents to answer questions in a way that others may see more favorably (Chung & Monroe, 2003). To alleviate the bias, the answers were anonymized, and the information about which companies participated was kept confidential.

3.8 Summary Statistics

Characteristics of the remaining 433 companies after selection criteria and assumption tests are described in Table 1. The size of the companies spans from 5 to 471 employees, with most companies on the lower end of the scale. The companies' range in establishment year is from 1799 to 2021. The majority of them are young, with a median of 1985. The companies are registered as industrial companies with the European standard NACE code 10-33 (NACE, 2008).

Table 1: Sample characteristics

	Min	**Median**	**Max**	**Mean**	**S.D.**
Year of establishment	1799	1985	2021	1976,8	30,8
Number of employees	5	26	471	51,9	69,6

Table 2 shows an overview of industries represented in the cluster (NACE, 2008). Most of them are low-tech, with approximately 75%. A total of 22 industries are represented (Eurostat, 2016). The most common industry is the "manufacture of fabricated metal products, except machinery and equipment." "Manufacture of basic pharmaceutical products and pharmaceutical preparations" and "manufacture of leather and related product" are the least common.

Table 2: Industries represented in the sample

Industry	**Frequency**	**Percentage**
Manufacturing of food products	38	9,10%
Manufacturing of beverages	6	1,50%
Manufacturing of textiles	15	3,70%
Manufacturing of wearing apparel	4	1,00%
Manufacture of leather and related product	1	0,20%
Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	45	11,00%
Manufacture of paper and paper products	3	0,70%
Printing and reproduction of recorded media	10	2,40%
Manufacture of chemicals and chemical products	8	2,00%
Manufacture of basic pharmaceutical products and pharmaceutical preparations	1	0,20%
Manufacture of rubber and plastic products	20	4,90%
Manufacture of other non-metallic mineral products	24	5,90%
Manufacture of basic metals	6	1,50%
Manufacture of fabricated metal products, except machinery and equipment	75	18,30%

Manufacture of computer, electronic and optical products	20	4,90%
Manufacture of electrical equipment	19	4,60%
Manufacture of machinery and equipment n.e.c.	34	8,30%
Manufacture of motor vehicles, trailers, and semi-trailers	10	2,40%
Manufacture of other transport equipment	11	2,70%
Manufacture of furniture	20	4,90%
Other manufacturing	15	3,70%
Repair and installation of machinery and equipment	25	6,10%
High-tech	103	25,10%
Low-tech	307	74,90%

4 Results

This chapter contains the results from the analyses. The first part consists of a description of the clustering process followed by the characteristics of the groups. Afterward, follows the comparative analysis of the groups. The final section concludes which hypotheses were supported and rejected.

4.1 Cluster Analysis

The sample was clustered into four groups created by conducting a K-Means cluster analysis based on the two variables sustainability performance and digitalization performance. The resulting groups were compact and well-separated from each other. Figure 1 shows the relative position of the clusters, and Table 3 shows the coordinates and size of the clusters. Among the 421 cases, the Digitals cluster is the largest, followed by Green Digitals, Sustainables, and Laggards.

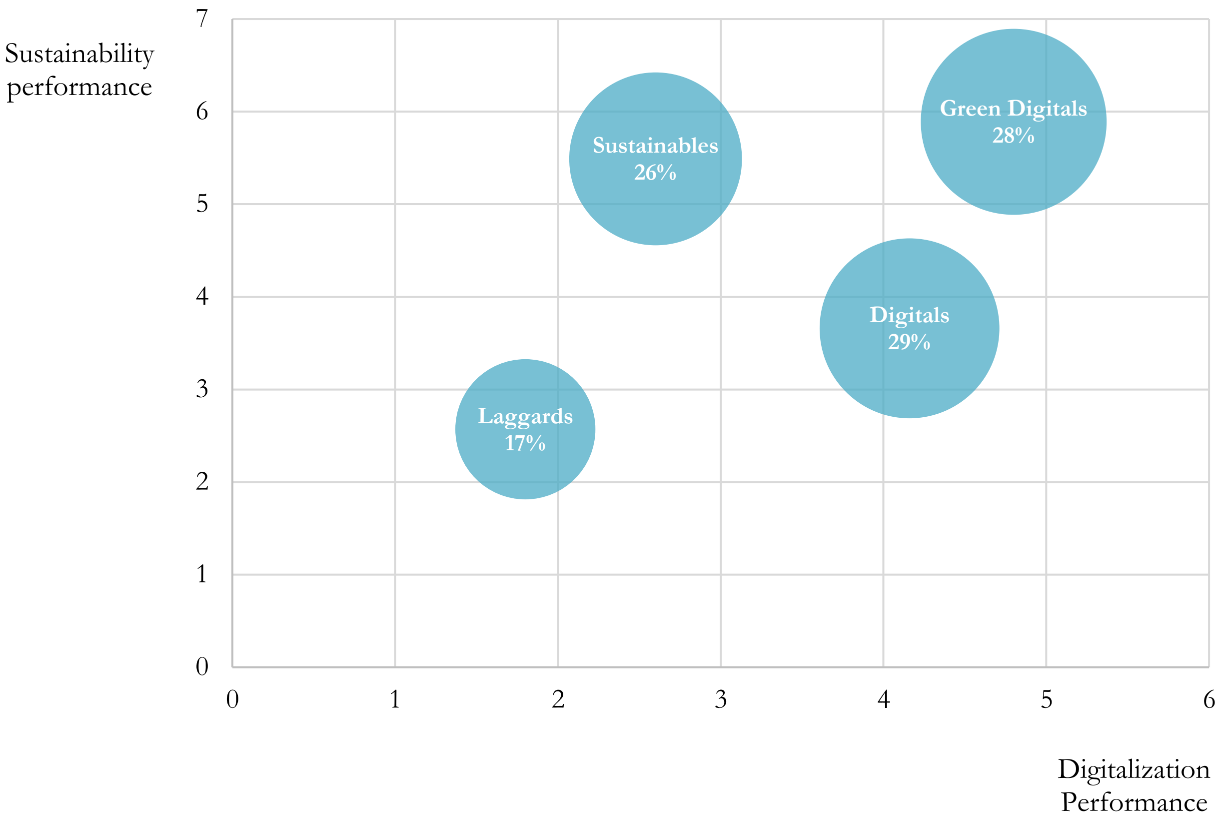

Figure 1: Clusters of Norwegian manufacturing companies

Based on the size of the clusters, one can derive that 54% of the sample shows high sustainability performance, and 57% perform highly on digitalization. Furthermore, 83% of the sample has a high scores on either or both sustainability and digitalization.

Table 3: Cluster centres

	Sustainables	Green Digitals	Digitals	Laggards
Sustainability performance	5,49	5,89	3,66	2,57
Digitalization	2,6	4,8	4,16	1,8
Number of cases	108	117	125	71
Percentage	26%	28%	29%	17%

4.2 Comparative Analysis of Clusters

4.2.1 General Characteristics

Table 4 displays the general characteristics of the different clusters. As seen from the mean value, the Green Digitals cluster has the highest number of employees, with an average of 77,3. In contrast, the Laggards companies have an average of 28, which is a significant difference. Regarding age, there is no significant difference between the means across the clusters.

Table 4: Characteristics of the clusters

	Cluster	Min	Median	Max	Mean	S.D.	F-value
Year of establishment	Sustainables	1866	1986,5	2019	1977,4	31,9	1,294
	Green Digitals	1891	1983	2017	1978,4	26,3	
	Digitals	1799	1983	2015	1973,1	34,8	
	Laggards	1886	1989	2021	1981,6	25,8	
Number of employees	Sustainables	5	22	231	39,3	46,1	10,454***
	Green Digitals	5	43	471	77,3	90,7	
	Digitals	5	28	427	52,9	73,8	
	Laggards	5	14	217	28	35,8	

*p<0,1, **p<0.05, ***p<0.001

4.2.2 Firm Performance

Table 5 shows the results from the ANOVA analysis on the difference in *Market Performance* and *Knowledge Acquisition* between the clusters. It is important to have in mind when interpreting the results that the sample here is reduced to 182 companies since only companies with export activities were encouraged to answer questions within this category. *Market Performance* includes the first five questions in Table 5, while *Knowledge Acquisition* includes the two last questions in Table 5. The table illustrates the differences between the clusters for each question and the two defined factors.

Table 5: Comparison of firm performance

Satisfaction with export activities in terms of …	**Mean Values**				**ANOVA**
	Sustainables	**Green Digitals**	**Digitals**	**Laggards**	**F-value**
… achieved market share	4,07	4,36	4,25	4,25	0,598
… sales growth	4,27	4,51	4,47	4,45	0,396
… sales growth compared to competitors	4,41	4,60	4,54	4,24	0,767
… profitability	4,19	4,61	4,34	4,30	1,037
… overall results of the export activities in recent years	4,30	4,82[3,4]	4,24[2]	3,90[2]	5,865***
… gaining new knowledge through contact with customers and partners	3,80[2]	4,29[1,3,4]	3,86[2]	3,29[2]	8,355***
… gaining new knowledge about alternative business models	4,33	4,72	4,58	4,29	1,302
Market Performance	4,26	4,6	4,49	4,34	1,129
Knowledge Acquisition	4,06[2]	4,65[1,3,4]	3,99[2]	3,66[2]	12,461***

*p<0,1, **p<0.05, ***p<0.001
1,2,3: denote significant group differences, Bonferroni test

The results in Table 5 clearly show no significant difference in either the factor *Market Performance* or the questions that comprise the factor. Thus, the clusters appear to be equally satisfied with their performance in terms of market share, sales growth, profitability, and the overall results of their export activities. Furthermore, all the questions related to the *Market Performance* factor have similar means, with the lowest being 4,07 and the highest being 4,72. Contrary to *Market Performance*, the *Knowledge Acquisition* factor and related variables have highly significant mean differences across the clusters. The difference is most evident between the Green Digitals and the three other clusters, where the Green Digitals score significantly higher than the others. One pattern that can be seen is that the Sustainables and Digitals clusters have similar means in both the factor and the related questions. Another pattern is that the Laggards cluster always has the lowest mean, while the Sustainables and Digitals lie between the Green Digitals and Laggards. Moreover, there is a consistent difference between the means of the two *Knowledge Acquisition* variables. The variable related to gaining new knowledge through contact with customers and partners has constantly higher means than the variable related to gaining new knowledge about alternative business models.

4.2.3 Effectuation Versus Causation

This subchapter consists of several analyses, beginning by comparing the clusters and looking at one decision-making logic at a time. Then follows a summary of the decision-making logic pattern cluster by cluster. Afterward, the mean between the effectuation subconstructs is calculated to compare the use of effectuation versus causation per cluster. Next comes a comparison of the sample's total use of each decision-making logic. After, the use of effectuation versus causation is compared for the entire sample. Lastly, the mean between effectuation and causation is calculated for each cluster to investigate which cluster reports the highest use of the decision-making logics in general.

Table 6: Comparison of decision-making logics

	Mean Values				ANOVA
	Sustainables	**Green Digitals**	**Digitals**	**Laggards**	**F-value**
Experimentation	3,59[2,4]	4,24[1,3,4]	3,66[2,4]	2,57[1,2,3]	27,688***
Affordable Loss	4,65	4,96	4,62	4,31	2,420*
Flexibility	5,26	5,53[3,4]	5,05[2]	4,63[2]	6,533***
Pre-commitments	4,47[4]	4,86[3,4]	4,35[2,4]	3,62[1,2,3]	10,560***
Causation	4,42[2,4]	5,04[1,3,4]	4,10[2,4]	2,92[1,2,3]	35,035***

*p<0,1, **p<0.05, ***p<0.001
1,2,3: denote significant group differences, Bonferroni test was applied when using the ANOVA method, and Games-Howell test was applied when using the Welch method
ANOVA was applied for *Experimentation,* and Welch was applied for *Affordable Loss, Flexibility, Pre-commitments,* and *Causation*

Comparing the clusters for each decision-making logic
Table 6 shows that there is a highly significant difference between some clusters for all the decision-making logics except Affordable Loss, where the significance level is weak. The high significance level is mostly caused by the large variations between the Green Digitals' high scores and the Laggards' low scores. One consistent pattern is that the Green Digitals cluster has the highest score on all the decision-making logics, and the Laggards score the lowest.

As seen in Table 6, *Experimentation* has the second highest F-value. The Green Digitals uses *Experimentation* significantly more than all the three other clusters. Furthermore, the Sustainables and the Digitals experiment approximately the same amount and significantly more than the Laggards. Overall, there is never a considerable difference between the Sustainables' and Digitals' scores. Another observation about the *Experimentation* scores is that the scores correlate with the scores in the *Knowledge Acquisition* variable about gaining new knowledge about alternative business models for all the clusters except the Laggards. As mentioned, there are no considerable differences in the use of *Affordable Loss.* However, it is noteworthy that the differences follow the same pattern as the rest of the factors, with the Green Digitals cluster having the highest mean, followed by the Sustainables and Digitals, and finally, Laggards. The *Affordable Loss* means are the second highest after *Flexibility* for all the clusters except for the Green Digitals, where *Causation* has the second highest score. Nevertheless, the difference between *Affordable Loss* and *Causation* for the Green Digitals cluster is just 0,08. Thus, *Affordable Loss* is one of the decision-making logics the entire sample prioritizes the most. The clusters seem to value *Flexibility* even more since the related scores are substantially higher than the other decision-making logics. *Flexibility* has the lowest F-value after *Affordable Loss,* and therefore, the usage is somewhat even among the clusters. The *Pre-commitments* means are relatively high for all the clusters except the Laggards, and followingly a quite important strategy for these groups. Another interesting finding is that the *Pre-commitments* means correspond to the means in the *Knowledge Acquisition's* variable regarding gaining new knowledge through contact with customers and partners. The most considerable variation between means can be seen in *Causation*, where the difference between the Green Digitals and Laggards is 2,12. Accordingly, it has the highest F-value. Additionally, the largest variation between the Sustainables and Digitals clusters can be observed in their use of *Causation,* with a difference of 0,32.

Comparing the levels of the decision-making logics per cluster
As noted, the clusters vary in the extent to which they use the different types of decision-making logics. However, the Sustainables, Digitals, and Laggards clusters follow the same pattern. For instance, all the effectuation subconstructs are higher than *Causation* except *Experimentation.* The order from the most to the least applied is *Flexibility, Affordable Loss, Pre-commitments, Causation,* and *Experimentation.* The Green Digitals cluster, on the other hand, has the order: *Flexibility, Causation, Affordable Loss, Pre-commitments,* and *Experimentation.* Hence, the Green Digitals cluster uses the *Causation* logic more than the other clusters. Some clusters have larger spans than others, from the most to the least used decision-making logic. For the Laggards, the difference between *Flexibility* and *Experimentation* is 2,06, while the same difference for the Green Digitals cluster is 1,29.

Effectuation versus causation per cluster

Table 7: Effectuation versus causation per cluster

	Mean Values			
	Sustainables	**Green Digitals**	**Digitals**	**Laggards**
Effectuation	4,493	4,898	4,42	3,783
Causation	4,42	5,04	4,10	2,92

Table 7 shows that there is no significant difference between the level of *Effectuation* and *Causation* in the clusters, except for the Laggards. The Laggards' high score on *Affordable Loss* and *Flexibility,* and lower score on *Causation,* are the main contributors to this difference. The Green Digitals cluster is the only one with a higher score on *Causation* than *Effectuation*. However, the difference is not significant. Not surprisingly, the Green Digitals score higher than the other clusters on both *Effectuation* and *Causation*, the Sustainables and Digitals score approximately the same, and the Laggards score the lowest. In conclusion, the two decision-making logics are not mutually exclusive.

Comparing the sample's total use of each decision-making logic

Table 8: The sample's total use of each decision-making logic

	Mean Values
Experimentation	3,515
Affordable Loss	4,635
Flexibility	5,1175
Pre-commitments	4,325
Causation	4,12

Table 8 illustrates that the usage pattern for the entire sample is the same as for the Sustainables, Digitals, and Laggards, namely from *Flexibility* with the highest score, followed by *Affordable Loss, Pre-commitments, Causation,* and finally, *Experimentation* with the lowest score. There is a considerable variation in means. For instance, *Experimentation* has a significantly lower mean than the other decision-making logics.

Effectuation versus causation for the sample

These values are calculated by finding the mean between the effectuation subconstructs in Table 8 and comparing it with the causation mean. For *Effectuation,* the mean is 4,40, and for C*ausation,* the mean is 4,12. Consequently, the difference between the means is 0,28, which is not significant. In other words, they are not mutually exclusive.

The mean between effectuation and causation per cluster

Table 9: The mean between effectuation and causation per cluster

	Mean Values			
	Sustainables	**Green Digitals**	**Digitals**	**Laggards**
Effectuation and causation	4,478	4,926	4,356	3,61

In Table 9, the mean between *Effectuation* and *Causation* is calculated per cluster to identify which cluster reports the highest use of decision-making logics in general. As seen before, the Green Digitals tend to use more decision-making logics, followed by the Sustainables, Digitals, and lastly, Laggards.

4.3 Hypothesis Evaluation

The results in Chapter 4 are summarized in Table 10 with an overview of the posited hypotheses and whether they were supported or rejected. All the hypotheses were supported except for the *Market Performance* factor in hypothesis one and the *Affordable Loss* factor in hypothesis three. Thus, the results showed no significant difference between the clusters in *Market Performance* and a weak significance in the difference between the clusters on applying the *Affordable Loss* logic. Part two of hypothesis one was supported as the study showed that the more sustainable and digitalized, the more focus on acquiring knowledge. The data analysis of effectuation versus causation in each cluster and for the entire sample proved that the decision-making logics are not mutually exclusive and that the companies tend to apply an even mix of both on average. Finally, the test of hypothesis three revealed that the Green Digitals apply the highest level of all the decision-making logics, followed by the Sustainables and Digitals, while the Laggards have the lowest score on all of them. The Bonferroni and Games-Howell tests uncovered that the large gap in means between the Green Digitals and Laggards was the leading cause behind the high significance levels. The results will be discussed in the following chapter.

Table 10: Hypothesis evaluation

Hypothesis	**Model parameters**	**Difference in mean**	**Hypothesis evaluation**
H1	Market Performance Knowledge Acquisition	Not significant Significant	Rejected Supported
H2	Sustainables Green Digitals Digitals Laggards Sample	Not significant Not significant Not significant Not significant Not significant	Supported Supported Supported Supported Supported
H3	Experimentation Affordable Loss Flexibility Pre-commitments Causation	Significant Weak significance Significant Significant Significant	Supported Rejected Supported Supported Supported

5 Discussion

This chapter summarizes and discusses the key findings. In sections 5.1 and 5.2, the key findings in chapter 4 will be discussed in light of the applied theory. Then, the implications for theory, managers, and policymakers are discussed in section 5.3. Next, the limitations of the study are presented in section 5.4. Finally, recommendations for future research are covered in section 5.5.

The goal of this study was to examine the characteristics of companies with different degrees of sustainability and digitalization performance in the form of a cluster analysis. The first part aimed to investigate the clusters' level of *Market Performance* and *Knowledge Acquisition*. The second part sought to calculate the clusters' use of the decision-making logics effectuation and causation to establish if they are mutually exclusive and confirm if any of the clusters score differently on the use of the decision-making logics.

The findings rejected the hypothesis that companies that excel in either or both sustainability and digitalization have greater *Market Performance*. On the other hand, sustainable and digitalized companies score significantly higher on *Knowledge Acquisition* in the form of gaining new knowledge through stakeholders and about alternative business models. Effectuation and causation were proven to not be mutually exclusive decision-making logics for any of the individual clusters or the entire sample. Lastly, the results showed that the Laggards companies score significantly lower on all the decision-making logic constructs except *Affordable Loss*.

5.1 Sustainability and Digitalization as Paths for Increased Firm Performance

5.1.1 Market Performance

The findings imply that Norwegian companies that pursue to excel in sustainability and digitalization do not experience higher scores on *Market Performance*. Hence, the analysis' outcome deviates from the findings by authors such as Cai & Li (2018), Porter & van der Linde (1995), Gomes et al. (2011), Bos-Brouwers (2010), Denicolai et al. (2021), and Ferreira et al. (2019). These authors emphasized that sustainability and digitalization can lower costs, increase efficiency and innovation, strengthen competitiveness, and ensure higher economic performance.

The results can have several explanations and stress the need for holistic analyses. Firstly, the results can strengthen the theory about the double externality problem. Secondly, the findings confirm the complexity of changing to a sustainable and digitalized business (Lee & Falahat, 2019; Reim et al., 2021). The results can have been affected by legislative barriers because there are not enough laws and regulations that benefit sustainable and digitalized companies (Urbinati et al., 2021). Furthermore, since many companies have implemented sustainability and digitalization relatively recently, it normally takes time before the results can be detected in firm performance (Coad & Rao, 2009). High initial investment costs can be one explanation (Bos-Brouwers, 2010). It naturally takes time to succeed when developing business models and trying to gain a foothold in new markets. Additionally, the results in *Market Performance* for both sustainable and digitalized companies can stem from the complexity that arises when trying to implement both growth strategies (Denicolai et al., 2021). The data support the notion that sustainability and digitalization strategy requires more research to tailor the innovation methods. Moreover, it is evident that the Laggards are still benefiting from their business models, which can indicate that they are too comfortable to see the value of innovation, at least yet. As seen in the cluster analysis, the Laggards cluster only constitutes 17% of the sample, and this figure will likely decrease in the future.

Seen from another perspective, one intriguing interpretation of the findings is that since the Sustainables, Green Digitals, and Digitals are not performing worse than the Laggards, the double externality problem and others barriers to performance in sustainability and digitalization could be diminishing. This contradicts the idea that having a sustainable business model is less profitable and results in a competitive disadvantage. A second hypothesis is that since the Green Digitals perform equally well, companies can cope with the complexity of implementing both growth strategies simultaneously. Furthermore, one can assume that combining the strategies can help overcome the double externality problem with digital technologies that both promote efficiency and sustainability (Alsamhi et al., 2019). On the other hand, the similarities in performance can also result from the fact that companies with more resources and capabilities can invest more in sustainability and digitalization. For instance, the general characteristics of the clusters show that the Green Digitals, Sustainables, and Digitals have more employees on average than the Laggards cluster. In line with Ocasio (1997) and Freeman et al. (1983), the Laggards can thus be the victim of the "attention allocation problem" and "liability of smallness." Furthermore, the findings by Ionașcu et al. (2022) and Eccless & Klimenko (2019) contribute to the assumption that the Sustainables, Green Digitals, and Digitals clusters' performance level is affected by advantages in financial resources. They found that investors tend to favor sustainable and digitalized companies.

Nevertheless, the findings in this thesis undoubtedly challenge studies by Ardito et al. (2021) and Alsamhi et al. (2019), which highlight that pursuing both growth paths can hamper performance and even be detrimental. Therefore, it seems that the combination, to some degree, positively impacts performance (Braun & Sieger, 2021; Johnson & Hörisch, 2022; Smolka et al., 2018; Vanderstraeten et al., 2020). Likewise, one can question if the consequences of sustainability and digitalization's conflicting goals are as severe as portrayed in the studies by Guandalini (2022) and Markman et al. (2016). Besides, the Green Digitals' cluster size of 28% gives the impression that it is a popular strategic combination. This result is not unexpected since a growing number of sustainable initiatives are enabled by digital technology (Agrawal et al., 2022; Guandalini, 2022; Martin et al., 2018).

5.1.2 Knowledge Acquisition

In contrast with *Market Performance*, there is a striking difference in the *Knowledge Acquisition* factor and its related questions between the clusters. The numbers show that the Green Digitals are far more concerned with acquiring knowledge than the other clusters. Even though not significant, the Laggards' scores are noticeably lower than the Sustainables and Digitals. From the findings, one can declare how sustainability- and digitalization-oriented companies focus more on learning and renewing themselves by exploring new business models and securing knowledge and resources through their network. It seems that the companies from the Laggards cluster are more set in their ways and are not in a phase where they act on the urgency for a transition to sustainable business models. Another interesting observation is that the Sustainables and Digitals score almost identically on the *Knowledge Acquisition* factor and the associated questions. The close connection was not anticipated because of the two growth strategies' intrinsic differences (Ardito et al., 2021; Dewick et al., 2006; Guandalini, 2022; Markman et al., 2016; Rock et al., 2009).

The findings are consistent with the studies by al Koliby et al. (2022), Awan et al. (2021), and Abbas & Sağsan (2019), who found a positive connection between knowledge acquisition, sustainable performance, green innovation, and corporate sustainable development. Additionally, the results support the positive relationship found by Ordieres-Meré et al. (2020) between digitalization performance, sustainability performance, and knowledge creation. There are good reasons to believe that the Sustainables, Green Digitals, and Digitals clusters are better positioned for the future because new knowledge is a key driver for innovation. These clusters' focus on exploring alternative business models conforms with Berger et al. (2021), who link digitalization as the most significant force behind innovation, and Michelino et al. (2019), who found that sustainable companies are more innovative. Their findings are supported by the fact that most of the necessary technology required to meet the sustainability goals has not yet been developed and implemented and relies on rethinking current solutions and innovation.

It is not unexpected that the analysis shows that the Sustainables, Green Digitals, and Digitals concentrate more on gaining knowledge through customers and partners. All the research done for this thesis has shown that creating, expanding, and interacting with one's network can increase sustainability and digitalization performance (Agrawal et al., 2022; Brown et al., 2021a; Brown et al., 2021b; Urbinati et al., 2021). Collaboration can give access to knowledge, resources, feedback, and new opportunities, which can give a safety net when companies explore new business ventures (Frese et al., 2020; Mansoori & Lackéus, 2020; Smolka et al., 2018). As the clusters' means of gaining new knowledge through contact with customers and partners has constantly higher means than the variable related to gaining new knowledge about alternative business models, it can be another proof of its importance. Interaction with customers allows companies to provide products and services that fulfill the customers' needs faster. Followingly, the efficiency of the innovation process can be increased, and consequently, the companies can experience higher performance (Agrawal et al., 2022). In addition, the focus on learning can be especially beneficial since stakeholders, such as investors, might require evidence to be convinced to support the implementation of sustainable business models (Brown et al., 2021b). The complexity related to implementing sustainability and digitalization combined with a constant stream of new laws and regulations that must be followed verifies the benefits of collaboration (Santa-Maria et al., 2021).

However, collaboration does not come without risk. For instance, orchestrating circular ecosystems involves uncertainties and a high level of complexity (Brown et al., 2021b; Konietzko et al., 2020). For instance, a reverse supply chain requires suitable partners and capabilities such as supply chain and customer management (Urbinati et al., 2021). Another issue can be the "coordination problem," a phenomenon where the lack of simultaneous and coordinated entrance of businesses can create a first-mover disadvantage (Aspelund et al., 2021).

5.2 Effectuation and Causation

As pointed out earlier, there is a need for more research on how to successfully implement sustainability and digitalization in businesses. Therefore, it is useful to identify what strategies and decision-making logics sustainability- and digitalization-oriented companies apply (Ebrahim et al., 2014). The literature review revealed that there is not enough research on the typical decision-making logic patterns of the different clusters (Johnson & Hörisch, 2022). However, scholars are showing more interest in effectuation and causation in general, especially effectuation, which has received more attention recently (Chandler et al., 2011).

5.2.1 Distribution of Decision-making Logics Between the Clusters

For most decision-making logics, except *Affordable Loss*, the difference in use between the clusters is highly significant. This implies that it without doubt matters which cluster one belongs to and that there are trends to interpret. Additionally, there are parallels between some decision-making logics and components of *Knowledge Acquisition.*

The difference in the use of *Experimentation* can be explained by how sustainable and digitalized companies tend to be more innovative (Berger et al., 2021; Cai & Li, 2018; Kuzma et al., 2020; Michelino et al., 2019). Not surprisingly, the *Experimentation* means overlap with the means in the question under *Knowledge Acquisition* about gaining new knowledge about alternative business models. Experimenting and exploring alternative business models are considered more necessary for sustainability- and digitalization-oriented companies (Denicolai et al., 2021; Lacy & Rutqvist, 2016). Moreover, there is reason to believe that the use of *Experimentation* among the Sustainables, Green Digitals, and Digitals can be related to new trends such as Design Thinking and Lean Start-up methodology. However, *Experimentation* has the lowest adoption rate among the clusters. This can be caused by the until now dominance of the causation approach, the lack of experience and expertise with experimental approaches, and fear of the risk involved with experimentation.

Affordable Loss' equal adoption level suggests that independent of the cluster, the companies can experience a shortage of resources and uncertainty in their business environment which requires this decision-making logic (Frese et al., 2020; Galkina et al., 2022; Lacy & Rutqvist, 2016). Regarding *Flexibility*, the overall high means further witness today's ever-changing conditions for business (Göbel et al., 2021; Xu & Koivumäki, 2019). The highly significant differences between the clusters support that the Sustainables, Green Digitals, and Digitals face more contingencies than the Laggards. From the *Pre-commitments* means, and in line with the presented theory, one can conclude that it is more critical for the Sustainables, Green Digitals, and Digitals clusters to integrate collaboration as a central part of their business (Agrawal et al., 2022; Frese et al., 2020; Mansoori & Lackéus, 2020; Smolka et al., 2018; Urbinati et al., 2021). Besides*, Pre-commitments* correlate with the other component of *Knowledge Acquisition* about gaining knowledge through customers and partners. The same arguments as presented in 5.1.2 Knowledge Acquisition also count for *Pre-commitments.*

The results on *Causation* have various implications. Firstly, the significantly low mean in the Laggards cluster signifies that they are not as concerned with planning for the future and analyzing new opportunities and markets. From this, one can interpret that not focusing on either sustainability or digitalization correlates with not planning ahead (Denicolai et al., 2021). As argued earlier, the results can indicate that the companies in the Laggards cluster are too comfortable with their position in the market to apply more causation. Secondly, the Sustainables, Green Digitals, and Digitals score very high on *Causation,* which is natural since they follow today's "megatrends." It makes sense that the Green Digitals have an even higher level of *Causation* because they show awareness and dedication to both trends. Another component of the *Causation* factor is planning marketing efforts. The difference in means of the *Causation factor* makes room for several hypotheses. For instance, the Sustainables and Green Digitals may score higher because they want to proclaim their sustainability efforts. The Laggards' low mean could suggest that they introduce few new products and services compared to the other clusters, which can underpin the theory about the Laggards cluster being too comfortable with their business model.

5.2.2 Distribution of Decision-making Logics Within Each Cluster

As seen in the results, the clusters have their patterns in the order of which decision-making logics they apply the most. For example, the Sustainables, Laggards, and Digitals' order of applied decision-making logics from highest to lowest is *Flexibility, Affordable Loss, Pre-commitments, Causation,* and *Experimentation*, while the order for the Green Digitals is *Flexibility, Causation, Affordable Loss, Pre-commitments,* and *Experimentation.*

It is important to keep in mind throughout the discussion that the findings in this thesis do not guarantee which decision-making logics positively or negatively influences sustainability and digitalization. They only show what the clusters prioritize. Companies may implement decision-making logics that harms their sustainability and digitalization performance without them knowing it. Therefore, the results can only give implications since one can assume that companies try to strategize in a way that promotes sustainability and digitalization. Moreover, different subconstruct and specific actions regarding the decision-making logics can have different impacts on the growth strategies.

For the Sustainables cluster, there is no significant difference in the application of effectuation versus causation. Therefore, it seems like the cluster follows Johnson & Hörisch's (2022) conclusion about the two being equally important for sustainability. Accordingly, Muhd Yusuf et al. (2018) who argued that causation is more important for sustainability performance, and Long et al. (2021) and Uzhegova & Torkkeli (2022), who argued that effectuation has a more positive influence on sustainability performance might have reached the wrong conclusions. Martín-Tapia et al. (2010) found that the flexibility logic is necessary to be environmentally proactive, which corresponds to the Sustainables' high mean on *Flexibility*. On the other hand, Long et al. (2021) insist that companies should steer clear of contingencies to promote sustainability. As argued in section 5.2.1, *Pre-commitments* and *Causation* are beneficial for sustainability performance, which is also in line with the results. Theory about sustainability and innovation suggests that the level of

Experimentation could be high for this cluster (Kuzma et al., 2020; Michelino et al., 2019). Nevertheless, the number might not be low, relatively speaking, if one accounts for the arguments from section 5.2.1 for why *Experimentation* is the decision-making logic with the lowest means into account. No specific literature on the connection between affordable loss and sustainability was found in the literature review. One can only assume that it is beneficial to apply this decision-making logic when innovating and experiencing uncertainties in the business environment.

As mentioned, there probably does not exist theory about effectuation and causation in companies with a combined focus on sustainability and digitalization. Even so, since sustainability is a component of the Green Digitals cluster, one can suspect that the same logics presented above also apply to this cluster. In conclusion, it is not surprising that the findings show that effectuation and causation are not mutually exclusive among the Green Digitals companies. The only significant differences between the Green Digitals and the Sustainables and Digitals clusters are seen in the *Experimentation* and *Causation* factors. These results follow the same logic as discussed above. Firstly, since the Green Digitals are more progressive in their business model, it is natural that they apply more experimentation. Secondly, the fact that they integrate two key growth strategies for competitive advantage in the future suggests that causation is a central decision-making logic for this cluster. Furthermore, it is noteworthy that the Green Digitals manage to apply such a high level of all decision-making logics without it having a negative effect on performance (Braun & Sieger, 2021; Johnson & Hörisch, 2022; Smolka et al., 2018; Vanderstraeten et al., 2020). Hence, it does not make them suffer the "attention allocation problem."

Regarding the Digitals cluster, the results reflect the findings by Mero et al. (2020), Baber et al. (2019), and Anagnou et al. (2019). They consider a balance between effectuation and causation natural and advantageous for digitalization performance. According to Denicolai et al. (2021) and Lacy & Rutqvist (2016), digitalized companies typically score high on Experimentation, Flexibility, and Pre-commitments. The results of this study support their findings. Similarly, one can hypothesize that the Green Digitals' high score on *Experimentation, Flexibility,* and *Pre-commitments* also stems from the fact that digitalization is integrated into the strategic focus of the Green Digitals cluster. The high level of *Causation* can be explained by how progressive digitalization is. As with all the other clusters, it is natural that the *Affordable Loss* factor is high in today's business context. A final interesting remark is how the Digitals and Sustainables have consistently similar means regarding *Knowledge Acquisition, Effectuation,* and *Causation.* In other words, the findings show that the two clusters require the same level of investment in applying decision-making logics, despite their differences in nature. This opens more discussions on the relationship between the two growth paths and their synergy. One obvious similarity that can lead to equal means is how both growth paths require more effectuation and causation than non-sustainable and non-digitalized companies.

The discussion about the Laggards' decision-making logic pattern overlaps with what has already been covered earlier in the discussion. Hence, some parts in this section will be presented briefly. As with the other clusters, little scientific literature exists about effectuation and causation for non-sustainable and non-digitalized companies to compare the results with. The Laggards'

Causation mean is very low and significantly lower than the combined *Effectuation* factor. Even though there is a larger difference between *Effectuation* and *Causation* for the Laggards, they are not deemed non-mutually exclusive. Their score on *Effectuation* may be higher because they too must adapt to a rapidly changing business environment. As pointed out earlier, the Laggards' low *Causation* score can be explained by how they seem not to be focusing on trends that will be key for competitive advantage in the future. As discussed, their low score on *Experimentation* can be explained by how sustainable and digitalized companies tend to be more innovative (Berger et al., 2021; Cai & Li, 2018; Kuzma et al., 2020; Michelino et al., 2019). Regarding *Pre-commitments*, they might not need to alter their value chains as much as what is necessary for sustainability- and digitalization-oriented companies. *Affordable Loss* can be equally important because of a scarcity of resources and a higher tempo of changes in the business environment. In terms of *Flexibility,* they share the same needs as the other clusters. The Laggards' on average small size could justify to some degree why they score lower on all the decision-making logics. Fewer employees can imply less awareness, capabilities, and resources to focus on strategy and investments in sustainability and digitalization. Another implication is that smaller companies can experience less pressure from stakeholders to perform in sustainability if they have a lower impact on the environment due to their size.

Several factors can contribute to the Laggards' lower score on the decision-making logics. Some companies might operate in an industry with little room for and need for innovation and where the potential to lower emissions is low. The digitalization potential also varies based on business operations and industry. Furthermore, if business as usual is economically viable, companies might not be incentivized to plan and analyze new opportunities and markets. Finally, the Laggards might experience less external pressure from stakeholders to innovate.

5.2.3 Does Effectuation and Causation Exclude Each Other?

Despite conflicts in literature and the tensions that can take place when companies try to implement both decision-making logics at the same time, the theory and results show that a combination is the most common for the entire sample (Chandler et al., 2011; Frese et al., 2020; Galkina et al., 2022; Perry et al., 2012; Sarasvathy, 2001). These findings implicate an end to an era in business development where causation historically has had a strong position (Chesbrough, 2010; Teece, 2010; Zott et al., 2011; Zott & Amit, 2010). The higher use of effectuation demonstrates the effect of an unpredictable business environment that calls for a more diverse strategy field (Göbel et al., 2021). The results also reflect today's trends with more experimental approaches in business development. Research and practice have proved that effectuation is more appropriate in certain phases and tasks, such as during ideation processes (Baber et al., 2019; Futterer et al., 2018; Mero et al., 2020; Reymen et al., 2015; Sarasvathy, 2001).

5.3 Implications

The findings in this thesis contribute to a hot and fragmented research field that, among other goals, seeks to support companies' performance while simultaneously contributing to solving environmental and societal problems. In order to do so, scholars need to understand the relationship between today's strategic "megatrends," sustainability, and digitalization, how they are affected by different strategies and decision-making logics, and how they affect firm performance (Ebrahim et al., 2014). The study demonstrates that sustainability and digitalization are at the top of the priority list of 83% of Norwegian manufacturing companies. The results can send a signal to the remaining 17% to follow in their footsteps. The following sections describe the findings' contribution and implications for scholars, managers, and policymakers.

5.3.1 Implications for Theory

How to carry out the transition to sustainable and digitalized businesses is a popular topic in research today. The findings challenge and nuance dominating views in literature and have several implications for scholars. The field of business model development is changing, and innovation is not exactly what it used to be. The Green Digitals, Sustainables, and Digitals' higher performance in *Knowledge Acquisition* and equal score in *Market Performance* justify criticizing prior research that claims that aiming for both sustainability and digitalization can yield poorer performance.

The attention allocation problem and double externality problem are challenged and need to be reassessed in light of the synergy between sustainability, digitalization, and modern business development. In addition, a new situation is emerging in which sustainability is becoming a "meta-driver" capable of facilitating other growth trajectories, such as digitalization or internationalization. As a result, the growth paths seem more intertwined and have more in common than assumed. For instance, it is striking how similar the Sustainables and Digitals score on every factor in this study. Scholars can help clarify the unsolved questions by monitoring the development and conducting longitudinal studies.

This thesis adds to the growing body of literature about effectuation and causation by relating them to sustainability and digitalization performance through a cluster analysis. The findings show that effectuation and causation are not mutually exclusive and that it is advantageous to implement a high amount of both. Hence, the results defend a critique of previous research that claims that one dominates over the other. Another takeaway for scholars is that the tensions between them are not strong enough that it is hampering to apply them both.

The findings imply that scholars must reevaluate effectuation and causation measures in the strategy and decision-making logic field because of their non-mutually exclusiveness for all the clusters. Their non-mutually exclusiveness makes them seem unsuitable to distinguish the clusters from each other based on their decision-making logic pattern. However, they can reveal some information about the level of innovativeness, ambition, and competitiveness of the different clusters.

5.3.2 Implications for Managers

This research may support and encourage managers to pursue growth through sustainability and digitalization by providing insight into enabling strategies, decision-making logic patterns, and their effect on firm performance. It is hard to argue against the fact that these trends will evolve and become increasingly tactical across sectors and borders. The findings and literature review can imply that sustainability- and digitalization-oriented companies will be in a stronger position to compete in the future.

Firstly, the findings justify investments in both sustainability and digitalization. There are plenty of excellent examples to draw on regarding a complementary relationship between sustainability and digital transformation. If it is challenging to invest in both due to resource or other restrictions, the findings about the Sustainables and Digitals show that it is still rewarding to proceed with one of them. Additionally, investors are showing more interest in companies with high sustainability and digitalization ambition and performance.

Secondly, companies should try to acquire relevant knowledge, capabilities, resources, and employees even if they are not feeling pressure from their stakeholders or by poorer performance. Furthermore, managers should be motivated to learn about modern business model innovation and key trends if they want to be a part of the Green Digitals, Sustainables, and Digitals clusters. Moreover, sustainability and digitalization should be anchored at a high level in the organization and employee training.

Finally, the findings about effectuation and causation imply that the Green Digitals' success comes from being progressive in following trends and applying an equal and high amount of effectuation and causation. The Green Digitals are strategically determined and goal-oriented to ensure future competitive advantage. Companies can be incentivized by the fact that it is obtainable to pursue both and still sustain firm performance. To move forward, business managers are encouraged to experiment with different decision-making logic patterns and pay attention to potential synergies and benefits of applying them for different tasks, processes, and phases.

5.3.3 Implications for Policymakers

Policymakers can use the research findings to guide policies and incentivize companies to adopt sustainability and digitalization. Regulatory barriers can hinder their adoption, and appropriate legislation is crucial for a successful transition. As economic viability is essential for companies (Santa-Maria et al., 2021; Tura et al., 2019), policymakers should focus on public funding, reducing risks and costs of investments in sustainability and digitalization (Trigkas et al., 2020). Because of the value of competitive advantage, it is crucial to ensure that competition laws do not punish companies but rather incentivize them. Gusmerotti et al. (2019) discovered that current circular economy legislation fails to engage and create pressure that encourages practitioners to adopt circular principles. Policymakers must tailor the right combination of demand and control, market-based instruments, and volunteer initiatives (Gusmerotti et al., 2019). Furthermore, policy-making authorities should cooperate across borders and with organizations, companies, and academia. Finally, the importance of international law cannot be overstated since environmental concerns transcend national borders (Meskic et al., 2022). International environmental legislation should promote the transfer of existing clean technologies and analyze the sustainability of emerging technologies.

5.4 Limitations

In addition to the limitations described in the methodology chapter, there are more limitations to elaborate on. First, limitations related to bi-directional relationships are typical when conducting variance analysis. It is impossible to guarantee the direction of the relationship between the analyzed factors. To illustrate, one cannot be certain if high performance in sustainability results in more knowledge acquirement or whether acquiring more knowledge leads to higher sustainability performance. Therefore, the cause and effect should be studied in more detail in future research. This study can also be supplied by qualitative research to make progress in understanding the correlation.

With every scientific study follows the choice of pursuing depth or breadth in the data collection. This study's application of cross-sectional data generates further limitations. This method gives a snapshot of the company's situation when the respondent answers the questionnaire. The contribution can be improved by carrying out a follow-up study with the same sample to add much-needed longitudinal studies (Eccles et al., 2014). For instance, the findings in this thesis are probably affected by Covid-19's influence on an already uncertain business environment. The pandemic forced companies worldwide to digitalize and shed light on the urgency of solving the environmental crisis (Denicolai et al., 2021).

Furthermore, the survey format gives results affected by the respondent's biases and knowledge base. The respondent can be affected by the social desirability bias and report higher scores on sustainability to come across as more environmentally friendly (Windolph et al., 2014). The opposite can also occur. A respondent can underestimate their level of sustainability, digitalization, and firm performance. Additionally, the survey was answered by a single respondent from each company. Also, there might be similarities between the companies that choose to answer the survey. One can hypothesize that they are more concerned with sustainability and innovation.

The external validity and generalizability are affected by the sample's context. First, the sample only consists of Norwegian manufacturers. Norway is characterized by strict regulations regarding environmental and social responsibility and ideal manufacturing conditions with cheaper and renewable energy. More companies from Norway have the resources and capabilities to prioritize investments in sustainability and digitalization compared to companies from less developed countries. Finally, the sample is comprised of several industries. Different industries have different cultures, innovation levels, and sustainability and digitalization potential for a transformation to sustainability and digitalization and regulations that affect the collected data.

5.5 Recommendations for Future Research

This study opens up many possible future research paths. First, it would be interesting to see tests of similar hypotheses as in this thesis but by studying different aspects and specific activities in sustainability and digitalization because of the concepts' impreciseness. Second, to provide more research using the same data set to provide a bigger picture. For instance, scholars can examine more characteristics of the clusters, such as the level of uncertainty in the markets they operate in, their level of innovation, and which industries dominate in the different clusters. Third, there is a potential for many future studies within the effectuation and causation field in relation to innovation, sustainability, and digitalization. Scholars can seek to develop frameworks on the effect of the decision-making logics on sustainability and digitalization. The decision-making logics can be divided into specific processes and tasks, and then one can study their effect on sustainability and digitalization. Further, one can study in which phases and tasks the different decision-making logics are involved and their level of synergy. Finally, scholars can investigate the decision-making logic patterns in young versus older companies and small versus larger companies since most literature about effectuation and causation focuses on entrepreneurship and start-ups. Moreover, the dynamic between the decision-making logics varies over the lifetime of companies.

6 Conclusion

The environmental crisis is posing an extraordinary threat to the globe. Advancing in sustainable development and digitalization represent some of the most significant challenges in modern society and are top priorities among business managers. The synergy between sustainability and digitalization plays a far more important role than previously recognized in an already fragmented research field. The purpose of this research was twofold. First, to determine the firm performance of sustainable and digitalized companies. Second, to provide further insight into how businesses can increase their sustainability and digitalization performance by identifying enabling decision-making logic patterns.

The issues were addressed by using survey data from 461 Norwegian manufacturing companies, clustering the respondents into four groups based on their sustainability and digitalization performance, and conducting an analysis of variance (ANOVA) to detect the differences among the groups. The study has three main findings. Firstly, there is no significant difference between the clusters on *Market Performance,* but the Green Digitals, Sustainables, and Digitals outperform the Laggards on *Knowledge Acquisition.* The findings thus challenge previous research claiming that pursuing both growth paths can yield poorer performance. Furthermore, the difference in *Knowledge Acquisition* implies that businesses need to prioritize new knowledge if they want to stay relevant in the sustainable and digital transition. As of now, the sustainability- and digitalization-oriented companies prioritize learning through stakeholders slightly more than exploring new business models. Accordingly, the results support the already proclaimed advice of strengthening key stakeholder relationships. Moreover, the findings imply that companies need more relevant business cases and frameworks as guidelines to explore alternative business models. The implications are clear. Companies can confidently increase their ambition and strive for both these valuable growth paths simultaneously.

The second central finding is that the decision-making logics, effectuation and causation, are non-mutually exclusive and that the clusters apply an even mix of both on average. This implies that the traditional decision-making logic patterns with a dominance of causation has shifted towards a more diverse approach. The shift can reflect a rapidly changing business environment and how the current business model innovation research field is outdated. Their non-mutually exclusiveness suggests that scholars should reevaluate the measures because they currently fail to sufficiently distinguish the clusters based on decision-making logic patterns. A third principal finding is that the Green Digitals, Sustainables, and Digitals seem more strategically assertive and goal-oriented by applying a higher level of all the decision-making logics compared to the Laggards. Consequently, it is recommended to be ambitious in implementing effectuation and causation to thrive in both sustainability and digitalization. Further research is needed to understand the synergy between sustainability and digitalization, and between effectuation and causation. Researchers should also conduct longitudinal studies and monitor sustainability and digitalization’s effect on firm performance as the impact naturally evolves with time.

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Appendix A Questionnaire Items

No.	Item
	Sustainability Performance
1	Sustainability is strategically anchored at management and board level
2	Sustainability is a driver for the development of new products and services
3	Sustainability is an inspiration for continuous improvement of our production (either products or services)
4	Sustainability is an integral part of our business strategy
5	Sustainability is a fundamental value for our company
6	We clearly profile the company as sustainable
	Digitalization Performance
7	The company's sales and marketing activities largely controlled by digital tools
8	The company's value creation and business model are mainly based on digital solutions
9	We have used digital technology to adapt or improve existing products or services
10	We have developed new products or services where digital technology is central
11	We have used digital solutions to reach new customer groups or markets
	Market Performance
12	Satisfaction with export activities in terms of achieved market share
13	Satisfaction with export activities in terms of sales growth
14	Satisfaction with export activities in terms of sales growth compared to competitors
15	Satisfaction with export activities in terms of profitability

16	Satisfaction with the overall results of the export activities in recent years
	Knowledge Acquisition
17	Satisfaction with export activities in terms of gaining new knowledge through contact with customers and partners
18	Satisfaction with export activities in terms of gaining new knowledge about alternative business models
	Experimentation
19	We experiment with different solutions for our products/services
20	When we develop new products and services we often end up with different solutions than originally planned
21	We try a number of different approaches until we find a business model that works
	Flexibility
22	In business development, we use procedures that ensure flexibility and adaptability
23	We adapt business development to the resources that are available to us
24	We develop the business as opportunities emerge
	Affordable Loss
25	In business development processes, we are careful not to commit more resources than we could afford to lose
26	In business development processes, we are careful not to risk more resources than we were willing to lose with our initial idea
	Causation
27	We develop long run business strategies and plans
28	We organize and implement control processes and monitoring systems to make sure we meet our objectives
29	We plan production and marketing efforts in detail in advance before we enter new markets
	Pre-commitments
30	We involve customers, suppliers, and other stakeholders in business development processes to reduce the amount of uncertainty.

31	We often approach customers and suppliers to evaluate new business opportunities
32	Strategic decisions are coordinated with customers and suppliers

- The questions 1 to 11 and 19 to 32 were answered on a 7-point Likert scale from 1 “to a small degree” to 7 “to a very large extent.”
- The questions 12 to 18 were answered on a 7-point Likert scale from 1 “very dissatisfied” to 7 “very satisfied.”

Appendix B Tests of Normality

No.	Item	Mean	Skewness	S.E.	Kurtosis	S.E.
	Sustainability Performance	4.6803	-0,492	0,118	-0,361	0,235
1	Sustainability is strategically anchored at management and board level	5,14	-0,741	0,118	-0,016	0,235
2	Sustainability is a driver for the development of new products and services	4,64	-0,487	0,118	-0,586	0,235
3	Sustainability is an inspiration for continuous improvement of our production (either products or services)	4.82	-0,681	0,118	-0,269	0,235
4	Sustainability is an integral part of our business strategy	4,72	-0,511	0,118	-0,562	0,235
5	Sustainability is a fundamental value for our company	4,62	-0,483	0,118	-0,694	0,235
6	We clearly profile the company as sustainable	4,08	-0,117	0,118	-0,993	0,235
	Digitalization Performance	3,6216	-0,173	0,118	-0,548	0,236
7	The company's sales and marketing activities largely controlled by digital tools	4,04	-0,251	0,118	-0,926	0,236
8	The company's value creation and business model are mainly based on digital solutions	3,09	0,306	0,118	-0,949	0,236
9	We have used digital technology to adapt or improve existing products or services	3,89	-0,269	0,118	-0,887	0,236
10	We have developed new products or services where digital technology is central	3,25	0,300	0,118	-1,130	0,236
11	We have used digital solutions to reach new customer groups or markets	3,83	-0,081	0,118	-1,082	0,236
	Market Performance	4,4667	0,189	0,180	-0,187	0,357
12	Satisfaction with export activities in terms of achieved market share	4,25	0,278	0,177	-0,131	0,352

13	Satisfaction with export activities in terms of sales growth	4,44	0,015	0,177	-0,234	0,352
14	Satisfaction with export activities in terms of sales growth compared to competitors	4,51	0,428	0,175	0,141	0,349
15	Satisfaction with export activities in terms of profitability	4,39	-0,002	0,177	-0,571	0,325
16	Satisfaction with the overall results of the export activities in recent years	4,56	-0,191	0,177	-0,389	0,352
	Knowledge Acquisition	4,1953	-0,054	0,175	0,503	0,349
17	Satisfaction with export activities in terms of gaining new knowledge through contact with customers and partners	4,45	-0,050	0,175	-0,091	0,349
18	Satisfaction with export activities in terms of gaining new knowledge about alternative business models	3,94	-0,135	0,175	0,352	0,348
	Experimentation	3,6154	-0,181	0,119	-0,507	0,237
19	We experiment with different solutions for our products/services	4,20	-0,308	0,118	-0,395	0,235
20	When we develop new products and services we often end up with different solutions than originally planned	3,39	0,035	0,118	-0,757	0,236
21	We try a number of different approaches until we find a business model that works	3,24	0,065	0,118	-0,872	0,236
	Flexibility	5,17	-0,313	0,119	0,134	0,238
22	In business development, we use procedures that ensure flexibility and adaptability	4,87	-0,693	0,118	0,756	0,236
23	We adapt business development to the resources that are available to us	5,26	-0,981	0,119	1,262	0,237
24	We develop the business as opportunities emerge	5,39	-1,090	0,118	1,769	0,236

	Affordable Loss	4,6738	-0,565	0,119	-0,060	0,238
25	In business development processes, we are careful not to commit more resources than we could afford to lose	4,75	-0,584	0,119	-0,276	0,237
26	In business development processes, we are careful not to risk more resources than we were willing to lose with our initial idea	4,60	-0,436	0,119	-0,221	0,237
	Causation	4,2454	-0,350	0,119	-0,439	0,237
27	We develop long run business strategies and plans	4,41	-0,433	0,118	-0,612	0,236
28	We organize and implement control processes and monitoring systems to make sure we meet our objectives	4,24	-0,319	0,118	-0,571	0,236
29	We plan production and marketing efforts in detail in advance before we enter new markets	4,06	-0,206	0,118	-0,646	0,236
	Pre-commitments	4,3829	-0,394	0,119	-0,188	0,237
30	We involve customers, suppliers, and other stakeholders in ("business development processes"?) to reduce the amount of uncertainty.	4,86	-0,683	0,118	0,009	0,235
31	We often approach customers and suppliers to evaluate new business opportunities	4,35	-0,385	0,118	-0,630	0,236
32	Strategic decisions are coordinated with customers and suppliers	3,91	-0,239	0,118	-0,707	0,235

Appendix C Factor Analysis Results

No.	Item	Loadings	Cronbach's Alpha
	Sustainability Performance		0,943
1	Sustainability is strategically anchored at management and board level	0,831	
2	Sustainability is a driver for the development of new products and services	0,849	
3	Sustainability is an inspiration for continuous improvement of our production (either products or services)	0,821	
4	Sustainability is an integral part of our business strategy	0,913	
5	Sustainability is a fundamental value for our company	0,956	
6	We clearly profile the company as sustainable	0,857	
	Digitalization Performance		0,841
7	The company's sales and marketing activities largely controlled by digital tools	0,709	
8	The company's value creation and business model are mainly based on digital solutions	0,857	
9	We have used digital technology to adapt or improve existing products or services	0,805	
10	We have developed new products or services where digital technology is central	0,705	
11	We have used digital solutions to reach new customer groups or markets	0,727	
	Market Performance		0,862
12	Satisfaction with export activities in terms of achieved market share	0,905	
13	Satisfaction with export activities in terms of sales growth	0,908	
14	Satisfaction with export activities in terms of sales growth compared to competitors	0,841	
15	Satisfaction with export activities in terms of profitability	0,489	

16	Satisfaction with the overall results of the export activities in recent years	0,793	
	Knowledge Acquisition		0.526
17	Satisfaction with export activities in terms of gaining new knowledge through contact with customers and partners	0,551	
18	Satisfaction with export activities in terms of gaining new knowledge about alternative business models	0,933	
	Experimentation		0,800
19	We experiment with different solutions for our products/services	-0,770	
20	When we develop new products and services we often end up with different solutions than originally planned	-0,864	
21	We try a number of different approaches until we find a business model that works	-0,722	
	Flexibility		0,825
22	In business development, we use procedures that ensure flexibility and adaptability	-0,675	
23	We adapt business development to the resources that are available to us	-0,835	
24	We develop the business as opportunities emerge	-0,870	
	Affordable Loss		0,909
25	In business development processes, we are careful not to commit more resources than we could afford to lose	0,933	
26	In business development processes, we are careful not to risk more resources than we were willing to lose with our initial idea	0,951	
	Causation		0,855
27	We develop long run business strategies and plans	-0,793	

28	We organize and implement control processes and monitoring systems to make sure we meet our objectives	-0,886	
29	We plan production and marketing efforts in detail in advance before we enter new markets	-0,856	
	Pre-commitments		0,825
30	We involve customers, suppliers, and other stakeholders in business development processes to reduce the amount of uncertainty.	-0,825	
31	We often approach customers and suppliers to evaluate new business opportunities	-0,750	
32	Strategic decisions are coordinated with customers and suppliers	-0,898	

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