The Dual-edged Sword: Strategic Dynamics of Digital and Sustainable practices in Dutch cleantech startups

An exploratory qualitative interview study on the synergies and trade-offs between digital and sustainable practices, and their dynamics within Dutch cleantech startups

MSc Complex Systems Engineering and Management

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An exploratory qualitative interview study on the synergies and trade-offs between digital and sustainable practices and their dynamics within Dutch cleantech startups

By

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Acknowledgements

Dear reader,

Last summer, during my final year of the master's programme in Complex Systems Engineering and Management, I began to think about potential graduation topics. During my internship at ABN AMRO Bank, I learned much about sustainable finance and how regulations increasingly interfered with technical challenges. My growing interest in sustainable practices, combined with my interests in entrepreneurship, artificial intelligence, and economics, forms the basis of my research topic. It began with ideas about the utility of carbon credit taxes within banks, which evolved into the complex topic I researched over the last six months. I am happy to share my Delft University of Technology graduation project, ***"The Dual-edged Sword: Strategic Dynamics of Digital and Sustainable Practices in Dutch Cleantech Startups."***

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I hope you enjoy reading my master's thesis report.

A. van Grotenhuis,
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Abstract

The 21st century has seen a significant rise in clean technologies driven by urgent environmental challenges alongside transformative digital innovations shaping global interactions. Despite these significant events, cleantech startups face substantial challenges and missed opportunities in effectively integrating digital technologies into their sustainable business strategies. To fully harness the potential of digital innovations, addressing the trade-offs and synergies cleantech startups encountered between digital and sustainable strategic practices is crucial, as is understanding the underlying causes of their strategic choices. Despite the rising interest of academia in sustainable and digital entrepreneurship, academic research fails to identify these trade-offs and synergies within cleantech startups.

As a result, the main objective of this research is to explore and identify trade-offs and synergies that arise when entrepreneurs follow a sustainable and digital strategy simultaneously within cleantech startups and how they are influenced by their stakeholders, resources, and external environment. By examining the influences of resources, stakeholders, and external pressures, the research seeks to understand entrepreneurs' strategic decision-making process and the implementation of digital technologies within a complex environment. The main research question is defined as follows:

"How do Dutch cleantech startups navigate the synergies and trade-offs between digital and sustainable practices, and what are the underlying dynamics shaping these interactions?"

A systematic literature review mapped the existing academic perspectives on the strategic practices of Dutch cleantech startups, revealing the research gaps. The study employs the resource-based view theory and is complemented by the institutional theory as the foundation of the research. The research uses the concepts of digital and sustainability strategic orientation to explain how their practices are influenced and define the resources and external incentives as moderators. Semi-structured interviews were conducted with nine Dutch cleantech startups in various industries, such as agriculture, shipping and renewable energies. A qualitative content analysis was conducted to explore the trade-offs and synergies, resources and incentives, followed by a stakeholders analysis, interview comparison and relational analysis to research the underlying dynamics.

The findings show that the startups navigate complex trade-offs between sustainable and digital practices, balancing investment in digital tools for profitability and scalability with commitments to sustainable R&D. Pressures from financial investors prioritise digital scaling and profitability over sustainable impact. Startups prioritise external sustainability impacts over internal sustainable practices and technical talent acquisition over workforce equality. Synergies emerge from leveraging technologies like AI, machine learning, dashboards, and blockchain to enhance product quality, validation, credibility, operational efficiency, and regulatory compliance, supported by collaborations with universities and incubators. Stricter sustainable regulations secure funding and stimulate market demand, facilitating the integration of digital and sustainable strategies. Moderating dynamics are financial resources, influencing the balance between profit-driven practices and sustainable investments. Technical team knowledge enhances digital capabilities, and social networks with incubators and R&D institutions foster collaboration synergies despite challenges in data exchange due to limited digital infrastructure. Normative pressures from customers' expectations and coercive pressures from investors and regulators further shape strategic priorities, emphasising compliance with technical standards.

Further research is recommended to evaluate the impact of various digital technologies in enhancing synergies and trade-offs. Furthermore, the direct relationship between resources and external incentives warrants further exploration to understand their influence on strategic practices. Additionally, addressing investor influence, including distinctions between impact investors and traditional venture capitalists, could be helpful. Broader studies with diverse samples from different regions and countries and longitudinal studies are recommended to explore the long-term effects of digital and sustainable orientations and practices.

KEYWORDS: DUTCH: Cleantech startups, strategic practices, digital orientation, sustainability orientation, trade-offs, synergies, resource-based view, institutional theory, qualitative content analysis,

Abbreviations

AI	Artificial Intelligence
Cleantech	Clean Technology
DO	Digital Orientation
EO	Entrepreneurial Orientation
ESO	Environmental Sustainability Orientation
IoT	Internet of Things
ML	Machine Learning
MQ	Main Question
QCA	Qualitative Content Analysis
R&D	Research and Development
RBV	Resource-based view
SDG	Sustainable Development Goal
SLR	Systematic Literature Review
SO	Sustainability Orientation
SQ	Sub Question
SSO	Social Sustainability Orientation

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1. Introduction

1.1 Research background and problem statement

The 21st century is marked by two critical events that are shaping the modern world. First, climate change is an undeniable and urgent global challenge that poses a threat to ecosystems, human health, and the economy (United Nations, 2021). Digitalisation created significant opportunities and reshaped global interactions, revolutionising innovation and communication in the modern world (Verhoef et al., 2021). Simultaneously, integrating digital technologies into sustainable businesses has revealed various challenges. This research delves deeper into the world of clean technology, examining how businesses develop these technologies, the barriers and opportunities presented by digital innovations, and how the environment influences businesses shaping their strategic directions towards a better future.

1.1.1 Clean energy transition from a socio-technical perspective

The growing recognition of global warming has raised a societal demand for sustainable solutions, raising the demand for developing clean technologies. While the world is focusing on the technology itself, it is essential to note that successful implementation transcends firm-level practices and involves a complex interplay between technological systems, societal importance, and multi-level governance (Cooke, 2010).

The literature on digital entrepreneurship states that digital tools can enhance operations and overall productivity and efficiency of businesses (Šimberová et al., 2022). However, these technologies involve complex engineering, technical skills and integration with existing infrastructure and institutional layers (Cooke, 2010). For example, implementing smart city solutions for environmental sustainability requires navigating social acceptance of IoT sensors, economic feasibility for municipality budgets, ethical data privacy concerns, and collaboration across governmental institutions. By transitioning to cleaner energy sources and more efficient systems, society can combat the adverse effects of climate change and strive for a more sustainable and equitable future, aligning with the goals of the Paris Agreement and UN SDGs (Gosens et al., 2013). Digital technologies can help these innovations assess the SDGs more effectively by optimising energy efficiencies and community building. However, they can also give rise to challenges related to social equality, workforce discrimination, and rising e-waste, which can undermine societal progress (Laitinen, 2015).

Regulators play a crucial role in promoting innovation of environmentally friendly technologies, such as innovation subsidies and carbon pricing policies. Policies can provide financial incentives and economic frameworks that encourage developing and adopting green technologies (Laitinen, 2015). Therefore, from a socio-technical perspective, integrating novel technologies involves more than technical advancements, with necessary changes in regulatory, strategic behaviour and stakeholder management.

Overall, This means that technical, economic, institutional and social dimensions must be considered to ensure that clean technologies are accepted and used responsibly within society (Laitinen, 2015). This holistic view helps to identify and address the various challenges and opportunities that arise at different levels of governance and within society. (Cooke, 2010).

1.1.2 Rise of cleantech in the Netherlands

Clean technologies, which originated in the late 1990s and early 2000s, encompass various environmentally and socially conscious practices and technologies (Fernando, 2022). Growing sustainable awareness, increasing regulatory support, and technological advancement have stimulated the emergence and growth of businesses, not only adding economic value but also prioritising their environmental impact. (Leonard, 2019). The cleantech industry encompasses a wide range of products, including renewable energies, water management systems, and green transportation, and is expected to cover more industries in the future.

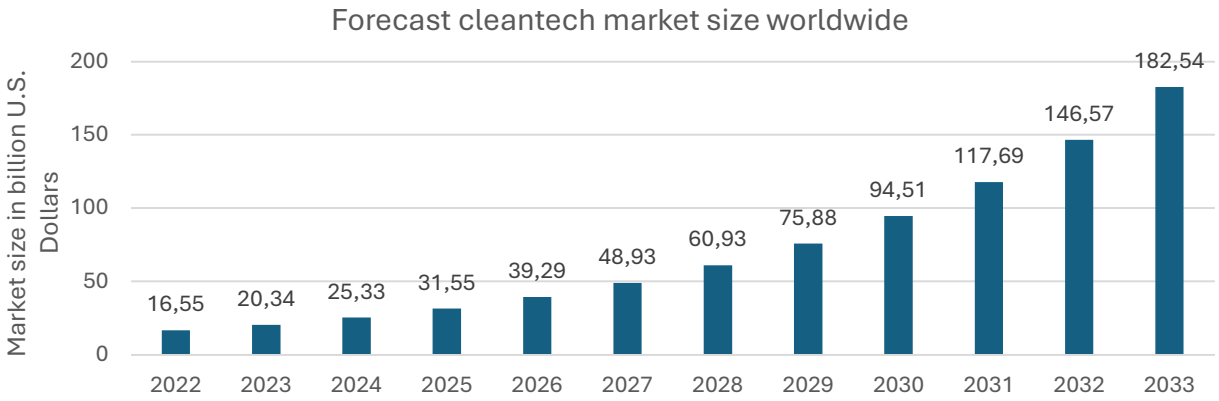

Figure 1: Worldwide forecast cleantech market from Statista (2023)

After a stagnation in global cleantech investment between 2003 and 2011, the technologies regained investment popularity in 2018 (Leonard, 2019). Since then, there has been a record level of investment in clean technologies, with a global target of 70.1 billion US dollars by 2022 (Statista, 2023; HolonIQ, 2023). The global market size outlook looks even more promising, with a 10x increase from 2022 to 2033. The increased awareness of climate change and the growing urgency to provide solutions to mitigate climate change are driving this growth (Statista, 2023).

In 2022, the Netherlands was ranked sixth in the number of startups and scaleups, with one of the best ecosystems, governmental support, and incubator support (Tiseo, 2023). Despite this ranking, the Netherlands is still facing some serious challenges. The startup-to-scaleup ratio in the Netherlands is significantly lower than in other countries in the EU, and a survey in 2022 revealed that Dutch entrepreneurs encounter obstacles in diverse domains such as physical infrastructure, finance, regulations, social and cultural norms, and market dynamics (McKinsey, 2023; Thomas, 2023). In addition, cleantech startups face challenges in finding a balance between their primary goal of sustainability and the need for profitability, struggling to attract investors who prioritise sustainability over profitability. With increasing consumer expectations and regulatory and investor pressures, Dutch cleantech startups face even more challenges that must be tackled. (Invest-NL, 2023; Little, 2023.; PWC, 2022).

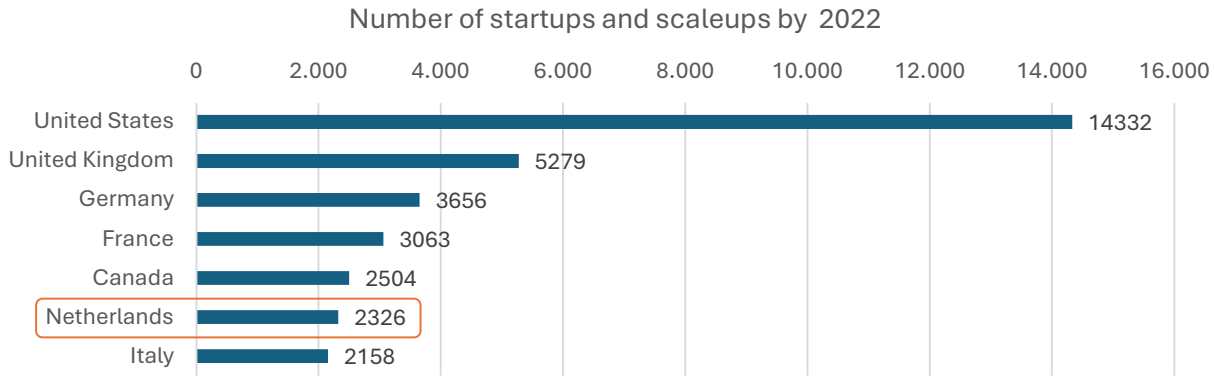

Figure 2: Number of startups by 2022 in western countries from Statista (2023)

1.1.3 Opportunities and concerns regarding digitalisation and sustainable practices

Cleantech startups use digital practices to improve their sustainability, such as data intelligence, cost reduction and supply chain optimisation (Stefanovic et al., 2021; Lichtenthaler, 2021). For example, sensors, big data analytics, blockchain, and artificial intelligence may help optimise resources, customer interaction, more efficient resource tracking, and community building. Digitisation can improve knowledge management and information exchange, reducing information asymmetry within and outside the organisation. This, in turn, could boost employee and stakeholder engagement, enhance the company's transparency and raise awareness of its digital and sustainable practices (Detecon, 2023).

Despite the benefits digitalisation can bring to sustainable practices, there is a growing concern about using digital practices for sustainability goals. Increased digital practices may increase e-waste and carbon emissions due to increased electricity consumption (Andrea et al., 2023). Poor digital implementation can have negative economic consequences, such as misallocation of resources and high R&D costs. The acceleration of digital practices can furthermore create a digital social divide, leaving employees without the necessary skills and resulting in technological unemployment (Lichtenthaler, 2021). Digital practices require many resources and can be risky, which smaller companies cannot afford, resulting in a gap between small and large businesses. Consequentially, scaling up digital practices without caution can lead to data abuse, raising privacy and security concerns (Costa Melo et al., 2023; Li et al., 2023; Lichtenthaler, 2021; Saáry et al., 2022; Stefanovic et al., 2021).

Combining sustainable and digital practices can be considered a dual-edged sword. They leverage each other to create economic, social, technological, and sustainable synergies. However, if not carefully managed, the implementation can have serious social, environmental, and financial consequences for the startups, such as high sunk costs and privacy breaches (Lichtenthaler, 2021). Investigating how businesses make strategic decisions and what motivates entrepreneurs to adopt sustainable and digital practices is critical to tackling the risks and utilising the opportunities.

1.1.4 Concepts and use of strategic orientations

Organisations strive to improve their performances by implementing unique strategies that can create a competitive advantage. A business strategy can have different definitions and approaches but often refers to the initiatives a company pursues to create value for the organisation and its stakeholders. It refers to a plan, approach, or set of actions to achieve specific goals set by the company, ultimately gaining a competitive advantage (Boyles, 2022). This strategy could integrate economic, environmental, and social aspects into the company's goals and values.

Applying a strategy is crucial for a firm to use its resources and capabilities as effectively as possible and to comply with the internal and external environments. To achieve these goals, firms must develop a strategic orientation. This orientation can be seen as their guide towards a specific strategic direction, whether entrepreneurial, digital, or sustainable (Long, 2020; Obeidat, 2016). Firms can achieve their goals by being proactive, risk-taking, and curious about specific innovations. Despite the growing academic interest in different types of strategic orientations, no empirical research has been done on Dutch cleantech startups and their strategic orientations. Additionally, researchers suggest future studies should explore the qualitative relationships of sustainable and digital orientations and practices (Khizar et al., 2021, 2022, 2023; Ardito et al., 2021).

Researching multiple strategic orientations is especially crucial for cleantech startups, as this helps them navigate the unique challenges (increase in E-waste, energy consumption, privacy issues, technological unemployment and social divide) and opportunities (optimising operational and product efficiency, regulatory compliance and community building. A good understanding of strategic orientations, dynamics, and relationships can help them create a competitive advantage, utilise the capabilities of their scarce resources, and navigate through the different stakeholders' expectations.

1.1.5 Problem Statement

Despite the growing interest in clean technologies, startups continue navigating a complex landscape of challenges and missed opportunities. Moreover, while digitalisation presents itself as an enabler for enhancing sustainable practices by increasing the efficiency and quality of their products, it also introduces concerns related to environmental sustainability, economic viability, and social equity (Lichtenthaler, 2021). Therefore, the interplay of digital and sustainable practices needs further research. (Ardito et al., 2021). There is a lack of understanding of how different strategic orientations formed within cleantech startups and how these relate to potential trade-offs and synergies the startups make between digital and sustainable practices. A socio-technical perspective is essential, as integrating clean technologies is not only about the technology itself but encompasses external influences and a change in stakeholders' perspectives. The research moreover focuses on how external incentives and available resources affect the combination of digital and sustainability goals to find synergies, balance trade-offs, and make strategic decisions that lead to competitive advantage and long-term value creation.

1.2 Research Gaps

As a result of the literature review conducted, several research gaps have been identified that must be addressed. These are found as follows:

1. ***Lack of knowledge if there are any trade-offs and synergies that arise when a cleantech startup enhances a dual focus on sustainable and digital practices***
   Much research has been done on using a single orientation and its effect on a company's business performance. However, the interaction between different orientations within startups with sustainable and digital goals has not yet been examined. As Khizar et al. (2021) point out, there is a gap in the literature that studies the coherence of different orientations. Some studies have been done on digital solutions and how they can leverage or hinder sustainability goals and vice versa. However, these are the effects of entrepreneurs' decision-making processes, not the practices themselves. Furthermore, These findings focus on big firms, which eventually have more resources to use. Startups face resource shortages, allocation and attention problems, and pressure from external stakeholders. It is still unclear how and why Dutch cleantech startups make strategic decisions and prioritise digital practices over sustainable practices or vice versa. Exploring these trade-offs and synergies remains crucial for strategic planning and adaptive management in this complex, dynamic environment.

2. ***Lack of qualitative research on the representation of sustainability and digital orientation within Dutch cleantech startups.***
   Much research has been done on the relationship between a specific kind of strategic orientation, mainly entrepreneurial-, market-, and learning orientation, and how these orientations influence business performance. As Khizar et al. (2021) state, over 90% of all studies focused on a sustainability orientation are based on quantitative data and research the statistical relationship between different dimensions of the orientation and business performances. There is a general lack of qualitative strategic orientation research where the intrinsic drivers of a specific orientation are studied. Bridging the gap between what drives entrepreneurs to have a digital and sustainability orientation is crucial to understanding how these orientations are formed and how these drivers influence their strategic choices (Khizar et al., 2021).

3. ***Lack of understanding of how Dutch cleantech startups allocate their resources in order to translate their strategic orientation into actual practices***
   As Barney (1991) states, resources are essential for creating a competitive advantage. Literature often sees strategic orientation as a resource and seeks a statistical correlation between business performance and orientation (Khizar et al. 2021). While the literature often speaks of resource allocation problems and scarcity within startups, no research has been found that explains the relationship between available resources and the relationship between strategic orientation and their translation into strategic practices (Khizar et al., 2021). Furthermore, only one other study has identified resources within digital cleantech startups (Kurowski, 2024). However, this research is limited to only

identifying their resources and not how they relate to companies' strategic orientations and practices. Therefore, the research builds on the recommendations of Kurowski (2024), emphasising the need for research into the relationship between digitalisation, sustainability, and resource allocation. At last, little is known about the strategic orientations and available resources of Dutch startups and their ecosystem. Identifying these resources helps to integrate their technology into the market, effectively allocate their resources, and see where resources are missing to create certain strategic practices (Clough et al., 2018). It also presents a novel and exciting opportunity for further research.

4. ***Lack of understanding of how external incentives influence digital and sustainability orientations***

   Despite the popularity of the institutional theory developed by DiMaggio and Powell (1983), no literature was found on the effects of institutional pressures on the strategic orientations of cleantech startups. Furthermore, most institutional theory research is quantitative, analysing the statistical correlation between strategic practices and pressures (Cojoianu et al., 2020). No qualitative research has been found seeking to explore the influence of external incentives on digital and sustainability orientations and how regulations and pressures can enhance or hinder the execution of digital and sustainable strategic practices. Understanding this is of great importance for policymakers and entrepreneurs. A misunderstanding of the incentives can lead to inadequate policy utilisation, misalignment of strategy with incentives, and wrong policies that create innovation barriers and slow down the sustainable impact of startups (Cojoianu et al., 2020; Liao, 2018; Zhu et al., 2023). The potential risks of such misunderstandings underline the urgency and importance of this research.

5. ***Lack of understanding of how stakeholders enable resources and shape the external environment for Dutch cleantech startups***

   Finally, the literature emphasises the importance of external stakeholders. Startups depend on them to exchange resources with them and feel external pressures towards certain behaviours (Chatburn, 2022). Managing these stakeholders could be challenging, especially within green entrepreneurship, as some stakeholders have different goals, norms and values. Marcon and Ribeiro (2021) analysed how different actors are enabling resources. Still, no research has been found on how these stakeholders are positioned when comparing sustainable and digital practices and how they exert pressure towards these practices. Mapping these stakeholders is needed to gain new insights into how startups can more efficiently prioritise their stakeholders for better resource leverage and pressure management.

1.3 Research objectives

As shown in the literature review, several research gaps have been identified, which are essential for successfully implementing digital technologies into sustainable businesses. Based on the knowledge gaps, **The main objective of this research is to explore the trade-offs and synergies that arise when cleantech entrepreneurs follow a sustainable and digital strategy simultaneously within cleantech startups and how they are influenced by their stakeholders, resources, and external incentives.** The following sub-objectives are defined in order to reach the main objective during the research:

1. To explore the different trade-offs and synergies that arise when using a combined digital and sustainability strategy practices
2. To Identify the digital and sustainability orientations of cleantech startups and how these influence their practices towards digital and sustainable strategic practices
3. To identify the different resources that Dutch cleantech startups have and how they allocate them to enhance their strategic practices
4. To identify the different external incentives that Dutch cleantech startups experience and analyse how this influences their strategic practices
5. To explore how stakeholders act towards digital and sustainable practices and their relationship with the availability of resources and the presence of external incentives

1.4 Research questions

To reach the different objectives, a main research question has been set up to fulfil the main objective of the research and fill up the identified research gaps. The main research question is stated as follows:

"How do Dutch cleantech startups navigate the synergies and trade-offs between digital and sustainable practices, and what are the underlying dynamics shaping these interactions?"

In order to answer the main research question fully and to ensure that the objectives are met, several sub-questions have been set up that are answered as the research progresses:

Sub question to objective 1 (SQ1): *"What are the trade-offs and synergies that cleantech startups face between digital and sustainable practices?"*

Sub question to objective 2 (SQ2): *"What impact does a sustainability and digital orientation have on sustainable and digital strategic practices of Dutch cleantech startups?"*

Sub question to objective 3 (SQ3): *"How do the resources available to Dutch cleantech startups influence the relationship between strategic orientation and their practices?"*

Sub question to objective 4 (SQ4): *"How do external incentives for sustainability and digital innovation shape the strategic practices of cleantech startups in the Netherlands?"*

Sub question to objective 5 (SQ5): *"How do stakeholder actions towards digital and sustainable practices in cleantech startups relate to the availability of resources and presence of external incentives?"*

1.5 Relevance of research

1.5.1 Societal relevance

Identifying potential trade-offs and synergies and their underlying dynamics can help policymakers steer their policy-making and support mechanisms, encouraging startups to leverage their digital technologies and tackle barriers, resulting in increasing sustainable and social impact. The research findings can ultimately enhance broader environmental and economic policy objectives. For investors, incubators, and universities, this research provides insights into the challenges and opportunities cleantech startups face. These insights can enhance the support, resources, and training the startup ecosystem provides. Entrepreneurs can use the findings to make better strategic decisions, optimise resource allocation, network with stakeholders, and manage pressures, fostering more resilient startups. The results promote sustainable development and technological advancements, helping communities combat climate change and address social inequality.

1.5.2 Academic relevance

This study is highly relevant to academic fields, addressing and contributing to scholarly research. It explores the application of various strategic orientations within an intensely entrepreneurial context. As noted in the research gaps section, limited qualitative research exists on the interrelationship between digital and sustainability practices. This study aims better to understand the relationship and interplay between these orientations.

Building on the resource-based view theory, this research provides practical insights on how startups can leverage their resources to gain a competitive advantage. Furthermore, the research contributes to institutional theory research by examining how digital and sustainable strategic practices are influenced by external factors. By combining both theories, the problem is analysed from a socio-technical perspective, enhancing the understanding of the environment of cleantech startups and the impact of resources and external incentives on strategic practices. These insights have direct implications for the real-world operations of startups.

1.5.3 Relevance to the CoSEM Programme

This research has been conducted as part of the master's programme in Complex System engineering and management at Delft University of Technology. A CoSEM research looks beyond the technology, analysing the environment in which innovation occurs. To achieve successful implantation, aspects such as regulations, behaviour, cultures, economics, and stakeholders must be considered in the design. The structure and findings reflect the core principles of the CoSEM programme and thinking, focusing on merging technical, economic, social, and institutional perspectives on implementing digital technologies within Dutch cleantech startups. The research focuses on technical digital innovation within cleantech startups, considering the technical challenges, analysing their stakeholders, and identifying external institutional incentives that come with these innovation practices.

From a technical perspective, the different digital technologies and the resources required to implement those resources are identified. This can include software programmes, digital infrastructure, blockchain, and AI. The research examines how these technical practices influence the efficiency of startups' processes and operations. The social perspectives include the startups' behaviour and how they prioritise their sustainable and digital practices. The research focuses on the stakeholders and how they interact with the startups. Furthermore, social aspects such as corporate culture and social behaviour, such as the ethical use of AI and technology unemployment, are analysed. The thesis also reveals the extent of the startups' societal and sustainable impact. It analyses how different resources influence these startups' social, economic, and sustainable behaviour. Moreover, the research gives valuable insights into how social practices influence the implementation and use of these technological interventions. Finally, the different external incentives are analysed in terms of how the startups perceive and how they influence their strategic practices. The effects of current regulations, grants, mimetic pressures from competitors, and pressures from their customers are explored.

Overall, examining the relationships reflects the complexity of these interventions, which is central to the CoSEM programme. The research critically examines the connections between cleantech startups' use of digital tools. Using several analysis techniques, such as deductive, inductive coding, colour coding, and stakeholder analysis, the explored relationships and results are valuable for further managerial and institutional decision-making. This research aims to enhance the potential of digital practices in order to create a more significant social and sustainable impact on tackling climate change.

1.6 Report structure

The structure of the report is as follows: a systematic literature review has been conducted to gain a better understanding of the different literature regarding strategic orientations, cleantech startups, their resources, and the environment. Several research gaps have been identified from the literature review, and objectives have been made. In Chapter 3, a conceptual framework is made based on the literature to visualise the research questions and relationships between major components. Chapter 4 elaborates on the development of the methodology. Chapter 5 elaborates on the data collection method and the development of the QCA and codebook. Chapter 6 shows the results of the QCA and identifies levels of the orientations, resources, and stakeholders, resulting in identifying trade-offs and synergies. Chapter 7 shows us the different analyses done to expose the relationships between the different components and to find patterns in the data. In Chapter 8, the results are discussed, together with managerial and policy implications. Finally, Chapter 9 gives the research conclusion and recommends future directions.

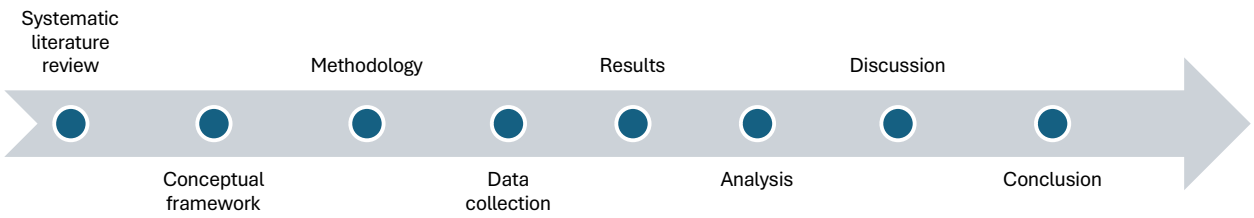

Figure 3: Report structure

2. Literature review

Chapter 2 presents the systematic literature review conducted during the research. It begins with a review of the theoretical framework used within sustainable and digital entrepreneurial research, followed by the fundamental concepts of digital and sustainability orientation literature. The literature review further maps the known resources available to Dutch startups and the external pressures they experience. Finally, it presents the known challenges and opportunities that digital and sustainable practices bring.

2.1 Theoretical framework

Two theoretical frameworks form the foundation of the research. The resource-based view (RBV) theory is the primary theory to uncover the variety of resources startups have and how they use them to create a competitive advantage. Complementary to the RBV theory, the institutional theory explores and explains the external environment and its importance in implementing digital technologies within sustainable entrepreneurship.

2.1.1 Classical resource-based view

The literature defines several theories for examining strategies within companies, such as Porter's five forces, industry life cycle theory, and resource-based view theory. After reviewing several theories, the RBV theory was chosen as the most suitable because it focuses on a company's internal resources and capabilities. It is, moreover, suitable for analysing startups in dynamic and innovative environments and offers a holistic view of the value creation process.

The RBV theory, developed by Barney (1991), is a crucial management theory that views a company as a specific set of assets (Wernerfelt, 1984). The RBV framework helps differentiate and outperform competitors by examining how resources and capabilities affect a company's competitiveness. According to Barney (1991), resources must be valuable, rare, inimitable, and organised to provide a competitive advantage. Assets under the RBV framework can be tangible or intangible. Tangible assets include buildings, equipment, and capital (Barney et al., 2001). These are common and easy to replicate. On the other hand, intangible assets include knowledge, brand reputation, intellectual property, and culture (Barney, 1991; Barney et al., 2001; Lockett, 2009). Intangible assets are often more unique and challenging to imitate, providing a more substantial basis for competitive advantage.

2.1.2 Extensions of the RBV

- *Natural resource-based view*

  With the evolution of climate change and the rising pressure to act against it, not only economic assets but also social and environmental resources and skills must be examined. Therefore, the natural resource-based view (NRBV) was developed by Hart (1995) as a reaction to the increasing concerns over environmental degradation. It emphasises the strategic value of environmental resources and capabilities in achieving a sustainable competitive advantage (Hart and Dowell, 2011). Hart (1995) addresses three primary skills firms must have to create this advantage: pollution prevention, product stewardship, and sustainable development. The NRBV posits that firms developing capabilities in these areas can create differentiation towards competitors, improve operational efficiencies, reduce costs, mitigate environmental risks, and comply with regulations and resource scarcity. As a theoretical extension to the classic RBV, the NRBV has a broader scope of applicability than the original RBV and has answered the demand to bridge the gap between humanity (and its economic structures) and the natural world (Hart and Dowell, 2011; Jaini and Hussin, 2019; McDougall et al., 2019).

– *Social Resource-based view*

In 2018, Tate and Bals extended the research on the RBV and NRBV by addressing the social aspects of a firm. Therefore, they added two different strategic capabilities to the framework of Hart (1995), resulting in the social resource-based view (SRBV). The first is a mission-driven approach (at inception and over time). The social driving force would be to maximise social and environmental benefits while breaking even and becoming profitable to perpetuate the business model with the critical resources of the founding team and mission. The second capability would be stakeholder management, which means maximising support regarding products, information, and funds from a broad stakeholder base (Tate and Bals, 2018). Figure 4 shows the framework of Tate and Bals regarding the different RBV

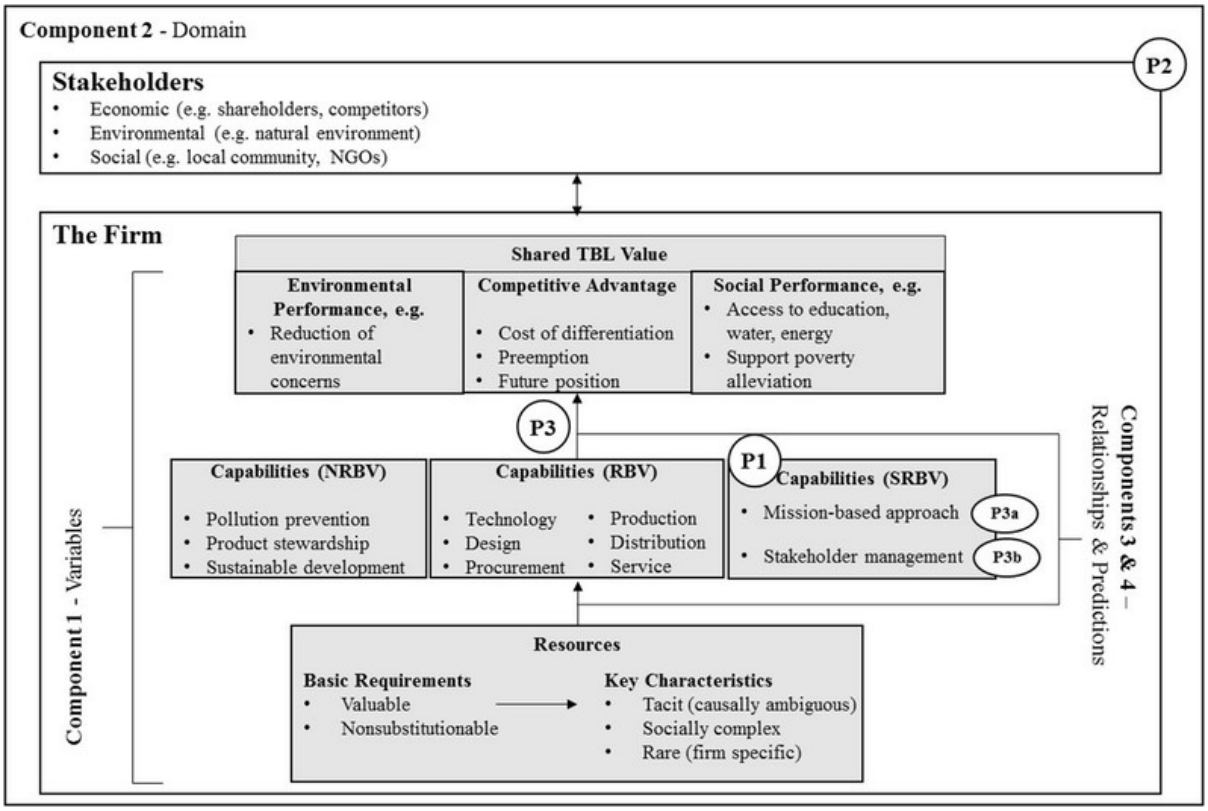

Figure 4: Overview of RBV forms by Tate and Bals (2018)

2.1.3 Institutional theory

Literature shows that cleantech startups operate in dynamic environments where external factors significantly influence their behaviour and operations (Nikolaou et al., 2018). Startups depend on external financial resources, must comply with technical regulations, practice ethical engineering, and mimic the behaviour of competitors (Cojoianu et al., 2020). Therefore, the literature suggests not only look at internal resources, as the RBV suggests but also consider the institutional environment in which they operate (Quinton et al., 2018). Therefore, the widely used institutional theory by DiMaggio and Powell (1983) complements the RBV theory gap.

This theory describes how organisations adjust to rules and norms to obtain legitimacy, which results in the uniformity of organisational structures and practices (DiMaggio and Powell, 1983). This results in appropriate organisational structures, practices, and behaviours. This theory assumes that companies are widely affected by the external environment and actions and behaviours like regulations, norms, values, and expectations from external stakeholders. (Liu et al., 2010; Latif et al., 2020; Kropp and Totzek, 202). Scott (1995) states that a company's external environment is governed by institutions manifesting social structures like schemas, rules, norms, and routines. These institutions determine the game rules that economic players and firms must apply to apply legitimacy, which can eventually boost their chances of economic survival and business performance. This legitimacy is eventually crucial for smaller firms whose

chances of survival are already smaller. Cleantech startups are built on social norms and values to create and help reduce society's environmental and social impact (Liu et al., 2010; (Stam et al., 2012). By finding and responding to these institutional structures, startups can gain legitimacy in the eyes of consumers, partners, stakeholders, and regulators, which can eventually give them a competitive advantage in the market (Aragòn-Correa et al., 2020; Ranta et al., 2018). Cleantech startups can benefit from these institutions by adopting their behaviour so that these pressures can help them develop unique innovations(Ranta et al., 2018). At last, these institutions can help them access resources and support, including funding, subsidies, and incentives for sustainable entrepreneurship.

To analyse why certain firms are acting in a certain way and how their intention is towards a specific strategy, DiMaggio and Powell (1983) identify three different categories of pressures. These are normative, mimetic, and coercive pressures. These pressures come from competitors, consumers, and regulatory bodies, and the firm's perception of these pressures affects its interpretation and attitude towards practices (Liu et al., 2010). Normative pressure comes from suppliers, customers, trade unions, and other social entities. They arise from professionalisation and show a cognitive base and legitimation for occupational autonomy. Normative pressures include norms and values from professional standards and educational systems. They are often associated with expectations about how a firm should operate to behave appropriately, leading to conformity through social obligations (Aragòn-Correa et al., 2020; DiMaggio and Powell, 1983; Latif et al., 2020). Mimetic pressures arise from a firm's perceived success compared to competitors, whereas firms tend to imitate competitors' structures, strategies, and processes. This imitation is often a result of uncertainty within the firm itself when goals or strategies are unclear. These can eventually arise in the startup environment due to high levels of uncertainty, fast-paced technological changes, and fluctuating market demands (DiMaggio and Powell, 1983; Latif et al., 2020). The last pressure category, coercive pressures, originates from political influences that firms must comply with. Coercive pressures are typical in entrepreneurship and operate through different stakeholders. These pressures include formal pressures like laws and regulations and informal pressures such as expectations from society and customers (DiMaggio and Powell, 1983; Kropp and Totzek, 2020).

2.2 Strategic orientation of startups

All companies, big or small, use a business strategy to adapt to their environment for market performance (O'Regan and Ghobadian, 2005). Having a strategy helps organisations coordinate their resources and capabilities and fit their internal and external environments (Obeidat, 2016). Strategic orientation directs firms toward their goals. The strategic orientation shows how an organisation plans strategically.

Miles and Snow (1978) are some of the early founders of strategic research, studying the relationship between structure and strategy and establishing multiple definitions of strategic orientation. The four organisational strategies are defenders, prospectors, analysts, and reactors. Different types achieve goals with different behaviours. Manu and Sriram (1996) expand on this typology by defining strategic orientation as how an organisation uses strategy to change its environment for a better fit. Another popular definition of strategic orientation is **"the reflection of the strategic direction implemented by a firm to create proper behaviour towards superior performances" by Gatignon and Xuereb (1997).** Other researchers, like Grawe et al. (2009) and Balodi (2014), view strategic orientation as an aspect of organisational culture that influences practices and resource allocation (Obeidat, 2016). A unified definition and interpretation are still missing despite the strong interest in strategic orientation research.

The development of different strategic orientations arises from the need to address complex, dynamic, and multi-level challenges and opportunities. Entrepreneurial, market, and technological orientation are the most well-known types of strategic orientation, having undergone extensive implementation and research (Alnawas and Abu Farha, 2020; Zhou et al., 2021). In the past two decades, innovation and societally complex problems have led to the development of two other orientations. The first is sustainability orientation, which represents integrating environmentally friendly and social practices into the company's strategy. The second one is digital orientation, an extension of the technological orientation in which firms use digital innovations to create a competitive advantage through digitalisation.

2.3 Sustainability Orientation

The extent to which an organisation is aware of its ecological and social responsibilities is known as its sustainability orientation. It reflects opinions on ethical business conduct and the acceptance of sustainable business practices (Kuckertz and Wagner, 2010). Previous research adopting an ecological strategy causes us to consider operational effectiveness and cost savings inside the business, which can eventually boost performance (Amankwah-Amoah et al., 2019; DiVito and Ingen-Housz, 2021). Dean and McMullen (2007) argue that EO and SO complement one another, creating greater market opportunities because of new environmental problems and market failures.

2.3.1 Definition of sustainability orientation

Previous research has been done on defining a sustainability orientation, and different measurement techniques have been used to assess the degree of sustainability orientation. Research also gives other names to sustainability orientation, such as sustainability orientation, sustainable management orientation, and sustainable development orientation (Khizar et al., 2022). Most definitions of SO have been conceptualised on a firm-level capability, whereas the firm's capabilities, philosophy, principles, and guidelines direct the firm's activities and policies (Khizar et al., 2022; Gagnon et al., 2013). These definitions emphasise the importance of non-monetary benefits, with a strong focus on environmental goods. These Definitions are not necessarily focused on sustainable practices but more on the values and attitudes that firms/entrepreneurs have towards sustainable practices. Moreover, most definitions of sustainability orientation have been built on the RBV of a firm, sustainable entrepreneurship theory, and the Upper Echelon theory (Khizar et al., 2022; Khizar et al., 2021). The table below provides an overview of the most used definitions and the level at which the sustainability orientation is represented.

Table 1: Overview of SO definitions

Author	Level of analysis	Definition	Theory
Kuckertz and Wagner (2010)	Individual	*"Individuals with stronger sustainability orientations are precisely those that value non-monetary benefits, as well as existence and option values with regard to environmental goods."*	Sustainable entrepreneurship
Emamisaleh and Rahmani (2017)	Organisational	*"...the active and committed decision-making of an organisation and its whole supply chain about the economic, social, and environmental issues." (Pagell and Wu, 2009)*	RBV
DiVito and Bohnsack (2017)	Individual	*"....founders of sustainable enterprises (green, social or both) have a sustainability orientation (SO) comprising values that shape formally and informally the decision-making processes and policies of the firm and the logic they use to choose between competing priorities."*	Sustainable entrepreneurship
Roxas and Coetzer (2012)	Organisational	The proactive strategic stance of firms towards integrating environmental concerns and practices into their strategic, tactical, and operational activities	RBV, Institutional theory, Upper Echelons Theory
Kraus et al. (2017)	Organisational	The incorporation of entrepreneurial behaviours, including opportunity recognition, innovation, and proactiveness, within the broader context of social entrepreneurship's mission and activities	RBV

2.3.2 Dimensions of sustainability orientation

Based on the literature review, several measurement scales where were analysed. One notable drawback of these measurement methods is their pronounced emphasis on environmental concerns, often at the expense of addressing social practices. Therefore, to cover sustainability in its whole definition, it was decided to split sustainability orientation into two different categories, namely, (social sustainability orientation (SSO) and environmental sustainability orientation (ESO).

– *Social sustainability orientation*

Several frameworks were analysed during the SLR, but the definition and measurement scales of Kraus et al. (2017) were chosen based on the level of analysis (firm level) and the theory used for the definition, which aligned with the chosen RBV theory. The dimensions address social sustainability orientation and are well-suited for qualitative research.

Kraus et al. (2017) lead their framework to the proposal of twelve items measuring four dimensions of social entrepreneurship orientation (SSO). This scale is based on existing Entrepreneurial Orientation (EO) scales, adjusted to the specific construct of social entrepreneurship. Innovativeness, risk-taking, and proactiveness were adjusted to the social mission of social-oriented firms (Kraus et al., 2017, 2018). Kraus et al. (2017) underpin the variety of definitions of social entrepreneurship and emphasise the focus on entrepreneurial approaches to solve social challenges. Social entrepreneurs, especially those running for-profit businesses, and social and financial value creation are seen as inseparable. This inseparability is critical in understanding the dual missions of social and financial goals and is integrated into the SSO-scale development of Kraus et al. (2017). In Table 2, an overview of the different dimensions can be found. Appendix B4 further represents a detailed overview of the dimensions and subcategories.

Table 2: Overview of SSO dimensions designed by Kraus et al. (2017)

Core category	Definition
Social Innovativeness	Refers to an organisation's focus on creating new solutions or approaches to address social problems. It encompasses the willingness to experiment and innovate to serve beneficiaries more effectively and solve social issues creatively and positively.
Social Risk-taking	It involves an organisation's willingness to engage in actions that entail significant uncertainty to achieve its social mission. This dimension highlights the readiness to take substantial risks to create social value, even when outcomes are uncertain.
Social Proactiveness	This refers to the organisation's forward-looking perspective, which seizes opportunities to create social value ahead of competitors. It involves actively pursuing new opportunities to serve social needs and being the first to act on these opportunities.
Socialness	Its primary objective is the degree to which an organisation focuses on creating social value and addressing social problems. It reflects the organisation's commitment to its social mission, which guides its strategy and operations.

The SSO scales let us understand social enterprise complexity, considering both mission-related and commercial opportunities. For policymakers, the scale helps differentiate between various types of organisations, aiding in target group-oriented support. For social impact investors, the scale can offer a new means to measure the motivations of different types of enterprises (Kraus et al., 2017).

– *Environmentally sustainability orientation*

For environmental orientation, the measurement scale put forth by Roxas and Coetzer (2012) is widely recognised in academic literature. Their study examines how the institutional environment and managerial attitudes influence startups' environmental sustainability orientation (ESO). Roxas and Coetzer (2012) conceptualise sustainability orientation as a firm-level construct of organisational culture or business philosophy. They operationalise ESO through a set of eighteen items, where respondents express their level of agreement or disagreement using a 5-point Likert scale. These items

can be categorised into different dimensions, including knowledge (six items), practices (eight items), and commitment (four items) (Khizar et al., 2021). A comprehensive overview of the dimensions can be found in Appendix B5.

Table 3: Overview of ESO Categories designed by Roxas and Coetzer (2012)

Core category	Definition
Knowledge	Awareness and understanding within the firm about various environmental challenges and the impact of business operations on the environment and to which firms are informed about climate change, waste management issues, the role of businesses in environmental protection, and available environmental protection programs
Practices	The actual environmental management practices implemented by a firm include recycling, training on environmental awareness, participation in environmental programs, adoption of low-impact manufacturing technologies, and communication with customers about environmental efforts.
Commitment	The company is dedicated to and pledges to pursue long-term environmental sustainability. It believes that environmental protection is an integral part of doing business, that sustainable practices benefit the business, and that they can attract more customers through environmental efforts.

2.4 Digital orientation

The digital age, which began in the late 1990s, dramatically changed our interactions. Industry 4.0 revolutionises how firms manufacture, improve, and distribute their services and products (IBM, 2022). Based on a study by Kane et al. (2015), around 90% of companies across sectors and countries expect digital innovations to shape their business and strategy. By integrating new technologies like IoT, cloud computing, big data analytics, blockchain, and AI, companies change how they interact and add value to their businesses. Digital innovation can help startups with support intelligence, cost reduction, and audience extension (Quinton et al., 2018). Digital technologies transform not only the company but also its strategy. (Kindermann et al., 2021). However, startups can face difficulties implementing digital transformation, particularly during dramatic structural change (Carsrud and Cucculelli, 2014; Quinton et al., 2018).

Digitalisation brings changes such as decentralisation, malleability, and generativity that other strategic orientations do not fully capture (Kindermann et al., 2021). Although extensive research has been conducted into strategic orientation and digital innovation, the concept of digital strategy orientation is relatively new. Therefore, theories of a digital orientation were first defined and conceptualised in the late 2010s by Khin and Ho (2018) and Quinton et al. (2018).

2.4.1 Definitions of Digital Orientation

Kindermann and Quinton conceptualise the most well-known theories of DO. These orientations are developed as part of a quantitative study to analyse the effect of digitalisation on a company's business performance. Quinton et al. (2018) build on the analysis of Zhou, Yim, and Tse (2005), who express that using a single orientation by companies can have disadvantages. Suppose an organisation only adapts to a market orientation. In that case, it may become reactive to consumers' expressed needs and not innovate, which can be catastrophic in a highly technological and innovative market. Quinton et al. (2018) developed a conceptual framework for DO based on market, learning, and entrepreneurial orientation. He states that combining these three orientations is necessary for startups to achieve responsiveness, insight, and innovation to succeed in the digital environment. He emphasises that companies must look beyond individual initiative and consider organisational practices in an ever-changing environment. Digital technologies form a unified fabric in which digital solutions never occur in complete isolation but interact with the environment. Building on Quinton et al. (2018), Dantshoho et al. (2020) state that proactive innovation is not enough to compete in digital ecosystems successfully and define DO as the tendency of a

firm to realign itself with the reality of the digital ecosystem through the use of new technologies to create a new business model, streamline operations, or improve the customer experience. (Dantsoho et al., 2020).

Other researchers apply the theory of Kindermann et al. (2021), which is derived from the strategic orientation defined by Zhou et al. (2005). Kindermann et al. (2021) state that the other definitions do not satisfy the characteristics of a proper digital strategy orientation. As a result, he states that digital orientation is not only about using digital technologies but also about transforming organisational processes and creating value in services. He highlights the definition of DO from an RBV perspective and strategic alignment models, focusing on decentralised resource agencies, dynamic environmental change, and generativity in value creation. Value creation using digital solutions is no longer well-bounded; products and services are less fixed, and the innovation process is more unpredictable (Nambisan et al. 2017). Organisational structures must become more responsive and adaptable due to digitalisation, prioritising modularisation and interoperability over fixed boundaries in other defined orientations.

Khin and Ho (2018) build on the technology orientation, where digital technology is defined as "a firm's commitment towards the application of digital technology to deliver innovative products, services, and solutions." DO firms are more open to digital technologies and embrace digital initiatives faster. The following table provides an overview of various definitions, their underlying theories, and their application in research.

Table 4: Overview of DO definitions

Author	Level of analysis	Definition	Theory
(Kindermann et al., 2021)	Organisational	*"The firm's strategic approach to leverage digital technology-enabled opportunities for competitive advantage."*	RBV and strategic alignment models
(Dantsoho et al., 2020)	Organisational	*"The tendency of a firm to realign itself with the reality of the digital ecosystem through the use of new technologies to create new business model, streamline operations and improve customer experience."*	RBV
(Quinton et al., 2018)	Individual	*"Deliberate adoption of a strategic position evolved from a positive attitude, and manifested through organisational actions and behaviours that encourage proactive innovation."*	market, learning and entrepreneurial orientation
(Khin and Ho, 2018)	Organisational	*"The firm's commitment to applying digital technology innovatively in product, service, and solution development."*	RBV and technology orientation
(Beutel, 2018)	Organisational	*"The firm's guiding principle is to foster the enablement and usage of digital technologies throughout its organisation to digitise products and services for the customer and its internal and external operations to achieve competitive advantage."*	RBV

2.4.2 Dimensions of digital orientation

Many definitions and dimensions of digital orientations focus on how a firm uses digital practices. However, as this research focuses on the attitude and strategic posture entrepreneurs adopt when making decisions about digital practices, the dimensions scale defined by Dantshoho et al. (2020) is used. This scale is rooted in a broad literature review and expert consultation, making it applicable across different industries and cultural contexts. This scale is also better suited for qualitative research because it clearly defines subitems of the dimensions compared to other definitions.

Dantshoho et al. (2020) view DO from a qualitative perspective, and project DO as a guide to digital practices. This ensures that they focus not only on digital solutions but also on their attitude towards digital entrepreneurship. The scale is developed through a comprehensive literature review, expert interviews, and a confirmatory factor analysis to ensure reliability and validity. The DO model is reflective and multi-dimensional. It pays attention to the nature of the construct, its underlying characteristics, and justification from theory and empirical perspectives. The four dimensions are defined as follows:

Table 5: Overview of DO dimensions designed by Dantsoho (2021)

Dimension	Description
Digital curiosity	The firm's desire to explore and understand new ideas and technologies in the digital ecosystem drives innovation and creative problem-solving.
Digital alertness	The firm's awareness and responsiveness to changes and opportunities in the digital landscape. It emphasises quick detection and reaction to potential threats and entrepreneurial opportunities.
Digital openness	The firm's willingness to engage with digital platforms, share information, and collaborate highlights the importance of adaptability and openness to digital changes and innovations.
Digital innovative passion	The intense positive feelings and motivation toward digital innovation reflect the entrepreneurial spirit and commitment to implementing and investing in new digital technologies.

2.5 Interaction between both orientations

Only a few papers address the use of multiple orientations despite extensive research on the influence of different orientations on innovation and business performance. To this point of knowledge, the literature states that a sustainability orientation positively affects a firm's sustainable, economic, and social performances. Digital technologies can enhance this relationship through efficiency, automation, and connectivity within and outside the company. The literature review from Denicolai et al. (2021) exposed that digitalisation can improve productivity, product quality, better decision-making, and flexibility within a firm. Timmermans et al. (2023) highlight that digital technologies can emphasise the achievement of the Sustainable Development Goals (SDGs). Digitalisation can help reduce carbon emissions through the supply chain of products by making the processes more efficient and achieving higher productivity, which can result in less workload for employees and potentially extend the lifecycle of products (Saáry et al., 2022). DO further enhances startup resources by giving attention to digital resources and assisting in acquiring new resources, which, from an RBV perspective, could enhance the competitive advantage. As previous research has shown, most research focuses on digital innovation, which can influence the sustainable performance of firms (Guandalini, 2022). However, it remains unclear if this influence is one-way or if a sustainable solution can also improve digital strategies.

Ardito et al. (2021) researched the simultaneous use of both digital orientations and analysed whether their relationship has a complementary or detrimental effect on product and process innovation performances. They discovered that a dual implementation does not benefit North American SMEs' process and product innovation performance. Managers and employees of startups are more likely to encounter the attention allocation problem due to their small size, as noted by Ardito et al. (2021). Denicolai et al. (2021) emphasise that startups tend to be less digitalised than larger firms due to the high risk of implementing novel technologies. A lack of understanding of the various trade-offs and synergies that startups represent can widen the gap between startups and larger firms. This could be disastrous for startups trying to survive in a competitive market. It could damage innovations, as startups are the heart of innovative technologies (Dulin, 2021). Lichtenthaler et al. (2021) emphasise that startups have less resistance to balancing profit and sustainability. Startups aim to survive and establish a competitive advantage to penetrate their market. Brenner et al. (2021) and Timmermans et al. (2023) also link the social consequences of digital transformation to the potential for increased inequalities within a firm. Younger firms (with digitally

educated people) would have an advantage over older, more experienced employees. Digitalisation improves process efficiency, potentially replacing labour with digital technologies, a phenomenon commonly referred to as technological unemployment. This contradicts the social responsibility of companies and, in the context of growing wage disparities, may contribute to heightened inequality within society (Avelar et al., 2024; Tick et al., 2022).

Currently, most research focuses on examining the impact of DO or SO on economic performance. Only one research study (from Ardito et al. (2021)) considers the combined effect of a digital and sustainability orientation on innovation performance. Since their study relies on a quantitative dataset, it remains unclear how this correlation emerges and what specific synergies and trade-offs arise when using both orientations simultaneously. Besides that, a startup's strategy focuses on allocating its resources, and that is a crucial problem identified when using both strategies. It is still unclear what trade-offs startups must make when applying a specific strategy to create a competitive advantage. Understanding the potential obstacles, the various internal cleantech sectors, and the external factors that shape and nurture these barriers is crucial.

2.6 The Cleantech Industry

Definitions of cleantech are broad and scattered. Cleantech startups are defined as young firms (mostly under ten years old) with less than 50 employees delivering any product, process, or service to improve environmental sustainability. These technologies aim to reduce resource consumption, minimise pollution, and mitigate climate change (Ali et al., 2020). The startups have an environmental and socioeconomic focus and use innovative technologies to provide market solutions. They can operate in different sectors related to renewable energies, energy efficiency, water management, sustainable agriculture, waste management, and green transportation (Dickel, 2017). Cleantech companies differentiate themselves by competing with technologies based on their unique value offerings, i.e., mitigating climate change and protecting the environment.

2.6.1 Resources of cleantech startups

A better understanding of available resources allows startups to maintain strategic flexibility by prioritising activities that align with their strategic orientation, whether they focus on sustainable or digital practices, resulting in a competitive advantage. The resource management theory, which is an extension of the RBV theory, encompasses how startups structure their resource portfolios and bundle them to create leverage and capabilities (Sirmon et al., 2007). Cleantech startups face unique resource mobilisation challenges due to their sector characteristics, such as product complexity, long R&D time, the necessity of early capital investment, and ever-changing regulations. However, by mobilising and leveraging these resources, cleantech startups can benefit from government grants, specific knowledge acquired through universities, and the availability of physical resources. Access to specific resources, such as incubator networks, funding, and patents, can eventually shape their strategic orientation.

As Barney (1991) states, these resources can be tangible and intangible assets, including management skills, organisational skills, and routines. To explore the resources available to cleantech startups, the research concentrates on those that are either semi-digital or fully digital. Semi-digital startups manifest in products and services that combine digital and physical components (Kurowski, 2024). These startups incorporate both physical and digital components into their products or combine them into a single product (Kurowski, 2024). These components leverage each other to create more value for the product (Kurowski, 2024). Examples are smart solar panels with sensors and apps, smart grid analytic systems, and recycling monitoring systems. Digital startups offer software as a product or service, utilising IT infrastructures to digitise and analyse analogue information for their customers (Marcon and Ribeiro, 2021). Examples of these products are smart building management software and virtual power plant software.

To classify the resources, an extension of the classic categories of financial, human, and social resources of Ireland et al. (2003) has been done by using the categorisation by Marcon and Ribeiro (2021), which includes three additional resources: organisational, innovation, and intellectual. Academic research on innovation ecosystems has previously utilised this extended framework to align with emerging

environments. This extension is ideally suited for cleantech startups, as they incorporate many stakeholder interactions beyond the traditional networks, such as customers, incubators, universities, and R&D institutions (Marcon and Ribeiro, 2021). The availability of resources is highly dependent on the environment in which the startup is working, the economic and political state, size, industry, pressure, and lifecycle phase of the startup (creation, development, or market phase).

Table 6: Resource categories overview

Resource	Theory	Definition
Innovation	Theory of innovative capabilities and intellectual capital	The routines and processes firms undertake to develop new or improved products, processes, and services to exploit the market. This also encompasses intellectual resources such as patents, trademarks, and knowledge management.
Social	Social Capital Theory, RBV	The relationships and networks that the startup builds with various stakeholders, including customers, partners, communities, and regulatory bodies. These relationships can facilitate market access, foster collaborations, and enhance reputation.
Human	Human Capital Theory, RBV	The talent and skills of the startup's team, including their experience, expertise, and creativity, are critical. This is especially true in a high-tech industry where the team's knowledge and capabilities can drive innovation and growth.
Physical	Physical Resource Theory, RBV	The tangible assets of a startup, such as its technology, machinery, facilities, and any other physical capital required to develop and deliver cleantech solutions.
Intellectual	Theory of Intellectual Capital	Patents, trademarks, proprietary knowledge, and other intellectual property can be leveraged for competitive advantage.
Organisational	Organisational Theory, RBV	The startup's structured systems and processes, including its management structure, culture, and internal networks, enable it to function effectively and adapt to changes.
Financial	Financial Theory	Capital and financial strategies that support the startup's operations, growth, and scalability, including investments, revenues, and funding

2.6.2 External incentives towards cleantech companies

As discussed in Chapter 2.1.3, it is essential to map the different external incentives that cleantech startups face to analyse their strategic behaviour. Academic research has widely adopted institutional theory; however, the qualitative measurement of these pressures has been surprisingly limited. To our knowledge, most research on pressures has been quantitative and related to firms' performance. Moreover, researchers have been focusing on pressures regarding environmental practices and not particularly on digital practices.

Startups are more sensitive to institutional pressure than mature firms due to their lack of legitimacy (Liu et al., 2022). Within environmental practice-oriented firms, institutional theories can be beneficial (Liu et al., 2022). The literature finds a positive relationship between pressures and a firm's absorptive capacity, resulting in corporate environmental practices (Colwell and Joshi, 2013). Coercive and normative pressure can also be an enabler in creating new market opportunities, as other consumers must comply with different regulations regarding social and environmental practices. The driver to adopt sustainable practices can eventually enhance its brand value and open new customer segments (Cojoianu et al., 2020; Liu et al., 2022). On the other hand, coercive pressures can also be counterproductive to innovation. Meeting up with regulations can involve financial investment, shifting their focus to prioritise compliance, and making startups more risk-averse to avoid penalties. (Shibin et al., 2020).

Furthermore, mimetic pressure can result in a lack of originality, hindering innovation and risking homogeneity. Normative pressures can hold up cleantech startups so that stakeholders' expectations can spread resources thin (Daddi et al., 2016; Davidsson et al., 2006). This can result in startups focusing more on meeting stakeholder expectations and losing sight of innovation. Because DiMaggio and Powell's (1983) theory is well known and used in the literature, they emphasise that the effects of these pressures are highly

context-specific and relative. Therefore, it is even more necessary to understand the pressures Dutch cleantech startups face due to their highly dynamic environment.

2.6.3 Challenges of cleantech startups

While startups are at the forefront of innovation, cleantech startups face unique challenges in bringing their products and services to the market. These challenges are distinct from those faced by traditional startups in the same sector, and understanding them is crucial for their successful implementation and growth.

– *Technical challenges*

Cleantech innovations are disruptive, differentiating themselves from competitors in the same sector or market. These innovations often face difficulties in establishing new systems, structures, and customer segments (Shakeel, 2021). Conventional technologies have already established themselves within a market, undergoing numerous lifecycle developments. They are often the first choice due to the market's trust and validation of the product or service. e. Despite the vast potential of renewable energy and their relatively competitive price (with the correct set of regulations and infrastructural support), they still have a low contribution to the global energy supply. This is partially due to the stability of conventional energy supply, centralised systems, and control by governments and multinational energy companies (Shakeel, 2021).

Startups, especially cleantech startups, are often the source of radical technologies. Their small size, while a strength in many ways, can also make them struggle to mobilise financial support, human resources, knowledge, and infrastructural support. (Brown et al., 2007). This is where the role of the industry and academia becomes crucial. It is, therefore, of utmost importance to provide them with comprehensive support throughout the different phases of their development. Additionally, cleantech products typically require more time for research and development (Shakeel, 2021). This results in higher initial costs, startup capital, and a longer time to achieve profitability. Researchers have coined this phase the "valley of death", referring to the period in a startup's life where it has initiated operations and incurred costs (Frankelius et al., 2011). Figure 5 illustrates that the “Valley of Death” is longer for cleantech startups due to extended development and commercialisation times, underscoring the urgency and necessity of our support.

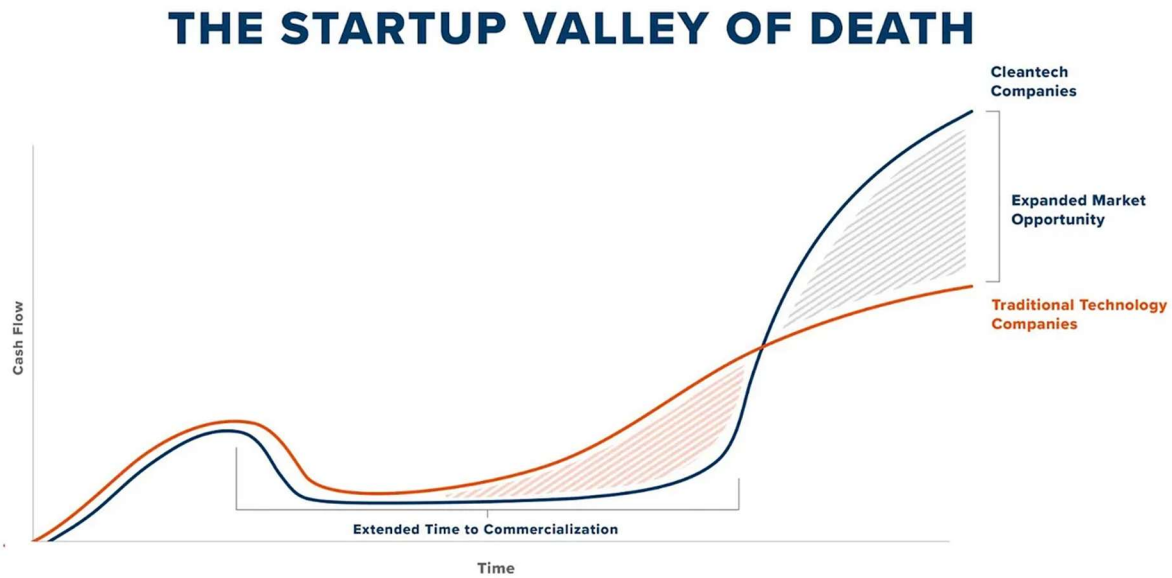

Figure 5: The “Valley of Death”” of cleantech startups (Mount, 2021)

– *Socio-economic challenges*

A technology's functionality should achieve higher efficiency than conventional alternatives within the same sector while having a positive environmental impact for cleantech companies. Suppose the unique selling point of the product or service is its positive, sustainable impact. In that case, it may face challenges in gaining market share, as only a tiny portion of the market is willing to pay for the environmental impact. Customers are more likely to purchase their product or service if it is also competitive in price or if the price difference between competitors is less, indicating that they are willing to pay for the environmental added value (Shakeel, 2019). Another factor to consider is the shift in consumer environmental awareness, which significantly impacts market demand. Increased awareness can lead to a greater valuation of environmental benefits and a willingness to invest in sustainable technologies. Governmental policies, corporate responsibilities, activism, and advocacy primarily influence this awareness (Shakeel, 2019).

– *Regulatory challenges*

Financial support from the government, such as incentives, subsidies, and favourable policies, is crucial. These tools help level the playing field with conventional technologies, which often benefit from established support structures and market familiarity. Such governmental backing is essential for initial technology development and for assisting cleantech solutions through the early market launch and adoption phases (Frankelius et al., 2011). The development and widespread adoption of cleantech solutions require an accommodating physical infrastructure and regulatory framework. This includes developing systems to meet the unique demands of cleantech products and services. Contributing to the fact that the cleantech business is fractured and decentralised, Frankelius et al. (2011) state that most customers (mostly B2B) require lots of quantities to deliver and that most cleantech startups are just too small to deliver on their demand. Experts from Sweden stated that most cleantech startups cannot bring their products to market (and strand in the Valley of Death) or experience growth barriers (Frankelius et al., 2011).

3. Conceptual Framework

This chapter proposes a conceptual framework based on the literature. This framework aims to clarify the research's design choices and the dynamic relationships between different components (see Figure 6).

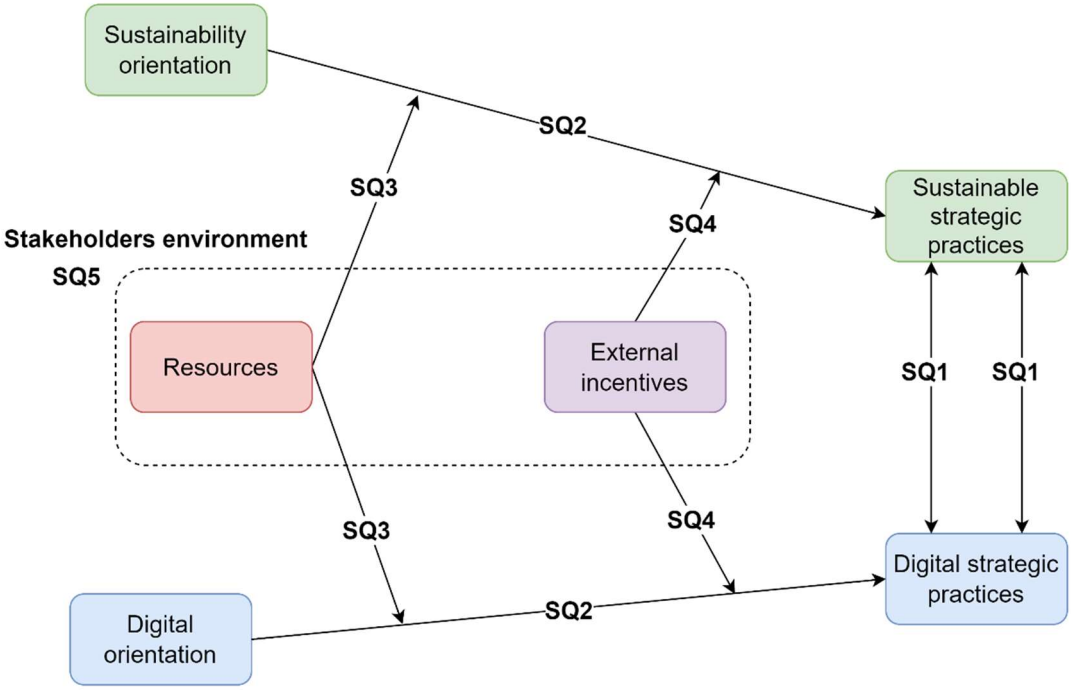

Figure 6: Conceptual framework

3.1 Design choices

– *Strategic Orientations*

The term "strategic orientation" is defined by Gatignon and Xuereb (1997) as a reflection of the strategic direction towards specific goals. According to Obeidat (2016), these principles guide and direct practices to ensure viability, competitive advantage, and superior performance. It lays the groundwork for exploring sustainability and digital orientations, and it ensures that our research focuses on firm behaviours rather than individual attitudes towards entrepreneurship, sustainability, and digital practices.

Definitions and dimensions of sustainability and digital orientation vary widely, with a strong focus on environmental aspects in existing literature. Both frameworks of Kraus et al. (2017) and Roxas and Coetzer (2012) are used for a holistic view of sustainability within cleantech startups. Kraus et al. (2017) define Social Sustainability Orientation (SSO) based on dimensions of entrepreneurial orientation (Miller, 1983), emphasising social risk-taking, innovativeness, and proactiveness. Roxas and Coetzer (2012) focus on environmental sustainability orientation (ESO), defining it as a firm's proactive attitude towards environmentally sustainable practices that reflect a strategic orientation towards ecological goals beyond mere economic objectives.

The choice of orientation perspectives aligns with Gatignon and Xuereb's (1997) firm-level view of strategic orientations and their suitability for qualitative research. Unlike approaches that were primarily made for quantitative analysis, like Kuckertz and Wagner's (2010) regression analysis or Kindermann et al.'s (2021) frequency analysis, our choices focus on how resources and outside incentives affect how organisations act, based on two theories and qualitative research.

– *Resources*
The RBV theory, as developed by Barney (1991), is widely used in strategic orientation literature. It explains how resources and capabilities enable firms to achieve competitive advantage and pursue strategic orientations. It is particularly relevant for startups, where resource scarcity can critically impact performance. The RBV emphasises that efficient resource allocation is critical for successful entrepreneurship. Additionally, the Natural RBV (NRBV) by Hart (1995) and the Social RBV (SRBV) by Tate and Bale (2018) expand the RBV to include environmental and social goals, highlighting how firms can leverage resources not just for competitive advantage but also for sustainability and social performance, addressing challenges like pollution prevention and employee equality. To fully understand their impact on orientations, Marcon and Ribeiro (2021) define seven types of resources. Previous research on innovation ecosystems has utilised this classification, making it suitable for this study.

– *External incentives*
The RBV theory often overlooks external factors. Regulations and stakeholder pressures heavily influence startups in dynamic, innovative industries. Therefore, it is crucial to incorporate these external elements. Literature suggests that external regulations and environmental factors significantly impact SMEs' adoption of clean technologies and DO (Nikolaou et al., 2018; Cojoianu et al., 2020). The literature often uses the institutional theory of Covin and Slevin (1989) to research these external incentives. Strict environmental regulations may moderate the relationship between a firm's sustainability orientation and its sustainable strategic practices, ensuring that firms not only desire to be sustainable but also implement actual sustainable practices to comply with the regulations. Industry standards for privacy and security in a digital context could moderate how much a firm's digital orientation translates into its digital practices. Societal expectations could push for corporate sustainability, increasing the pressure on firms to not just talk about sustainability but also implement tangible sustainable practices. The institutional theory is, therefore, ideally suited to investigate what kinds of incentives and pressures are pushing cleantech startups towards certain practices.

The RBV theory, complemented by the institutional theory, provides a holistic view of the factors influencing strategic practices, combining RBV's 'inside-out' perspective with institutional theory's 'outside-in' perspective. Furthermore, identifying resources and incentives can be leveraged to respond to or anticipate changes in institutional norms and pressures. For example, investing in green technologies is not only because they provide a competitive advantage but also because they align with societal expectations and regulatory requirements. Moreover, analysing risks from both an internal resource and an external institutional environment perspective enables startups to have a more comprehensive risk management strategy that includes regulatory compliance, social legitimacy, and the efficient use of internal resources.

3.2 Relationships between components

The conceptual framework demonstrates the relationships between the different components derived from the literature review. This subchapter elaborates further on the relational directions between the different components and the assumptions made. These assumptions have been made to guarantee the research's quality and keep focus on the research question.

– *Influence of strategic orientations on their strategic practices*
Strategic orientation in organisational management refers to the intention towards a specific behaviour (Agolla et al., 2019). Strategic orientation, as previously discussed in this chapter and the literature review, reflects the attitude, values, and direction startups aim to pursue towards specific goals. Startups implement their strategic orientation by taking actual actions (Lumpkin and Dess, 2001). The single arrow from orientation to practices represents a unidirectional relationship. This attitude and intentions are needed before actually carrying out practices. This relationship is also causal, as a firm's orientation leads to specific strategic behaviour. While certain practices may reflect future orientations, the relationship's primary direction is from orientation to practices (Keszey, 2020; Fatoki, 2020).

The RBV theory confirms this relationship. The strategic orientation is often seen as a strategic resource. The orientation can, at this moment, be seen as a valuable resource because it can drive innovation, improve brand reputation, and attract environmentally and socially conscious customers and investors (Ferreira et al., 2011). Following the RBV theory, startups that effectively align their orientation with their practices can create a competitive advantage. Furthermore, while the institutional theory does not explicitly state the relationship, the literature suggests that institutional factors influence a firm's strategic orientation, thereby guiding its strategic practices (Latif et al., 2020; Ranta et al., 2018; Wang et al., 2020). For instance, institutional pressures often prompt a startup with a strong sustainability orientation, leading to behaviours and practices that align with institutional norms and expectations (Latif et al., 2020; Ranta et al., 2018).

- *Resources as a moderator between SO/DO and sustainable/digital practices*

  The resources are crucial for startups, as mentioned in the literature. The literature demonstrates how to apply the RBV view in research, integrating resources and strategic orientations. Within the literature, the relationship between resources and strategic orientations can be both directional and moderating. This research views resources as a moderator that influences both orientation and practices. Empirical studies by Lumpkin and Dess (2001) and Wiklund and Shepherd (2003) have confirmed the moderating role of resources, which Barney (1991) has emphasised. Wiklund and Shepherd (2003) explore the moderating role of knowledge-based resources between EO and performance. They found that these resources are crucial for discovering and exploiting opportunities.

  Furthermore, resources improve strategic fit, contextual sensitivity, and dynamic capabilities, thus moderating strategic orientation. R&D and IT skills can moderate a company's DO towards digital innovation practices. Digital infrastructure can moderate how openness affects partnerships with suppliers and incubators (Zhou et al., 2005). Sustainable resources, such as waste reduction programmes, can shift the focus from minimal waste to circular economy practices. Strong supplier relationships, sustainable materials, and advanced supply chain management software can mitigate sustainability orientation's effects and improve their supply chain carbon footprint (Kohtamäki et al., 2019).

- *External incentives as moderators between SO/DO and sustainable/digital practices*

  External incentives and their relationship with strategic orientation and practices can be grounded in institutional theory (Liu et al., 2010). Therefore, the literature states that the theory posits that startups are subject to external pressures shaping organisational structure and practices. While these pressures can influence strategic orientation and practices, they often act as moderators by shaping the context in which strategic decisions are made. These incentives, such as tax benefits for sustainable practices and non-compliance penalties, can affect the relationship between the orientation and its practices. They create conditions that either increase or decrease the startup's strategic responses. Instead of directly impacting practices, they influence the effectiveness of strategic orientation in achieving desired outcomes (Emamisaleh and Rahmani, 2017; Liu et al., 2010; Quinton et al., 2018). For example, a startup may have a strong DO, but its execution depends on market demand, awareness, and regulatory requirements for digital security and privacy. A deterministic view, where external factors directly dictate organisational behaviour, would emerge if external incentives were a direct influence (Quinton et al., 2018). However, institutional theory argues that although environments influence organisations, they maintain agency in interpreting and responding to these incentives (Jansson et al., 2017; Quinton et al., 2018). Furthermore, this relationship is single-directional, as the firm’s orientation cannot influence the external environment.

– *Relationship between digital and sustainable practices*

These relationships, unlike previous ones, are not explicitly grounded in RBV theory or institutional theory. Even so, the dynamic capabilities theory and the resource orchestration theory, which are both extensions of the RBV theory, imply that the coordination of resources and capabilities may bring about chances, problems, or barriers, which may eventually cause trade-offs (Ahmad Zaidi and Othman, 2012). The orchestration theory explains how to efficiently orchestrate and coordinate resources to leverage them and create synergies (Eurico et al., 2022). On the other side, the theory states that resource scarcity might reduce one's availability (Eurico et al., 2022). For example, prioritising digital practices may shift funding and attention away from sustainability projects or vice versa (Lichtenthaler et al., 2021). If a startup overinvests in either digital or sustainable practices without considering the other, it may deplete resources and miss possible synergies (Eurico et al., 2022). Both arrows are bidirectional, meaning they can influence each other, creating trade-offs and synergies in both directions.

– *Stakeholders' relationship with resources and incentives*

Finally, the stakeholders provide the necessary resources and external incentives. This relationship is based on empirical data from the extended SRBV theory by Tate and Bals (2018), specifically the second capability of stakeholder management added by them. From an RBV perspective, stakeholders become critical suppliers of resources that contribute to a competitive advantage. Expectations and demand drive startups to allocate resources towards certain strategic practices (Latip et al., 2022). Securing long-term business sustainability depends on how owners and managers implement micro-level actions, which help them recognise, manage, and respond to stakeholders' claims (Del Giudice et al., 2017).

From an institutional theory perspective, stakeholder conforms to institutional norms and values in their environment. Stakeholder pressure is defined as the ability of stakeholders to influence a firm's decisions (Helmig et al., 2016). Stakeholders, such as customers, employees, regulators, and communities, embody these norms and expect firms to adopt sustainable practices. Startups can enhance their legitimacy, reputation, and competitive advantage by aligning with stakeholders' societal norms, regulatory requirements, and market expectations (Steurer, 2005).

It is important to note that stakeholders differ from social resources. Social resources refer to the non-physical assets derived from social structures, relationships, and networks the startups can leverage. At the same time, stakeholders are individuals or groups with an interest or power in the organisation's practices. Stakeholders facilitate these social networks through trust, networks, reputation, and social capital.

4. Methodology

A systematic literature review (SLR) has been conducted to explore the existing literature. This method is described in chapter 4.1. Subchapter 4.2 explains the qualitative research method used to answer the research gaps.

4.1 Systematic Literature Review

The research followed the SLR guidelines outlined in the PRISMA 2020 statement by Page et al. (2021). This method offers a comprehensive summary of the latest research and literature. The SLR procedure is systematic and consists of specific steps for defining, identifying, evaluating, and synthesising literature to fill research gaps in our field. In the upcoming sections, the outcomes of the SLR are presented to identify various research gaps in the research field.

4.1.1 Search Strategy and Flow Diagram

The SLR has been set up by searching the online literature databases Scopus, ScienceDirect, and Web of Science. Therefore, different search terms and filters are used for relevant articles. Appendix A1 provides a further detailed overview of the combinations of terms and filters per database.

Table 7: inclusion and exclusion criteria for the SLR

	Inclusion Criteria	Exclusion Criteria
Language	English, Dutch	Other languages than Dutch or English
Date relevance	After 2010	Before 2010
Research format Classification	– Scientific Papers, books, journals, and articles. – Must be peer-reviewed	Informal blogs, Website articles, master thesis papers
Research Topics	– Specific focus on strategic orientation or strategic entrepreneurship – Resources-based view towards the study – Articles related to RBV, institutional theory, and sustainable and digital practices	– No specific focus on strategic orientation – Too deep focus on the psychological practices of entrepreneurship – Focus on individual orientations or individual entrepreneurial intention
Research Area	Management, Business, Social sciences, Entrepreneurship, Environmental science, Digital Management, Economics, Decision-making science	Computer engineering, Environmental engineering, Mathematics, Software engineering, medical science

A three-stage literature filter was used to refine search results and find the proper research. In the first stage, the paper titles and abstracts were carefully scanned. The abstracts summarised each study's purpose, methodology, and main findings, making it easy to assess its relevance to the research objectives. At this stage, papers that did not meet the research criteria were excluded. The research then thoroughly screened papers that passed the first screening. The introductions and conclusions from selected articles were read to determine if they met the inclusion criteria. Study design, population, interventions, and outcomes could be criteria. Each secondary screening study was evaluated against the inclusion and exclusion criteria. Including only studies relevant to the research question and objectives in the review is essential. The diagram below provides a detailed overview of the PRISMA flow diagram.

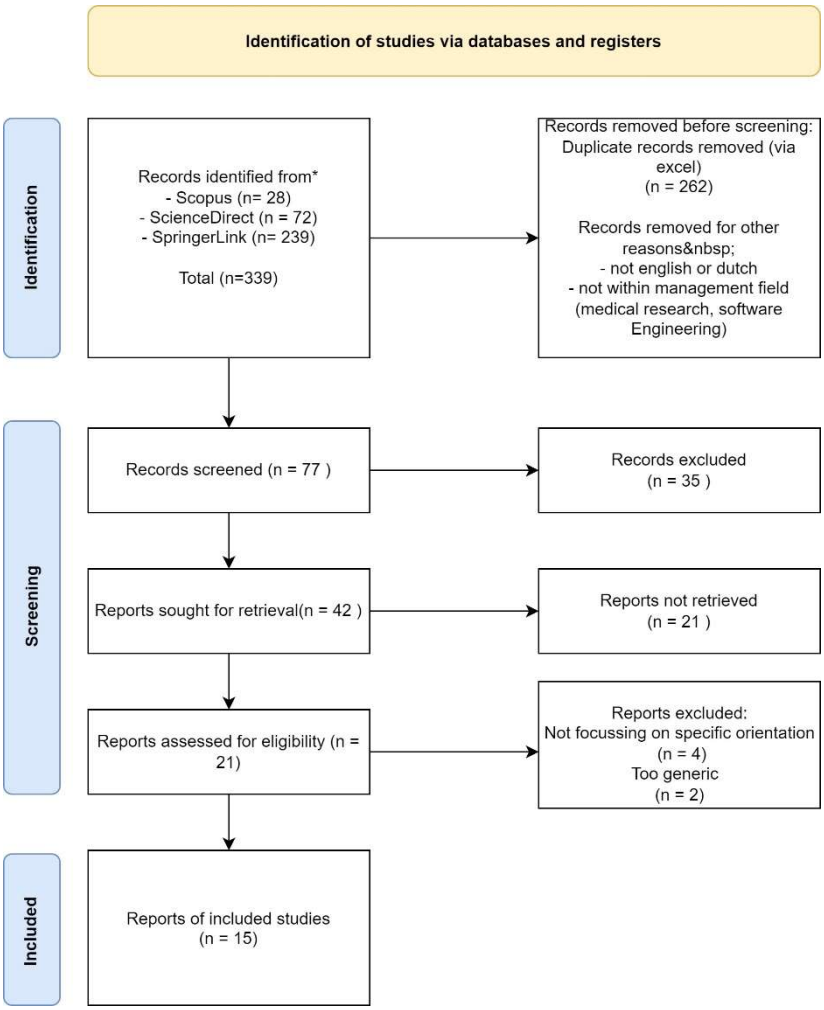

Figure 7: PRISMA flowchart of the systematic literature review

4.2 Qualitative Content Analysis

A qualitative content analysis (QCA) was used as a primary research method. QCA is a qualitative research methodology that analyses and interprets the content of qualitative data, such as text, audio, and visual output. It systematically categorises and interprets data to identify patterns and relations between different sources. This method is excellent for in-depth analysis of complex causal relationships because it uses systematic and objective ways to describe and quantify phenomena from textual and auditory data (Mayring, 2000). A qualitative method was chosen because the research goal is to explore and understand different complex relationships between components instead of confirming relationships of statistical significance.

Mayring (2000) defines two main types of QCA: inductive and deductive (Elo and Kyngäs, 2008; Mayring, 2000). Inductive QCA is based on inductive reasoning, in which categories and themes emerge from the data through content analysis and comparison. This method is used when there is insufficient knowledge about the problem. Given the predefined theories and categories of resources, institutions, orientations and the undefined trade-offs and synergies, both deductive and inductive approaches were employed.

– *Deductive Content Analysis*

  Deductive coding employs a systematic approach to content analysis. Mayring (2000) outlines several steps for this process, which is adopted in the research. These steps are illustrated in Figure 8. The first step is to find appropriate theories or concepts of the orientations, resources, and pressures. The literature review shows several definitions of digital and sustainability orientations. Several theories have been analysed, and based on the definitions, categories, and methods in which these concepts of orientations have been used, it has been decided to use the measurement scales of Kraus et al. (2017), Roxas and Coetzer (2012) and Dantshoho (2020). Based on Mayring's (2000) process, several codes

have been developed to identify the different resources, pressures, and levels of digital and sustainability orientations.

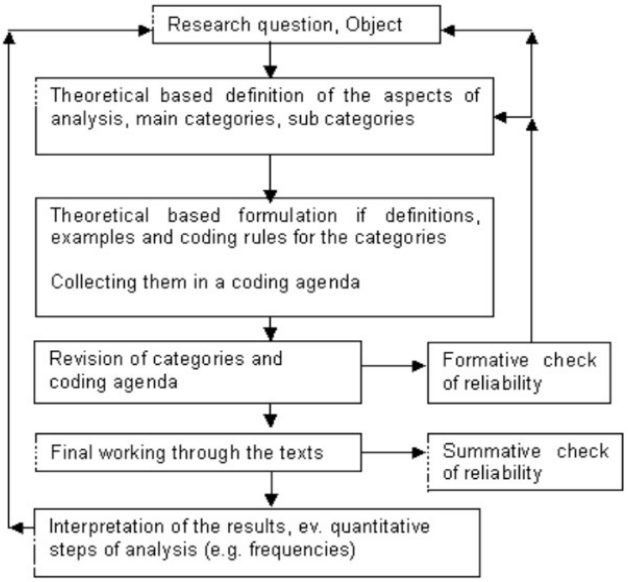

Figure 8: Step model of deductive coding (Mayring, 2000)

– *Inductive Content Analysis*

For the exploration of trade-offs and synergies, neither empirical nor theoretical literature is found on this topic. Therefore, the inductive approach of the QCA by Mayring (2000) is used. This form is particularly useful when little is known about a phenomenon, and no clear definitions are available in the current literature (Elo and Kyngäs, 2008). The main idea of the inductive procedure, as Mayring (2000) states, is to formulate a criterion of definition derived from theories that determine the aspects of the textual material considered. It is a systematic, rule-guided method to derive categories from raw data bottom-up. Unlike deductive methods, which begin with pre-defined categories and theories, inductive content analysis allows categories to emerge from the data, reflecting the content in a way that stays close to the material. Figure 9 shows us the sequential steps during an inductive QCA developed by Mayring (200

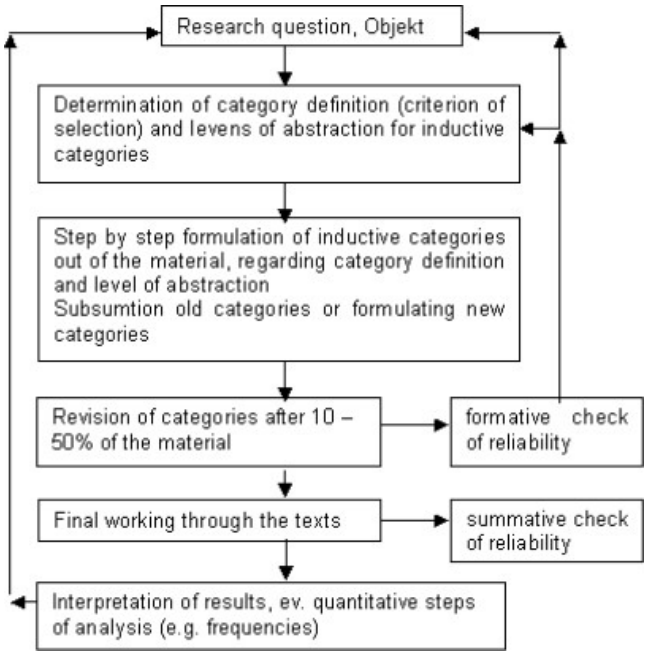

Figure 9: Step model of inductive coding (Mayring, 2000)

5. Data collection

Chapter 5 describes how the QCA has been set up using both deductive and inductive coding. The chapter details the data collection method, the participants' selection, and how the output data is analysed.

5.1 Data collection

In-depth interviews are conducted to collect the data and examine the various relationships. The following subchapters describe the suitability of interviews as a research method, the design of the interview guidelines, and the participant selection procedure.

5.1.1 Data collection method

The research focuses on the in-depth relationship between digital and sustainability practices within the Dutch startup ecosystem, necessitating a qualitative approach for data collection. Qualitative research offers a deep understanding of how individuals perceive and experience their environment, essential for gaining insights into entrepreneurs' strategic behaviours, values, and norms (Hlady-Rispal and Jouison-laffitte, 2014). The environment is critical for placing relationships in perspective, as different environments can influence the formation of trade-offs and synergies. For example, the French cleantech ecosystem might have legislation that fosters more digital, sustainable, risk-taking, or curious behaviours than the Dutch ecosystem. Resources such as financial, social, and physical assets can also vary in accessibility across sectors and countries.

Existing literature on strategic orientations calls for qualitative research, with over 90% of studies based on quantitative methods (Khizar et al., 2022). Qualitative research complements quantitative research by explaining the "why" behind the "what" (Busetto et al., 2020; Javadian et al., 2020). Managers and policymakers must understand the underlying reasons for these relationships. Given the lack of a theoretical framework for the interaction between digital and strategic practices, qualitative research is essential for further theory development.

One-on-one interviews were selected as the primary data collection method to understand the complexity of participants’ perceptions of digital and sustainable practices. Interviews allow for a nuanced understanding and in-depth insights, offering flexibility to explore new topics (Consalvo, 2023). As strategy direction can be a sensitive topic for startups, interviews ensure confidentiality and allow for an ethical and practical pace of data collection.

5.1.2 Interview design

There are three types of interviews: open, semi-structured, and structured. Open or unstructured interviews are the most flexible, as they do not follow a script or guide (Consalvo, 2023). Interviewers often use this type to explore sensitive and complex issues, adapting to the participant's responses. Conversely, structured interviews employ a predetermined set of questions presented consistently to each participant. This ensures consistency and comparability between participants' outputs (DiCicco-Bloom and Crabtree, 2006). In the middle of both styles lies the semi-structured interview. This interview structure has a framework of themes and questions but leaves room for further discussions, sub-questions, or even new topics based on the output (Consalvo, 2023; DiCicco-Bloom and Crabtree, 2006). A semi-structured interview structure was chosen based on the flexibility to explore new themes but also to identify predefined themes. Figure 10 provides an overview of the various components of the interview guideline.

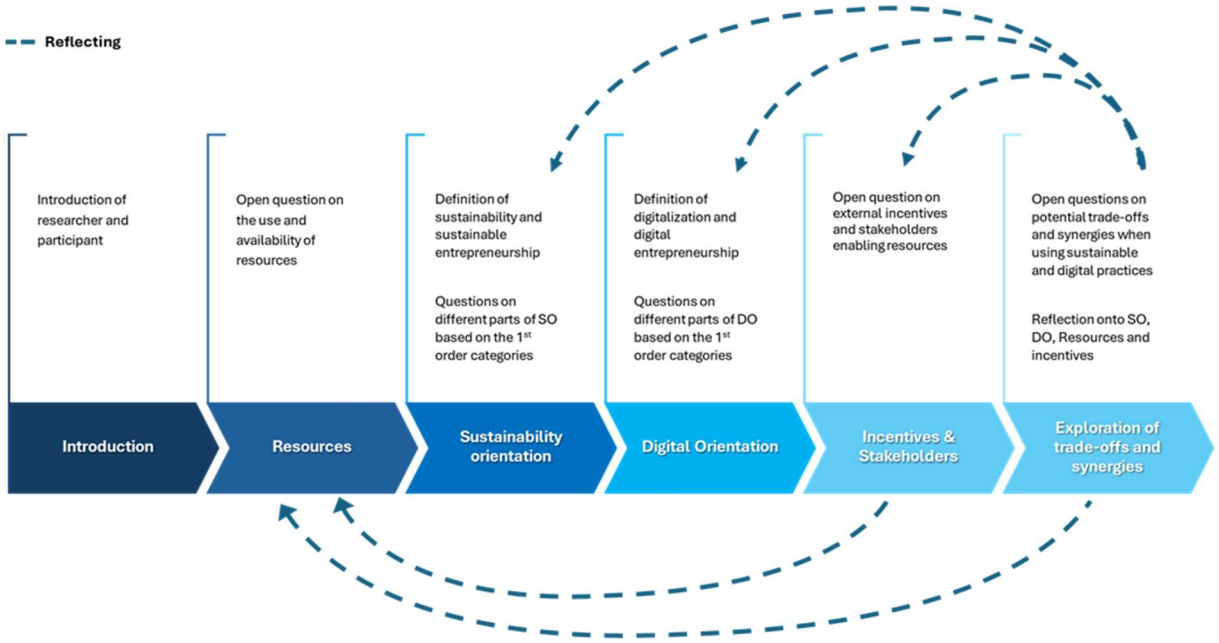

Figure 10: Interview structure overview

First, the researcher introduced himself and explained the research structure. He subsequently asked if there were any remaining questions about the HREC, which had been sent and signed before the interview. The initial question involved introducing the individual and their role within the startup. Before focusing on orientations, participants were asked to elaborate on the different resources the startups used within their operations, providing a comprehensive overview not limited to those utilised for sustainable and digital practices.

Open questions based on ESO and SSO categories were then conducted. Due to participants' limited time, the ESO and SSO dimensions were combined into a set of questions encompassing overarching themes. The second part began with the definitions of digital entrepreneurship and strategy, providing a framework for understanding how participants perceived these practices within their business operations. Open-ended questions were posed to uncover their business objectives.

Subsequently, the external incentives and stakeholders influencing these practices were discussed. The researcher reflected on the resources mentioned earlier and asked how they influenced their orientation towards digital and sustainable practices. This ensured the relationship between the resources and their moderating effects was addressed. The final section posed general questions about potential trade-offs and synergies using digital and sustainable practices. Responses to questions about DO, SO, resources, and incentives were considered. The discussion concluded by exploring the possibilities and drawbacks of digital and sustainable solutions beyond the company, providing additional insights into the future vision of entrepreneurs. Appendix H contains a comprehensive interview guide.

Due to practical considerations and participants' schedules, the interviews were conducted via Microsoft Teams and lasted between 45 and 60 minutes. Recordings were stored on TU Delft OneDrive, ensuring secure access. The interviews were conducted in English or Dutch, depending on participants' preferences.

5.1.3 Unit and scope of selected interviews

To ensure that digital and sustainable practices could be identified and valid, several criteria were set up for the selection. First, the startups needed to be involved in delivering products or services that enhance environmental or social sustainability and utilise digital technologies, either within their products or organisational processes. Secondly, startups from different industries were selected to broaden the research scope and comprehensively understand the relationships within various sectors. Thirdly, only Dutch startups that were more than three years old and had more than five employees were selected to ensure the validation of their business models and strategies. Ideally, participants were CEOs or founders of the cleantech startups, ensuring a thorough understanding of the company's strategy and business development. Figure 11 illustrates the funnel used to find, filter, and select the startups for this research. Eventually, The response rate was 50%, with two-thirds of respondents agreeing to participate in the research.

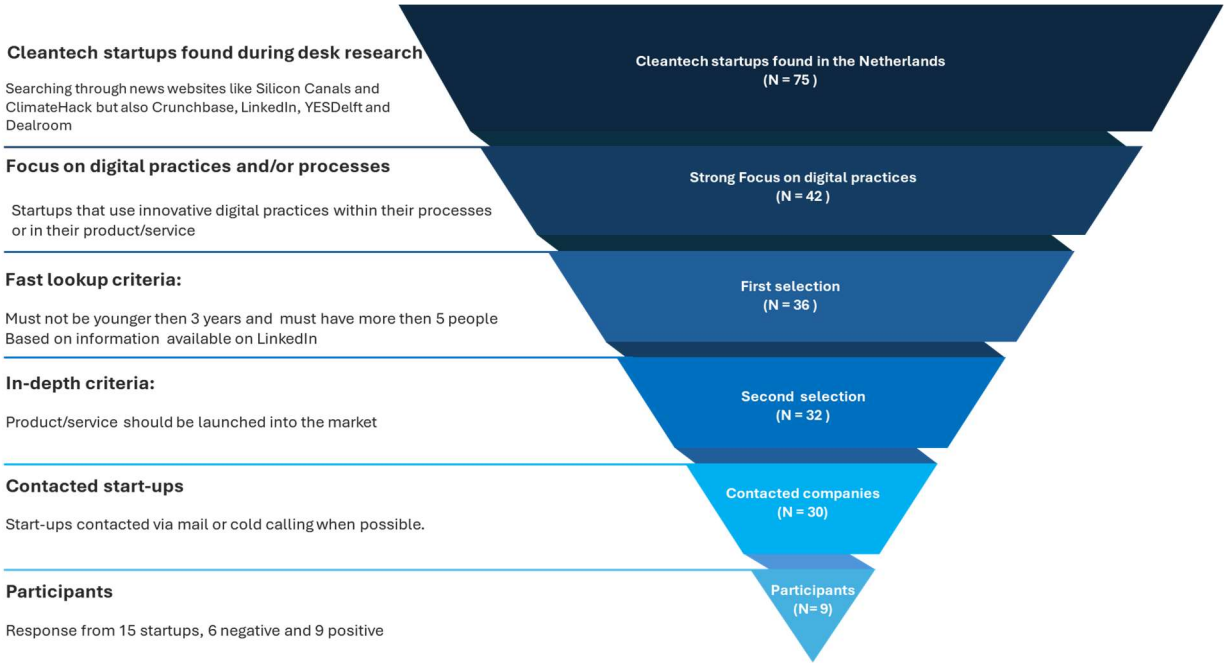

Figure 11: Selection funnel of participants

5.2 Overview of participants and startups

An overview and summary of the participants are provided in Table 8, including their roles, ages, experience level in entrepreneurship (beginner, intermediate, experienced), and the startups at which they work. This information thoroughly explains the research context and adds depth to the quotes emphasised during the QCA. Most startups had between five and ten employees, with participant 7 having the smallest with five employees and participant 8 having the largest with 33 employees. Outliers regarding age include participants 2 and 9, founded in 2010 and 2013, respectively, while the other startups were founded between 2016 and 2021. Most participants were co-founders and held executive positions within their startups.

Table 8: Participant overview

Partic-ipant	Industry	Founding Year	Size	Function of Participant	Date inter-viewed	Region
1	Biochemistry	2020	1-10	CEO/Founder	31/1/2024	South Holland
2	Circular/Waste management	2010	10-20	CEO	2/2/2024	Utrecht
3	Waste manage-ment	2019	1-10	CEO/Founder	5/2/2024	Overrijsel
4	Agriculture	2018	10-20	Business de-velopment	6/2/2024	South Holland

5	Logistics	2021	10-20	Co-Founder	13/2/2024	North Holland
6	Aerospace	2021	10-20	Co-Founder	13/2/2024	South Holland
7	Maritime	2018	1-10	CFO/Co-Founder	9/2/2024	South Holland
8	Energy	2016	30-40	COO	26/2/2024	South Holland
9	Finance	2013	20-30	CFO	17/4/2024	South Holland

– *Participant 1*

Co-founder and CEO | Age: 30+ | Chemical engineering background | Intermediate

The first participant is the CEO and co-founder of a biochemical startup specialising in lactic acid production through innovative fermentation methods. With a background in chemical engineering and experience as an oil engineer, the startup focuses on circular chemistry by revolutionising lactate fermentation using side streams for more sustainable production. The participant transitioned from an oil company to starting a cleantech startup to counterbalance his previous work in the oil industry. The startup targets several Sustainable Development Goals (SDGs) as part of its sustainability KPIs. The company is currently pre-revenue.

– *Participant 2*

CEO | Age: 50+ | Chemical and Mechanical engineering background | Highly experienced

Participant 2 is a highly experienced entrepreneur and engineer with a chemical and mechanical engineering background. Previously, he worked at major chemical companies, specialising in chemicals, pharmaceuticals, and biotech, along with sales and operations expertise. The startup enables the production of valuable raw materials (Carbon Black) from end-of-life tyres for reuse in tyres, technical rubber products, plastics, paint, and ink. They provide the technology, product development, and plant installation. They have four fundamental values: quality, sustainability, ease of use, and safety.

– *Participant 3*

Co-founder and CEO | Age: 20+ | Sustainable engineering background | Inexperienced

Participant 3 is the CEO and CTO of a smart waste management product. The motive for starting the startup is the increasing environmental degradation on the island where he grew up. He has an educational background in advanced sustainable engineering and smart cities. The startup initially started as a digital platform for people to exchange plastics for rewards, which later evolved into a B2B company creating intelligent bins to sort plastic waste. This waste management method is sustainable and cost-efficient for their clients, as they do not have to separate their waste afterwards.

– *Participant 4*

Business Development Lead | Age: 20+ | Business background | Inexperienced

Participant 4 is the business development lead of an aggrotech startup based in Delft. He is the only one with a business background responsible for the startup's financial and commercial aspects, including sales, marketing, and investment rounds. The startup focuses on using software to analyse crops for diseases. Their technology integrates machine learning with specialised sensors. The startup is strongly connected with YESDelft and is located in the Westland, close to greenhouses.

– *Participant 5*

Co-founder | Age: 30+ | Engineering background | Intermediate

The fifth participant is the co-founder of a platform assisting with sustainability footprints through the whole supply chain of customers, mainly focusing on the environmental impact of packaging. Through his earlier job as a strategy consultant, they found that there was still a need for a unified way to measure companies' whole supply chain footprint. The startup delivers a platform using blockchain and data analytics, providing sustainability insights. They work together with the TU Delft to improve their platform and algorithm further.

– *Participant 6*

Co-founder and CEO | Age: 20+ | Aerospace engineering background | Inexperienced

Participant 6 co-founded a startup combining aerospace technology with environmental data, monitoring the environment based on carbon mass, flooding mapping, hedges, and hydric stress. He has an educational background in aerospace engineering, and the startup idea was born from the ESA incubation programme.

– *Participant 7*

Co-founder and CFO | Age: 20+ | Business background | Inexperienced

Participant 7 is the co-founder and CFO of a maritime cleantech startup. His responsibilities include sales and finances, which match his business background. The startup is developing state-of-the-art control levers that optimise interaction between operator and shop. These levers and data analytics software can optimise fuel savings, increase safety, and reduce long-term operational costs. By using these levers and learning from their data, these levers can optimise the speed and fuel consumption of the ships.

– *Participant 8*

COO | Age: 40+ | Business background | Highly experienced

Participant 8 is the COO of a renewable energy startup. He has a business background and has worked at several other companies, ranging from communication agencies to media creators to finance. He is responsible for overseeing operations and the go-to-market strategy. The company aims to produce renewable energy through mobile wind energy. It uses simulation models to predict flight patterns and optimise energy production performance. Furthermore, it has TU Delft as a shareholder, which focuses on the company's long-term strategy.

– *Participant 9*

CFO | Age: 30+ | Business Background | Highly experienced

The last participant is the CFO and senior investment manager of a crowdfunding platform focused on fostering social impact and fighting poverty in developing countries. The participant has a business background and has previous work experience as a portfolio manager at an asset management firm and as the CFO of a tech company. The startup delivers an online platform connecting investors with emerging market social enterprises. It offers investments with fixed interest rates and defined repayment periods. However, they also clarify that investing in these projects carries risks, which investors should consider carefully.

5.3 Qualitative coding analysis

This chapter elaborates on the deductive and inductive coding process during the QCA. A complete list of the deductive and inductive codes can be found in Appendix B and C.

5.3.1 Deductive coding analysis

– *Preparation phase*

The first phase of deductive coding analysis is the preparation phase. This phase outlines the research questions and the theoretical background based on previous studies (Mayring, 2014). A selection of definitions from Dantshoho for DO, Kraus et al. (2017) for SSO, and Roxas and Coetzer (2012) for ESO were made, all grounded in the RBV theory. The author used the institutional theory to analyse the external environment, classifying external incentives into normative, coercive, and mimetic categories.

– *Definition of categories and subcategories*

The defined categories are checked to see if they are suitable for use within a business, sustainable, and digital context. The categories of Dantshoho et al. (2020) have been developed during qualitative research and validated by an expert panel with an entrepreneurial background. Furthermore, the categories of SSO were constructed based on the well-known categories of entrepreneurial orientation. ESO categories have been developed by conducting a Delphi study among entrepreneurs and social researchers. This ensures the constructs are well-validated and suited for social and sustainable

entrepreneurship. The institutional theory is used to classify the external incentives into normative, mimetic, and coercive pressures. The subcategories of the pressures have been derived from Latif et al., 2020 Liu et al., 2010 and Ranta et al., 2018. For the resources, the definition of Marcon and Ribeiro's (2021) is used, expanding the categorisation of Ireland (2003) for emerging technologies. This classification is focused on innovation ecosystems, which, in the research context, is ideal to use. Appendix B provides a comprehensive overview of the main categories, codes, and definitions.

The first and second interviews are used as test-run interviews to cope with the different codes. Some codes (from the theories) were slightly redundant within their category during the transcript coding. Therefore, some codes are merged. These mergers were only done with subcodes within their main category; otherwise, this could distort the main category and miss critical elements. A complete overview of the final codes can be found in Appendices B and C.

– *Coding and revision*

The interviews are coded in ATLAS.ti, specialised software for qualitative data analysis, including text documents, audio, and video. This ensured a systematically organised analysis of the results. These categories are in nominal order and should be independent of each other (except for the overarching category units). The coding was revised after participant 2, leading to the merging of some codes, as seen in Figure 12.

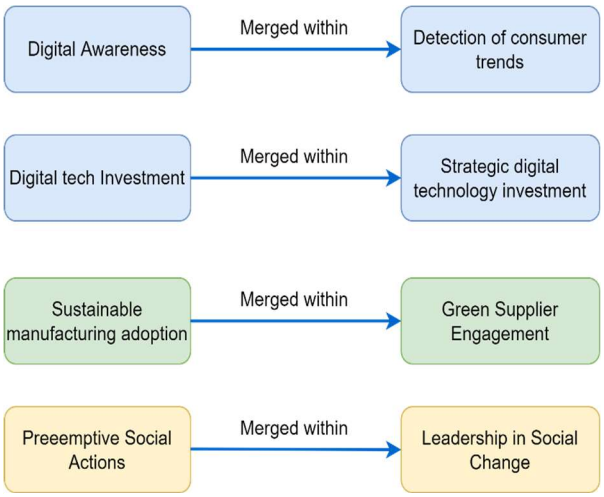

Figure 12: Merged codes during coding

– *Interpretation and Reporting*

The interpretation and reporting of the coding analysis is the final step to exploring the relationships between different components and interpreting the findings derived from the interviews. For the deductive QCA, the definitions of sustainability and digital entrepreneurship were derived from the participants. This is important because it gives context to the answers and shows how the participants see these practices. Often, their perspectives align with the product or service their startup has delivered. Next, an in-depth overview of the identified categories is given during the deductive content analysis. The data visualisation uses tools from ATLAS.ti (co-occurrence analysis) and Draw.io (graphs). Meaningful participant quotes are highlighted to support the results.

5.3.2 Inductive coding analysis

The code development is now directly represented as the preparation phase is the same as in the deductive part.

- *Code Development*
  The literature review explored research questions and the theoretical background related to the opportunities and challenges of utilising digital tools within sustainable businesses. The open coding process was initiated with an initial round to identify emerging themes and patterns. Following this, the first round of open coding was reviewed, and some categories were redefined. After the open coding, the codes were reviewed for similarities and overarching themes. Subsequently, the codes were grouped, ensuring each code fit into one theme without overlapping. An overview of the themes and codes can be found in Appendix C3.

5.3.3 Analysis

After identifying the different components during the QCA, the output is analysed in four ways to explore the underlying dynamics between the components and see what influences them.

- *Descriptive analysis*
  The first is the descriptive analysis, which gives insights into the resources, incentives, strategic orientations, trade-offs and synergies. The most prominent and outlying quotes from the participants are highlighted. This process gives us insights into what resources startups have, which incentives they feel from the environment and their strategic orientation levels.

- *Stakeholders' analysis*
  As it is crucial to analyse the different stakeholders and how they influence the resources and incentives, a stakeholders analysis has been done. The stakeholders are analysed based on their influence on sustainable and digital practices and mapped on a power-interest grid. Furthermore, a matrix has been created to clarify how they enable resources and what pressures they put on the participants.

- *Interview comparison*
  An interview comparison is made based on their demographics (age, size, industry) and the presence of orientations, incentives, and resources. A colour coding scheme is used to classify the components in three colours (red, yellow, and green), where red means that the category has not been identified, yellow means it has been identified but not further elaborated on, and green means that the category has been extensively present in several ways. This comparison gives us insights into patterns between the orientations and the trade-offs/synergies, helping to identify different relationships elaborated in the relational analysis.

- *Relational analysis*
  The code document and co-occurrence tools from ATLAS.ti and the interview comparison were used to explore these relationships. This relational analysis provides insights into the moderating/mediating/enabling role of resources and incentives between the orientation and their practices, improving our research findings.

5.4 Validation of results

The theoretical and empirical evidence in the academic literature has founded and validated the conceptual framework. Furthermore. The validation of the results from the QCA is done in several ways. The supervisors peer-reviewed the interview guidelines, delivering feedback based on their experiences and knowledge. The steps taken during the QCA and analysis were documented, including data collection, coding procedures and analysis, ensuring a clear justification of choices made. Furthermore, a reflection of the results on the conceptual frameworks is made in the discussion part, ensuring that the results were consistent with the conceptual framework. At last, a reflection on the author its own influence was made, together with a comparison with the academic literature and a presentation of the research limitations

5.5 Research Flow Diagram

Figure 13 presents an overview of the components of the research approach and where the different sub-questions are exposed. The research consists of two parts: deductive and inductive QCA. SQ1 is about the identification of the trade-offs and synergies. They appear during the descriptive analysis of the inductive QCA. The relationship between both parts is analysed using deductive and inductive descriptive analyses. The relational and interview comparison answers SQ2, 3 and 4. SQ5 is exposed during the stakeholder analysis. Eventually, when answering these sub-questions, an answer to the main question is given in the discussion

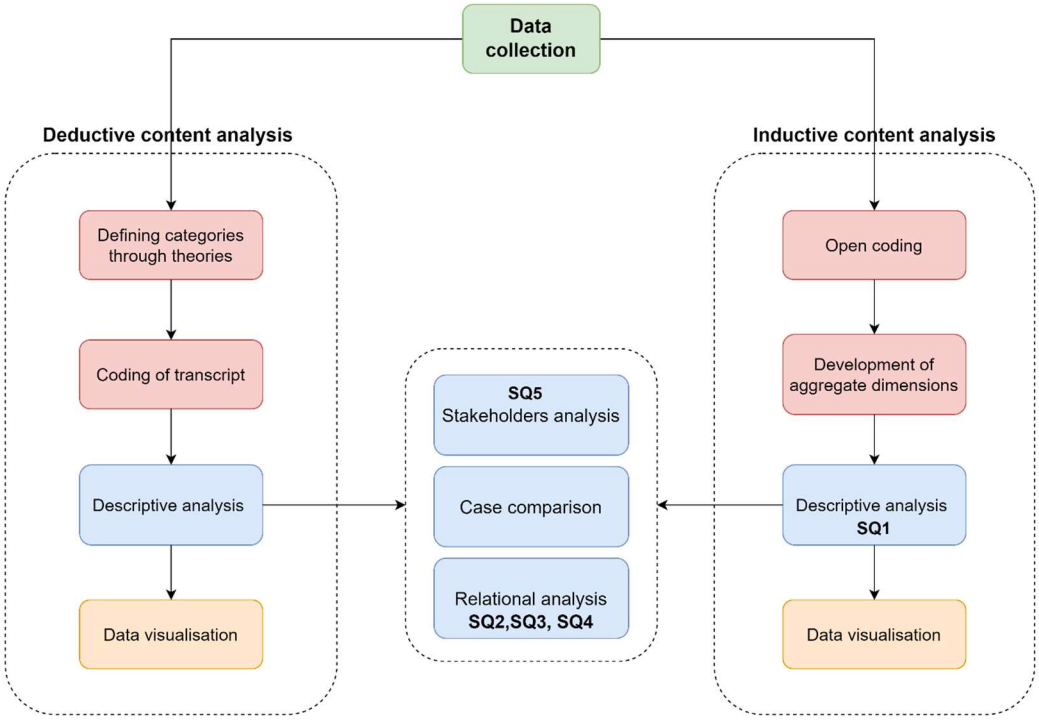

Figure 13: Research Flow Diagram

5.6 Ethics Approval

The interview process and the use of research with human trials are considered ethical aspects related to participant privacy and data security. Therefore, a data management plan and consent form were made to comply with the Human Research and Ethics Committee (HREC) ethical requirements. The participants were informed well before the interview about the study and how their data was collected, stored, and used in the study. They were sent and signed a consent form for the interview. Before the interview, the interviewer asked if this form had any ambiguities. During the reporting of the results, the quotes that were used explicitly were forwarded to the partners. In addition, a management plan has been drawn up to ensure that the collected data is stored and used ethically. The interviews were all conducted via a secure connection and Microsoft Teams. The recordings of the interviews and transcripts are all stored on TU Delft's OneDrive, to which only the author has access. These were removed after the investigation for confidentiality purposes. The data management plan and informed consent form were approved by TU Delft's HREC on 21/2/2024.

6. Results

Chapter 6 presents the results of the deductive and inductive QCA. The chapter begins with an overview of the participants and their definitions of sustainable and digital entrepreneurship. Next, the deductive QCA results are presented, followed by the results of the inductive QCA, which exposes the trade-offs and synergies.

6.1 Definitions of sustainable and digital entrepreneurship

Before diving deeper into the different dimensions of the research, it is essential to know how entrepreneurs see and define sustainable and digital entrepreneurship. The definitions give context for how they implement their strategies. Appendix D1 provides a comprehensive overview of the participants' definitions.

– *Sustainable entrepreneurship and strategy*

Participants defined sustainable entrepreneurship and strategy, primarily emphasising the environmental aspect of sustainability over the social aspect. Participants 1, 5, 8, and 9 acknowledged social sustainability in their definition of sustainable entrepreneurship while also acknowledging the SDG goals. A common theme was the necessity of acting in a way that does not harm the environment, focusing on resource responsibility, minimising waste, damage, and pollution, and ensuring actions are regenerative rather than depletive. Several definitions highlighted the goal of creating businesses that do not negatively affect future generations, suggesting that resources are used self-generative and that business practices consider the long-term. Participant 3 also noted integrating financial considerations with the commitment to creating positive environmental outcomes. Furthermore, participants have referred to sustainability as a focus on long-term goals. They refer to future strategies being scalable and future-proof, passing on knowledge to future generations, and minimizing the impact of current practices on future generations.

Many definitions aim to minimise environmental impact through waste management, pollution reduction, and resource management. Some responses, however, suggest a conflict between sustainability as a regulatory requirement or marketing strategy. The participants highlight the importance of regulations, finances, collaboration, awareness, and the company's public image.

"So sustainability for us is a way of creating a business that cannot negatively impact future generations in such a way that the resources that are used are self-generative and allow for more resources to continue to be used without harming the planet or making things more difficult for any other future generation. Moreover, in terms of sustainable entrepreneurship, basically that definition, but just in terms of finances, so whatever entrepreneurship you do, you can continue to do that entrepreneurship within that field." [participant 3]

"You speak about creating a positive impact, which improves user well-being while simultaneously generating revenue. This ensures that you are not dependent on subsidies. Sustainability and social impact are related to enhancing equality, addressing both gender issues and developmental aspects." [participant 9]

– *Digital entrepreneurship and strategy*

Digital entrepreneurship, like sustainable entrepreneurship, has multiple definitions due to its comprehensive context. However, a clear theme emerges: streamlining processes, increasing efficiency, and delivering customer value. It specialises in various tasks, including data analysis, algorithmic simulations, and software development. Participants emphasise using digital resources to achieve entrepreneurial objectives. This entails using available resources to expand revenue streams through digital methods or other means, emphasising the use of digital platforms for creating new revenue opportunities and highlighting the importance of scalability. This involves creating product ecosystems that enable users to operate independently and gain better insights through digital dashboards. These dashboards are crucial for making informed decisions by analysing comprehensive data and setting performance expectations.

Digital technology integration can help with collaborating with customers and external partners. This approach focuses on the importance of continuously adapting and innovating digital strategies. The participants have different definitions, showing digital entrepreneurship's intricate and ever-changing nature. Their perspectives differ depending on their context, industry, and digital practice goals. They stress the need to use existing resources, build ecosystems, and use data to make decisions.

"What we tried to do is we want to use what we have and take as much out of it as possible and turn that into different revenue streams, whether digital or not."[participant 3]

"In terms of our digital strategy, it is really about leveraging technology to enhance system performance and efficiency. We constantly develop and integrate various tech elements, such as algorithmic simulations and software. Using agile methodologies like Scrum, we are always refining our hardware, embedded software, simulations, data analysis, and user interfaces. Additionally, we are actively exploring new technologies and collaborating with external partners to integrate [...] models and geographical data, ensuring smoother operation and compliance with regulations." [participant 8]

Both sustainable and digital entrepreneurship definitions emphasise long-term goals, whether through minimising environmental impact or scalable, technology-driven business models. Innovation is central to both concepts, with sustainable entrepreneurship focusing on innovative solutions for environmental challenges and digital entrepreneurship concentrating on digital tools to improve their product and scalability.

6.2 Available resources

– *Financial resources*

The financial resources have been identified in three subcategories: cost management, funding strategies, and revenue management. Funding resources combine traditional and innovative approaches, such as loans, venture capital, and innovation subsidies. However, due to the perceived high risks associated with such investments, a cautious attitude exists towards venture capital and private equity, especially among startups with a strong sustainability focus. Subsidies are crucial financial support in the early stages of startup development and R&D. There is a call for more cohesive action from entities like the European Union to support startups through subsidy programmes. Cost management discussions reveal various views on primary financial pressures, focusing on reducing salary expenses through self-reliance. Product development and infrastructure investment, including software development, is flagged as a significant expense, emphasising the financial resources required for digital innovation and scaling.

"Companies with the primary goal of sustainability are way too risky for private equity firms. [....] Subsidy programmes are essential. I hope, therefore, that the EU will act much more as an EU than any country on its own." [participant 2]

"To build software, investment is necessary but building software is just extremely expensive." [participant 5]

So then it's interesting, but actually, you see that if there is not a lot of subsidy involved [participant 7]

We got a substantial grant from USAID to improve automation/digitisation" [participant 9]

– *Social Resources*

Social resources highlight how startups depend on relationships, networks, and interactions with stakeholders and regulatory bodies. The networks from incubators and accelerators emerge as important for learning, talent acquisition, and gaining credibility. Customer feedback enables startups to refine their products based on their clients' needs. Despite their social resources, the approach to managing in-house knowledge and external partnerships revealed a potential conflict in strategies. While some startups stress the importance of conducting as much engineering and development in-house as possible to maintain control over their technology, others see the absence of long-term contracts as strategically advantageous, favouring flexibility.

"I think the incubators and the programs are very important for us to learn how to build a company better. The biotech and sustainability area is very new, and people don't exactly know how to better build a company." [participant 1]

"We do as much engineering in-house as possible[...] you have to keep the technology in control all by yourself." [participant 2]

"They trusted us at the beginning...so we can say that we worked with ESA, which was very valuable when we wanted to engage with people because nobody knew, and still nobody knows our name." [participant 6]

"The fact that there is much interaction between [...] as a company to bring a product to the market and TU Delft with the aim of producing research [...] So we are not concerned with the strategy in 10, 15, 20 years. That is what TU Delft does. We are really thinking about the next five years. And that's nice and complementary." [participant 8]

– *Intellectual resources*

Intellectual resources are critical in fostering innovation and efficiency and protecting businesses. Many participants highlighted using intellectual property, such as patents, to protect their innovative technologies and certifications like CE and C to comply with several technical regulations and safety standards. Several participants highlighted the importance of external knowledge management from research institutions, incubators, and users. These actors help with R&D and feedback iterations of the product. Startups commonly adopt agile development methodologies, such as multi-week sprints. However, maintaining control over intellectual resources and knowledge, especially during fundraising, poses challenges. The public nature of patents and their easy avoidance underscore the value of know-how over patents.

"We do as much engineering in-house as possible." [participant 2]

" I myself have much more value for knowhow than for patents, because patents are public and so you can copy them and then you can work around them, moreover, patents in certain regions, are hardly enforceable." [participant 2]

– *Physical resources*

Physical resources, particularly operational assets like buildings, digital infrastructure and software (including AI models and blockchain), are crucial for the startups. The reliance on digital, logistical, and energy systems points to the need for a robust ecosystem, especially in sectors like biotech, where infrastructure is lacking. Challenges include making hardware reliable and sourcing affordable, sustainable parts. There is a preference for European suppliers over cheaper Chinese suppliers to ensure their products' logistic reliability and quality. The startup's location emerges as a strategic asset, with proximity to greenhouses, technical talent, and R&D facilities. Situated near academic institutions and within supportive ecosystems like YESDelft, the startup enhances access to engineering talent and creates an inspiring space for innovation.

"In biotech, it is a bit difficult nowadays, in this sense, because the ecosystem is not there. So, we need to develop many sub-optimal things so that they can work in the end. And for instance, upscaling, there are not a lot of companies that help us upscale. So we upscale ourselves." [participant 1]

"We are located at YESDelft. That's very nice in the sense that you're really next to TU Delft. So that's very easy if you want to attract new people and engineering talent. [...]YESDelft builds itself in terms of rent, facilities, and other things, which is really ideal." [...] "It is very important to us that our location is in the Westland, with many greenhouses around us and therefore also many customers. We have a lot of greenhouses where we can test our technology. Where we can get input and feedback from the end users. That makes it even more ideal in Delft." [participant 4]

– *Organisational Resources*

The values of knowledge exchange and the global applicability of products are essential. One participant emphasises the desire for their technology to be globally accessible, reflecting a response to market globalisation driven by digital practices. Participants also underscore the importance of work ethics in environmental sustainability, emphasising the importance of a passion for sustainable practices and daily operational decisions like choosing eco-friendly travel options and providing vegetarian meals at the office. Furthermore, remote working has been emphasised to enable flexible organisations and access to more talent.

"So we work 80% remotely, actually, and the 20% is when we come together to put the bins together. As a result, we have team members from all over the world. This helps with attracting people." [participant 3]

"We try to take the train instead of the plane. [...] We also facilitate vegetarian meals." [participant 8]

– *Innovation Resources*

Product innovation is reflected through activities such as R&D and launching products that are the first in the market. Examples include the development of new fermentation technology for biotechnological applications, enhancements in waste management systems focusing on process efficiency, and introducing mobile, sustainable renewable energy systems. Customer engagement strategies represent service innovation. Startups value customer feedback highly, as it informs continuous product improvement. One startup strives to adopt a consumer-led approach, modifying its operational scale to uphold service quality and guarantee sufficient training for customers to utilise their software. During the interviews, there was a brief mention of process innovation, not as a standalone resource but as a means to foster product and service innovations. Some mention refining business processes to support customer services through an AI chatbot or data analytics.

"We do pilots with the customers. They use the machines. We get the data, we train it, and it gets better." [participant 3]

"We have a lot of greenhouses where we can test our technology. Where we can get feedback and input from the end users" [participant 4]

"What we are ultimately working towards is that we want to be product-led. So that users can use it themselves. That also makes the scalability." [participant 5]

– *Human Resources*

A critical insight from the interviews highlights the importance of the team in driving the company's progress, with one participant underscoring that their team is the most critical resource. The startup's team composition consists predominantly of male engineers with industry-specific specialisations. One startup mentioned that only one member possesses a commercial background, indicating a high technical specialisation. Moreover, pursuing workforce diversity, especially gender diversity, is challenging, with most startups focusing on skills and talent rather than gender equality. One participant briefly mentioned training and development, indicating they participated in a training programme with their accelerator. At last, a strong statement from participant 2 regarding the language barrier was made, which can sometimes be predominantly Dutch-speaking. This makes it more challenging to cooperate with local clients in the Netherlands.

"It's a very, very strong barrier that is a blind spot for people who can speak Dutch. If you are dealing with people who only speak English in your team, who want to reach out, and like if you send an email in English, they won't respond to you. As soon as they send them Dutch, they respond to you. It's very, very over it with that." [participant 3]

"If you want to build a good company, I think it is very important to have people that trust the project." [participant 6]

"And, of course, the most important resource is really just the team. So basically, the team with which we try to get the company a step further day and night" [participant 8]

"Also (some) employees have been pushing the automation agenda significantly." [participant 9]

6.3 External incentives

– *Coercive Pressures*

Investor pressures emerged as a significant theme, revealing a complex landscape where sustainability expectations are balanced with profitability and scaling demands. These investor attitudes appear to vary, with some companies experiencing a more relaxed approach from their investors, described as *"very chill."* In contrast, others face pressure to generate profit, underscored by the imperative that *"it has to make money."* This variation implies that different investor strategies exist, with varying degrees of flexibility and patience with growth trajectories. Some investors prefer sustainable growth and long-term value creation over rapid expansion, favouring strategies that promise durability and resilience rather than immediate financial gains.

Companies report a variety of interactions with regulatory frameworks, ranging from proactive lobbying to the perception of regulations as either lagging behind industry innovation or as a facilitator for opening new markets. The results highlight the challenges with the compliance of technical regulations and opportunities presented by stricter sustainable regulatory compliance, fostering market demand. Some participants expressed a proactive attitude towards regulations, emphasising the importance of navigating these frameworks to avoid penalties and leverage them for market advantage. In contrast, others tried to work around the technical regulations.

"The thing about sustainability is sustainability does not make a business; you need to make a business case around it, and you need to return the money." [participant 1]

"You actually see that the regulations follow what the companies are doing; for example, with a green deal and everything, of course, we try to steer, but then you constantly run into things, and they have to be arranged, and so that is very clearly slowing us down." [participant 2].

"It's just, your sales market is just going to get bigger, because the legislation is making them stricter." [participant 4]

– Mimetic pressures

Startups can imitate or compare themselves to other organisations or competitors to improve their legitimacy, especially during uncertain times. Despite the lack of market validation of certain products and limited market awareness, there is a lack of mimetic pressures due to the novelty of the products.

However, some participants emphasise their role as industry leaders, leveraging early adoption of their technology and sustainable practices in a new market. This strategic positioning aims to lead the market and gain a majority, not by copying existing models or imitating competitors. Other participants emphasise value-based differentiation, prioritising the delivery of benefits over competitive pricing and quality strategies. Another aspect is the importance of validation and verification for sustainable practices, reflecting a strategic divergence from unverified imitation and emphasising the importance of credibility. Finally, as mentioned in the social sources section, the participants emphasise leveraging participation in accelerators and incubator programmes to gain credibility, outsource knowledge, and attract new talent to their teams. Furthermore, they do not feel pressure from incubators or accelerators to perform digitally or sustainably.

"If you want to stay ahead of the curve with your technology and therefore always have the most attractive technology, you have to continuously invest in technology."[...] We've been able to position that because we were one of the first ever, in 2016." [participant 2]

"We start a company, and immediately there is someone who says, here is a big bag of money; we will take you over. But that doesn't work because then you'll notice your sustainability claims." [participant 5]

– *Normative pressures*

Normative pressures are significantly present within the interviews, especially in sustainability. The discussions reveal a move towards practices that align with industry expectations for environmental sustainability. Furthermore, ethical standards also emerge as normative pressure, transcending digital and environmental considerations to include social practices. They also emphasise the significance of satisfying their customers through price competitiveness, quality service, and product reliability. They also raise customer awareness about sustainable practices and how digital practices can boost their business. An area that has received less attention is the ethical use of digital technologies. While some startups mention compliance with the GDPR, the discussion is often not extensive.

"Yes, there are always some customers that will be aware of this and some that won't. It depends on which area you're talking about." [participant 1]

"What we do know is that it is possible to get the AI good enough to actually sort of waste better, but people wanted yesterday." [participant 3]

"We're trying to make sure that it has a positive impact. One of the motives is this. It's not financial incentive." [participant 6]

6.4 Digital orientation

– *Digital curiosity*

Companies that adopt new technologies and leverage digital technologies use these capabilities to improve their product offerings, streamline operations, and improve customer interactions. The push for digital leadership accompanies the challenge of aligning technology with business objectives and customer needs.

There is a common understanding of customer needs and market complexity. Companies understand that customer engagement is more than just selling a product; it is also about raising (sustainable) awareness, providing value, and ensuring that their product or service fits their needs well. Their digital technologies, like AI chat and dashboards, can assist them in understanding the added value of their products and services and onboarding clients. The participants identify dependency on digital technologies as a clear risk.

Some participants emphasise an aggressive approach to scaling and creating technological leadership, such as releasing products quickly with potential "ugly and less efficient code" and later cleaning up the algorithm and aiming for the accuracy of their software code. On the other hand, caution is needed about the danger of scaling too quickly using digital practices without sufficient validation of their product, service, or market as stated by participant 5. Some participants develop their products with iterative feedback loops, releasing a minimum viable product and refining it over several iterations based on customer usage and feedback. Other participants focus on developing digital products based on the potential of the technology. A customer-centric approach can lead to products well-suited to current market demands but might be less revolutionary. In contrast, a tech-driven approach can lead to more innovative and disruptive products but carries the risk of developing something that the market is not ready for or does not perceive as valuable.

"The commercial part has a challenge of understanding what the customer wants." [participant 1]

"If you want to stay ahead of the curve with your technology and therefore always have the most attractive technology, you have to continuously invest in technology." [participant 2]

"But from the beginning, just always validating okay, we're going to make this, but do they want that, and actually always ask what exactly that customer wants." [participant 7]

– *Digital alertness*

The interviews and codes on digital alertness demonstrate a common understanding of the rapid changes in digital practices. The startups recognise the value of implementing digital practices to grow their businesses, comply with digital regulations, and improve quality through innovative technologies. Businesses use digital solutions to ensure regulatory compliance, particularly in carbon credit accounting. The ability to track and utilise data effectively is a common theme, indicating that businesses are keen on using data analytics to optimise their service and products. They often indicate the importance of robust data monitoring systems for informed decision-making, such as centralised dashboards and tracking systems. They emphasise the need for the interoperability of their systems with other digital solutions (such as AWS, Azure, etc.), which can foster collaboration and outsourcing of processes.

"That regulation is now under development, but two years ago, we were hopelessly stuck in it, and yes, then I also made a plea, I made a plea in an interview, so we really have to do something about this, we then lobbied a bit in the House of Representatives." [participant 2]

"We try to not be into a process that takes too much time to be certified, or to have regulation compliance." [participant 6]

– *Digital openness*

The companies emphasise the importance of activity control over their data and knowledge. There is a need to balance keeping engineering and core competencies in-house while encouraging collaborations and data exchange with institutions, investors, and incubators. Most startups form partnerships for non-core activities. This strategy enables them to expand their capabilities without exceeding their resources and protecting their technologies. However, participant 2 mentions that while maintaining control over core technologies is critical, external collaboration is required for growth and scalability. The participants expand on the concept of 'unlicencing' technology and dismiss licensing as a poor strategy, indicating a preference for direct control and flexibility in business model innovation.

Community engagement is another recurring topic in which startups work directly with early adopters and academic institutions to improve their products and contribute to the ecosystem. Although the startups are rather protective of data exchange with incubators and outside partners, they digitally interact with customers to get customer feedback and validate their products.

The startups did not mention open-source contributions and usage; instead, they relied on open-source software. It is unclear whether there is an emphasis on sharing findings, research, or innovations with the broader community, which would be an aspect of digital openness about knowledge exchange. Only a few mentioned that they apply different digital regulations for using and collecting data from their clients (GDPR).

"Anything that doesn't have to do with your core technology, you just have to enter into partnerships for it... So, equipment suppliers, then we have a real engineer contractor who can provide the parts details." [participant 2]

"We really determine our own technology. Our technological roadmap, so to speak... We're just really thinking about the next five years." [participant 8]

– *Digital innovative passion*

There is a strong desire to enable and enhance the client experience through digital practices. Startups use digital practices such as platforms, generative AI chatbots, and sensors to collect customer data while improving the client experience by providing digital support and analytics. Some participants expressed a willingness to allocate resources to digital development, such as attracting software engineers, facilitating data exchange, and using cloud computing (AWS). The participants demonstrate how they use digital practices to improve and innovate their business model by creating new revenue streams through digital channels. The findings shed light on the difficulties of scaling up technology from

a pilot to an industrial scale and the significant increase in capital expenditure that comes with it, a phenomenon known as the Valley of Death.

"What we did was take out the identification parts of Garby and make it into another product. We call it Garcia."[participant 3]

"But from the beginning, just always validating okay, we're going to make this, but do they want that, and actually always ask what exactly that customer wants."[participant 7]

"Our product can be technologically possible, it can already do a lot more, but you have to deal with a certain acceptance by the market, so you now have to offer a product that may be less possible but which is accepted." [participant 7]

6.5 Sustainability Orientation

6.5.1 Environmental Sustainability Orientation

– *Sustainable Knowledge*

There is overall recognition of climate change, and each startup has its own definition of tackling these problems, often related to their industry. Some participants mention sustainability and climate change as intrinsic motivations, while some mention their startup ideas in response to regulations, such as the SDG or customer needs. The startups are aware of the level of sustainable customer awareness. There is a notion that business models need to adapt to customer expectations, striving for sustainability while also meeting commercial goals.

Their technical and educational background is seen as a vital advantage for creating sustainable practices within these industries. Without this knowledge, it would become more difficult to understand the market, clients, and technology. Furthermore, they underpin the lack of a digital ecosystem and infrastructure, especially in newer industries. There is also awareness of regulatory and logistical barriers and the necessity of scaling sustainability efforts to meet significant environmental goals, like the EU's Green Deal.

"It's not financial incentive, the first motive. It's, of course, it is. But let's say it's at the second level or the same level as positive impact." [participant 6]

– *Sustainable Practices*

The sustainable practices emphasise how the startups organise their different operations to be as sustainable as possible. Within the cleantech startups, which also have sustainability as their primary goal, There is a clear distinction between the sustainability of their operations, such as the green manufacturing of their products, and the environmental impact that their service or product creates. However, there is a strong indication that there is still a great lack to adopt green operations and partner with green suppliers in order to minimize their own carbon footprint. There are references to the commitment, but there is less emphasis of these practices within their long-term sustainability strategy. Lastly, there are no quotes regarding employee training for sustainable practices.

"We haven't really focused much on assessing how 'green' our operations are, such as using scoring systems to measure our environmental impact. Although I have looked into it and considered how our website performs on sustainability scales, we haven't actively engaged with these measures. However, I recognise that as we grow, it will become increasingly important to evaluate and communicate our sustainability more formally. The real impact we're making right now is in helping our customers make more sustainable choices." [participant 5]

– *Sustainable Commitment*

Their sustainable commitment is based on the belief that a sustainable core in business attracts investors and customers, thereby increasing brand value. When startups commit to sustainability, they communicate to potential investors and customers that they are future-oriented and responsible, which can be a strong selling point. However, these statements highlight the inherent conflict between profit and purpose, suggesting that businesses strive to maintain sustainability without compromising profitability. For example, one statement underscores the need for a business model prioritising sustainability and ensuring a competitive return on investment. This implies that while sustainability is integral, it should not come at the expense of profitability.

The startups actively respond to sustainable regulatory changes. Not only are they keeping pace, but they are also actively participating in developing new regulations, as demonstrated by participant 2's involvement in lobbying. This engagement is critical in novel industries where regulations still catch up with startups' innovative practices. Statements indicate a firm reliance on community and social networks to further business operations, particularly in the early product development and testing stages. Utilising social resources can lead to faster prototyping and iteration. This approach can foster a sense of community involvement and potentially lead to more sustainable community practices.

"In the maritime sector, sustainability often feels more like a requirement than a genuine commitment. It's imposed by regulations and utilised as a marketing tool to appeal to younger generations." [participant 7]

"The biggest barrier to entry into the market at the moment is regulation." [participant 8]

6.5.2 Social sustainability orientation

– *Social Innovativeness*

Only a few startups had a social mission as a core goal. While some startups focus on work equality, they often struggle to allocate their time to exploring innovative ways to enhance their social impact. Only participant 9, whose main product facilitates Dutch crowdfunding for social projects in developing countries, had a clear primary mission to invest in social impact. Most participants did not emphasise the risks associated with digital practices or their operations in general. Innovatively, they only try to incorporate social goals as a side goal, not the primary business mission. This could be mainly due to the industry and purpose of their product or service.

"We aim to fight poverty in emerging countries by investing in people and businesses." [participant 9]

– *Social Risk-taking*

Social risk-taking refers to bold actions necessary to achieve their social mission. Although the risks were rarely related to a social goal, they were based on the goal of developing their product or launching it onto the market. They highlight taking strategic risks, such as investing heavily in technology and accepting that some innovations require a period of learning and potential failure. In addition to investing in unproven technology, the vagueness of regulations was one of the primary reasons they took risks to develop their products further, as mentioned by participant 8.

"One client decided to opt out as their products, supposedly sustainable items shipped from China, began to result worse in our analysis. They wanted better marketing scores, but we couldn't compromise on accuracy, so this led to the end of the relationship." *[participant 5]*

"We can just be best in the class and do everything exactly by the book, but then we won't test, we won't fly and develop our products, so every now and then you have to take a shortcut, take a conscious risk." [participant 8]

– *Social Proactiveness*

Social proactivity is the stance from which startups take the lead in addressing social goals or mimicking other companies that have already implemented similar social practices. Entrepreneurs perceive this proactive approach as demonstrating leadership in their industry, whereas participants 2 and 9 are the only two who have consistently identified this proactiveness. People perceive social sustainability not only as minimising harm but also as actively contributing positively to society. Startups recognise a consensus that attracting like-minded talent is crucial for companies with a social mission.

"So we have less to worry about on the management side... But yes, I do want to attract people in a moment. We are located in Eindhoven... You do have the talent to fish." [participant 2]

"The impact our platform makes is in line with the Sustainable Development Goals" [participant 9]

"We work closely with our portfolio companies and have regular personal contact with the entrepreneurs. We also monitor the social impact they make in their work area."[participant 9]

– *Socialness*

Sustainability and its importance in business operations are emphasised. While most startups originate from a sustainable perspective, others underscore the significance of promoting equality within their teams or addressing poverty in developing nations. They emphasise making an impact but must remain viable to continue creating social and sustainable impact. Furthermore, sustainable strategic partnerships are included in their strategy, such as collaborating with impact investors and participating in charitable initiatives. While some startups argue that sustainability or social impact is their core value, others mention that cost savings or profitability are often the first questions from clients or partners. While some say getting a workforce and talent is easy, others say finding a good balance between men and women is still challenging. They often argue that there are too few women with a technical background.

"If they really start thinking circularly, and not just in linear chains, but start thinking circularly,. Yes, I think that will give a whole new impulse to innovation." [participant 2]

"Making a positive impact is our core business. Our goal is to be transparent about the impact an investor makes." [participant 9]

6.6 Explored Trade-offs and Synergies

The second part of the QCA identifies different trade-offs and synergies when using digital and sustainable practices. There is no theoretical and empirical evidence of these trade-offs and synergies within Dutch cleantech startups, so an inductive approach was used to explore and identify these possible relationships. The following results answer sub-question 1.

6.6.1 Trade-offs

Table 9 presents an overview of the overarching trade-offs, with the participants identifying these trade-offs. This analysis is based on the inductive coding process, where dilemmas emerge. An overview of the inductive coding process and quotes found per trade-off can be found in Appendix C2 and C3.

Table 9: Overview of identified trade-off per participant

Participants	1	2	3	4	5	6	7	8	9
Strategic priorities trade-offs	✓	✓	✓	✓	✓	✓	✓		✓
Regulatory trade-off					✓	✓	✓	✓	✓
Resource allocation trade-offs	✓	✓	✓	✓	✓		✓	✓	✓
Operational trade-offs		✓	✓		✓		✓	✓	
Market Engagement trade-offs		✓	✓		✓	✓	✓	✓	

– *Strategic Priorities trade-offs*

The participants highlight five prominent themes within their strategic decision-making process, each in their context and which they see as significant considerations. These are profit, scalability, validation, R&D, and sustainable impact.

First, Startups face a trade-off **between profit and sustainable impact.** Participants recognise the tension between making sustainable choices and generating profit. While acknowledging the interdependence of social impact and financial survival, most emphasise financial concerns over sustainable impact. They often create business cases around sustainable products that offer clients impact and cost reduction. Second of all, a trade-off is identified between **sustainable impact and scaling**. For example, participant 3 had to choose between increasing waste sorting accuracy at the expense of longer processing times or reducing code complexity to shorten processing times without compromising sorting quality. This trade-off arises from differing user expectations and client requirements.

Thirdly, The discussions highlight a familiar tension **between scaling up quickly to gain market share and continuing to invest in R&D**. Participant 3 mentions pushing the current version of a sorting machine into the market despite knowing that more R&D could lead to a much better product. Fourth of all, startups face the dilemma of **investing in R&D and validating their products**. Significant resources may be spent on development, but without proper market validation, there is a risk that the investment will not pay off. This is particularly true in novel industries with long R&D cycles, such as cleantech.

Finally, participants seek to **balance validation and scaling**. They must weigh the benefits of quickly bringing a less capable product to market against taking the time to validate and potentially scale a more advanced product, emphasising the importance of timing and growth.

"There's sustainability, but the thing about sustainability is sustainability doesn't make a business, you need to make a business case by itself, you need to return the money, and the rate of return needs to be as high as you would get outside the market."[participant 1]

“Today it's really only about one thing, is that we get enough speed and now funding that we're going to get this ball rolling.” [participant 2]

“Most of the time, it's all about how we can save money using this machine.” [participant 3]

“The risk that we're taking is that we over are developing our tech.’’ [participant 6]

– *Regulatory trade-offs*

The second overarching theme pertains to the regulatory domain, where entrepreneurs make trade-offs. Four main themes were identified in which entrepreneurs faced dilemmas or trade-offs regarding the regulatory compliance of their products.

Participants 2, 5, 7, and 8 note a trade-off **between R&D development and regulatory compliance**. There is tension between adhering to current legislation and pushing innovation boundaries. Participants find specific sustainability regulations challenging, mainly when they apply to their suppliers rather than directly to their businesses. For example, participant 2 mentioned new regulations for sustainable tyre production, which complicate recycling due to additional materials. Participants also note that their R&D developments often outpace regulations, leading to bold actions such as testing products without permits or moving testing outside the Netherlands.

There is also a trade-off between **regulatory compliance and adapting to market demands**. Startups must be agile to respond to market needs, but certifications can slow market readiness and strain financial resources. Participant 6 mentions strategically working around specific certifications to save time and money. While participants recognise the importance of regulations that drive sustainability,

such as mandating recycling in product design, they acknowledge that market-driven solutions may be faster. They highlight the need for technologies that meet future regulatory requirements while being economically viable. Especially, the maritime and agricultural industries take a conservative approach, underscoring the need for increased awareness about sustainable practices and digital technologies.

"So when you talk about innovations and new technologies in the direction of sustainability, you actually see that the regulations follow what the companies are doing" [participant 2]

"As a startup, you need to go fast. And if you cannot go fast, you die. So we try to not be into a process that takes too much time to be certified, or to have regulation compliance. Of course, we want to be a regulation compliance for everything, but we try to go in ways that they do not need all the regulation, all the things." [participant 6]

"The biggest barrier to entry into the market at the moment is regulation. And what kind of system is it? Is it a drone? Is the plane? What is it really just? And is it allowed here? "[participant 8]

– *Resource Allocation trade-offs*

While the startups claim they have no trouble attracting new employees, they still struggle to achieve gender equality within their teams, resulting in a predominantly male workforce. **The startups prioritise technical skills over workforce equality.** Additionally, some startups prefer in-house knowledge over outsourcing to incubators and institutions. They fear their "special sauce" becomes public when patents expire before they are fully operational. Some participants also express caution about obtaining external financial resources due to dependence on investors, preferring to focus on sales and market penetration.

"It's much better to just put knowhow in a good team and just be clear with each other because we're going to share this and we're not going to share this, and then deal with that as much as you can." [participant 2]

"So we really do try to create diversity and male-female. Yes. But it's really, really hard because, yes, if you put out a tech job, then 90% of the people who are interested are just men." [participant 4]

– *Operational trade-offs*

The startups acknowledge their understanding of internal sustainable practices, such as using recycled materials, E-waste and managing emissions from data centres. Despite this recognition, most startups, except for participants 8 and 9, **consider their external sustainability and social impact more critical**. For example, one participant incorporated external sustainability metrics, citing a greater sustainable output than internal impact. Another participant initially used sustainable and recycled materials but found them not durable or reliable enough. Most participants prefer choosing more expensive European suppliers over cheaper options from China or South America due to the reliability of the parts and supply chain.

Since the COVID-19 pandemic, remote working has become extremely popular. Participant 3 relies entirely on remote work, facing challenges in manufacturing due to fewer people on the factory floor. Additionally, participant 3 mentions that using English as the primary language creates a larger-than-anticipated language barrier when engaging with Dutch-speaking clients.

" It is that impact is so great that everything we do, whether or not we travel to the office by train and buy green energy, is great. All of that pales into insignificance due to the impact of our product." [participant 2]

"Until the moment that you sail a ship more sustainably over us for a day, then we can make handles for another year, so to speak." [participant 7]

"My partner, John, is capable of doing it, and so is the one in Hungary capable of doing it. But he's landlocked. So it would be kind of weird to sort of get a replacement from someone there." [participant 3]

"A blind spot for people who can speak Dutch. If you are dealing with people who only speak English in your team, who want to reach out, and like if you send an email in English, they won't respond to you. As soon as they send them Dutch, they respond to you. It's very, very over it with that." [participant 3]

– *Market Engagement trade-offs*

Startups face pressure to deliver quality products due to increasing customer expectations driven by digital technologies like AI, big data, and blockchain. Customers demand higher quality and more advanced features as these technologies become more familiar. **Startups identified a trade-off between releasing a product quickly to meet customer demand (e.g., improved AI in waste sorting) and taking the time to enhance accuracy and functionality.** Additionally, they face a dilemma between providing bespoke solutions with tailored functionalities and achieving scalability for broader client use without extensive guidance or training.

Participant 5 mentioned that increased awareness through regulatory laws significantly raised demand for their supply chain management app, overwhelming their capacity to handle requests and onboard clients. Rapid scaling can worsen user experience, potentially harming the brand or app's reputation. While digital tools enhance scalability, apps often require onboarding guidance.

"The customers are willing to pay for accuracy, but they will get complaints about the time. "[participant 3]

"We could have been accurate faster at a quicker pace, but then the user experience goes down. So that's a bit of a trade-off there."[participant 3]

"Our product can be technologically possible, it can already do a lot more, but you have to deal with a certain acceptance by the market, so you now have to offer a product that may be less possible but which is accepted." [participant 5]

6.6.2 Synergies

Following the inductive coding process, 62 codes indicated synergies between the different components. These were eventually grouped into six overarching themes, covering efficiency, regulatory, operational, strategic and cultural synergies.

Table 10: Overview of identified synergy per participant

Participant	1	2	3	4	5	6	7	8	9
Digital integration and efficiency	✓	✓	✓	✓	✓	✓	✓	✓	✓
Digital practices fostering sustainable market awareness			✓			✓	✓		✓
Regulatory synergies				✓	✓	✓	✓	✓	✓
Operational synergies		✓	✓	✓				✓	✓
Networking synergies			✓	✓		✓	✓	✓	
Corporate culture synergies			✓					✓	✓

– *Digital integration and efficiency*

Digital practices like AI, blockchain, and digital dashboards significantly **influence the quality of startups' products and services.** Utilising these tools continuously enhances their products based on client data and feedback. For instance, AI can optimise processes and improve the accuracy of services, while digital dashboards provide real-time insights and analytics that help track performance and make informed decisions. Blockchain technology, in particular, is renowned for its capacity to guarantee data integrity. It provides transparency and confidence in environmental assertions by securely recording and verifying transactions. This transparency ensures that sustainability claims are trustworthy and verifiable, crucial for maintaining credibility with clients and stakeholders.

These digital practices are employed for better decision-making, data analysis, scaling, and product development. For example, data analysis helps identify trends and areas for improvement, while scaling solutions enable startups to expand their operations efficiently and reach a broader market. Product development benefits from continuous feedback loops facilitated by digital tools, allowing for iterative

improvements. However, it is noteworthy that these startups have not yet leveraged digitalisation to measure or improve their own energy usage.

"So the system that we use, so when you have an AI model, [...] the bigger the model, the more accurate it is." [participant 3]

"We do pilots with the customers. They use the machines. We get the data, we train it, and it gets better." [participant 3]

"So we are going to link it with blockchain technology. [...] We received a subsidy for this. We have algorithms that we build to predict those gaps." [participant 5]

However, for a comprehensive understanding of the system, having a digital dashboard is crucial. It allows you to gain insights into your ship's capabilities, its current behaviour, and how it should ideally perform. From there, you can make informed decisions. [participant 6]

"But if you want to have insight into your system, it is essential that you have a kind of digital dashboard for that and that you gain insight into what can your ship do, what does your ship do and how should it behave." [participant 7]

– *Digital practices fostering sustainable market awareness*

Startups are increasingly **leveraging AI and machine learning to improve the accuracy of their operations and enhance sustainability.** Startups understand the importance of presenting sustainability that appeals to the market and secures acceptance and adoption. Sustainable market awareness is particularly critical in traditional sectors like shipping and agriculture. Digital tools play a significant role in enhancing awareness through data collection and monitoring. These tools gather detailed information on resource usage, carbon footprint, and waste generation, providing valuable insights into the environmental impact of both individual and corporate activities. Predictive analytics can optimise supply chains, reduce waste, and improve energy efficiency, demonstrating the tangible benefits of sustainable practices to the market.

Moreover, **digital tools facilitate better communication about sustainability**. Real-time data and transparent reporting allow startups to showcase their environmental impact and improvements, fostering greater market trust and awareness. Continuous engagement with stakeholders and educating consumers on the benefits of sustainable practices are essential strategies.

"We do pilots with them. They use the machines. We get the data, we train it, and it gets better." [participant 3]

"You just have to create that awareness. It's a constant process, so we do this with the dashboards." [participant 4]

"For example, we're also trying to target a bit of ESG. But we want to be there in a way that we actually provide things. Right now, people are a bit sceptical about ESG." [participant 6]

– *Regulatory synergies*

Startups are not just navigating the landscape of sustainable and technological regulatory compliance but also leveraging it to their advantage. For instance, stricter pesticide regulations have opened up a new customer market. EU carbon emissions credits (EU ETS) are another example where customers can see both sustainable benefits and financial incentives. Digital tools like **blockchain enhance environmental claims' transparency, credibility, and validity**, aiding in technical compliance. As sustainable regulations become stricter, advancements in digital tools like carbon accounting software are expected to become more widespread. This synergy between regulatory compliance and digital technology is about meeting legal requirements and enhancing market position by demonstrating both sustainable and financial benefits to customers.

"What does play a role is that European legislation sees a lot of strict laws coming up around the use of chemicals, i.e. for the control of pests and diseases. Our technology can respond well to this and thus avoid the

need to use a lot of chemicals. So actually, our technology is really in line with that legislation in that respect." [participant 4]

Additionally, we're actively exploring new technologies and collaborating with external partners to integrate [...] models and geographical data, ensuring smoother operation and compliance with regulations." [participant 6]

– *Operational synergies*

The **specific resources they possess enable operational synergies**. Location has been identified as a critical factor in enhancing business responsiveness, customer interaction, and talent acquisition. Being close to industry hubs allows for quick client communication, effective networking, and access to talent. Examples include the maritime industry near the Port of Rotterdam, aerospace near ESA in The Hague, and agriculture near the greenhouses in Delft. Participant 2 also highlights their proximity to big tech player ASML as an advantage in talent acquisition. Some startups recognise the importance of sourcing materials that meet high environmental standards, even when part of their supply chain is international. European quality regulations improve product quality and encourage sourcing from suppliers who meet ethical and sustainable standards, thereby enhancing internal sustainability practices.

"We are located in Eindhoven. ASML is here. They are going to hire 30,000 employees here for a few years, so there are talents to fish for us" [participant 2]

"With the location next to the Westland, next to the greenhouses." [participant 4]

"So actually, the supply chain is mainly, almost entirely, Europe. So there is a certain quality standard. Just say that employees are treated in a good way." [participant 8]

– *Networking synergies*

Startups highlight the importance of **networking synergies in enhancing product offerings, client support, talent attraction, and R&D development.** Customer feedback is used to refine algorithms, which is crucial for improving and validating technologies and services. This iterative approach allows startups to remain agile and responsive to client needs and challenges.

Incubators like YESDelft, PortXL, and ESA provide crucial contacts and support startups with physical, human, social, and R&D resources. These incubators also add a layer of validation and credibility by associating startups with established and trusted entities in their respective fields. Additionally, partnerships with universities and R&D institutions bring valuable research and academic knowledge. These collaborations enable startups to continue developing new technologies while focusing on immediate objectives. This synergy benefits short-term and long-term product development goals, fostering a mutually beneficial relationship between academic research and market-driven goals.

"I think the incubators, the programs are very important for us to learn how to better build a company. The biotech and sustainability area is very new, and people don't exactly know how to better build a company." [participant 1]

"The incubators and programs are very important to us to learn how to better build a company [...] the incubators help because they help us to connect to people." [participant 1]

– *Corporate culture synergies*

Participants 3, 8, and 9 discuss the synergy that corporate culture can create with other operations. A **positive corporate culture fosters a productive work environment and attracts top talent**. By promoting a remote work culture, startups can build a global team without being limited by location or language barriers. Additionally, a company's strong ethical stance on diversity and sustainability can make it easier to secure public funding. As participant 8 mentions, public investors evaluate not only the financial viability but also the corporate culture of the startup.

A supportive corporate culture can lead to several other benefits, such as reducing turnover costs, attracting public grants and funding, and maintaining **institutional knowledge within the company.** A collaborative culture encourages innovation and creativity, as employees feel valued and are more likely to contribute new ideas. Remote work flexibility further broadens the talent pool, allowing startups to hire the best candidates regardless of their geographical location. This flexibility can lead to higher productivity, as employees can work in the most comfortable and efficient environments.

"So we work 80% remotely, actually, and the 20% is when we come together to actually put the bins together. As a result, we have team members from all over the world who help attract people." [participant 3]

"And, of course, the most important resource is really just the team. So basically, the team, we are just trying to do it day and night." [participant 8]

"Also some employees have been pushing the automation agenda significantly." [participant 9]

6.7 Summary of the results

Resources

Startups use financial resources through cost management, funding strategies, and revenue management but face high risks and difficulties obtaining subsidies. Social resources include networks with incubators and accelerators, creating trust and validation. However, long-term strategic partnerships are lacking. Intellectual resources focus on know-how over patents, with challenges in maintaining data control while collaborating with other actors. Physical resources include operational assets and infrastructure, with high costs in software development and a significant lack of digital infrastructure. Organisational resources emphasise knowledge exchange, while human resources highlight team composition and technical skills.

External incentives

Coercive pressures from investors and regulatory compliance require startups to balance sustainability with profitability. Cohesive support from entities like the EU in subsidy programs is lacking. Startups feel technical compliance pressure and experience vagueness in technical regulations. Normative pressures come from customers' expectations of added sustainable and economic value. The application of ethical standards in digital technology is insufficient, and no mimetic pressures are found due to the novelty of the industries with low competition. There is a lack of mimetic pressures due to low competitiveness in their novel industries.

Digital orientation

They integrate digital strategies to enhance products, streamline operations, and improve customer interactions despite challenges in aligning technology with business objectives and customer needs. They acknowledge the rapid changes in digital strategies and their significance for growth, regulatory compliance, and quality improvement, using data analytics and stressing system interoperability. Startups balance data control and knowledge exchange, enhance the customer experience and feedback with AI, chatbots, and sensors, and drive innovation while increasing market awareness and promoting sustainability.

Sustainability orientation

Startups emphasise environmental sustainability by tailoring solutions to industry-specific challenges driven by internal motivation and external factors such as regulations and customer demands. Measuring and implementing long-term sustainability strategies presents challenges due to financial constraints. Their commitment aims to attract investors and customers while balancing profit with sustainable impact. Startups actively respond to regulatory changes and contribute to new regulations, leveraging community and social networks to foster customer feedback and community building. Despite their strong environmental commitment and knowledge, internal sustainable practices are lacking. Startups lack a social orientation. Some participants acknowledge the importance of attracting like-minded talent, but it remains challenging to maintain gender diversity in their workforce due to the lack of female technical employees. Some participants do incorporate social activities.

Trade-offs

Startups face trade-offs in balancing digital innovation with sustainable practices. They must prioritise profitability by digital scaling while making a sustainable impact and improve digital tools while ensuring accessibility. Navigating regulations is challenging, as startups often push innovation boundaries ahead of existing regulations, causing delays and straining financial resources. Resource allocation dilemmas arise, prioritising technical skills over gender diversity and protecting intellectual property while avoiding financial dependency. Operationally, startups prioritise external sustainability impact and may choose reliable but costly suppliers. Remote manufacturing and communication add further challenges. In market engagement, startups balance rapid product release with accuracy and functionality, aiming for customised solutions while striving for scalability.

Synergies

Startups leverage synergies between digital and sustainable practices to boost efficiency, market awareness, regulatory compliance, operations, networking, and corporate culture. Digital tools like AI, blockchain, and dashboards improve product quality, optimise processes, and provide real-time insights while fostering market trust through transparency. Regulatory synergies arise from using compliance to open new markets and provide financial incentives. Operational synergies come from locating near industry hubs and sourcing high-standard materials. Networking through incubators and academic partnerships enhances product development and talent attraction. A positive corporate culture promotes productivity, innovation, and employee satisfaction, supported by remote work flexibility and ethical practices.

7. Analysis

This chapter compares the interviews to identify patterns between components regarding their industries, age, size level of orientation and available resources. The analysis identifies the stakeholders and how they enable their resources and pressure the startups. Eventually, a relational analysis elaborates on how resources and external incentives shape the interaction between strategic orientation and strategic practices.

7.1 Stakeholders' analysis

To fully understand how startups acquire their resources and external incentives, it is crucial to identify the stakeholders involved and how they enable or hinder these components. Stakeholders include investors, customers, suppliers, government agencies, industry associations, academic institutions, and non-governmental organisations. Each of these stakeholders uniquely facilitates or obstructs the acquisition of resources and incentives for startups. Furthermore, the power-interest grid on the startups' sustainable and digital practices shows us how stakeholders can be categorised and managed based on their influence and level of interest. This grid helps to identify which stakeholders are critical for the success of digital and sustainable practices and how to engage with them effectively. This analysis answers sub-question 5 of the research.

7.1.1 Stakeholders' relation to resources and incentives

Table 11: Stakeholders analysis matrix

	Resources							External Incentives		
	Phys.	Human	Social	Organ	Intell.	Financ.	Innov.	Coerc.	Mimet.	Norm.
Investors and shareholders				✓		✓		✓		✓
Suppliers	✓	✓					✓			
Regulators				✓		✓		✓		✓
Incubators	✓	✓	✓	✓	✓	✓				✓
Employees		✓		✓						✓
Customers					✓	✓	✓			✓
Academic / R&D institutions			✓		✓				✓	✓
Competitors					✓		✓		✓	
NGO's			✓							✓
Media		✓	✓							✓

Every identified stakeholder contributed to the startups' access to specific resources. The analysis shows that incubators are the primary providers of resources across various categories. They can help with physical resources (offices, test locations), human resources (talent attraction), social resources (networking), intellectual resources (knowledge management), and sometimes even financial resources such as grants. Investors and shareholders, although frequently mentioned, primarily provide financial resources and occasionally influence the startup's organisational structure. Furthermore, the results show that the only enablers of physical resources are incubators and suppliers, suggesting a significant reliance on these stakeholders to acquire physical resources.

Looking at the external incentives, most stakeholders are pushing for normative pressures. The focus is on industry expectations and ethical standards. Customers expect quality, customer service, and value for their money. Employees adhere to the startup's corporate culture, values, and ethical engineering standards. It is noteworthy that coercive pressure comes only from two stakeholders: investors and regulators. Investors are pressuring startups based on their financial performance rather than their sustainability and social performance. Regulators put pressure on the regulation of the startup's services

and products. These are mainly sustainable regulations, such as carbon emission regulations. Mimetic pressures come from competitors and academic institutions, which strive for industry leadership, and pressure from competitors in the price and quality of their products. These stakeholders, therefore, can significantly impact the pressure they put on startups and must be kept close by when making strategic decisions.

7.1.2 Power interest grid on strategic practices

It is crucial to analyse whether specific stakeholders possess the power and interest to influence behaviours toward digital and sustainable practices. Therefore, participants were asked if their stakeholders had significantly impacted their digital or sustainable practices. The power-interest grid (P-I grid) was used to map the stakeholders, classifying them into four categories based on their level of interest and power.

– *P-I grid towards sustainable practices*

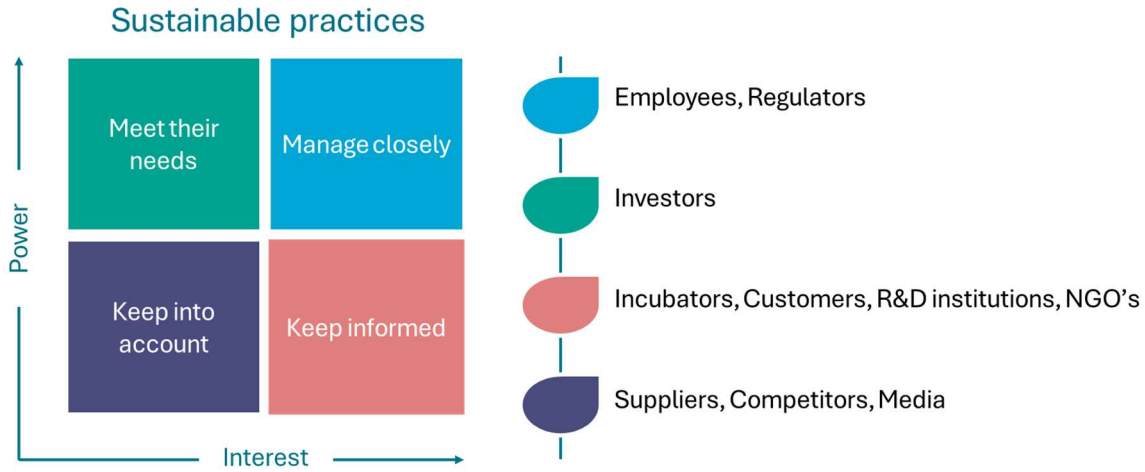

Figure 14: Power-interest grid sustainable practices

Figure 14 identifies employers and regulators as stakeholders with significant power and interest in startups' sustainable practices. Employees are highly skilled and knowledgeable about sustainability, giving them the power to influence these practices. Their interest is high due to personal values and job satisfaction. Regulators wield much power through sustainable legislation and regulation, directly affecting a startup's operations and business model. Their interest in sustainability is high, given the global emphasis on environmental regulation.

Investors must be satisfied, as they have great power in influencing the financial resources of the startups, focusing more on financial viability than sustainability performance. Customers have less individual power, but their collective sustainability awareness can shape market demand. R&D institutions offer expertise in sustainable research but typically do not directly influence a startup's sustainable strategy, except in the case of participant 8, where TU Delft demonstrated an evident impact on the long-term strategy. NGOs are interested in promoting sustainable practices but do not impose changes on startups' strategic direction. Competitors have their strategies, and while there is sustainable benchmarking, most startups aim to lead the industry by entering the market first rather than influencing their sustainable strategy. The media can influence public perception but may not be directly interested in a company's sustainability strategy.

"Socially, we are affiliated with an incubator like YESDelft...Within that network, there is a lot of attention to sustainability." [participant 4]

"Our shareholder ABN AMRO Sustainable Impact Fund "forces" us to work together with the Impact Institute to calculate the monetary equivalent for the impact created each year. Another shareholder, INCO, from France, "Negotiated to explicitly include impact targets in our shareholder agreement and report on them yearly." [participant 9]

– *P-I grid towards digital practices*

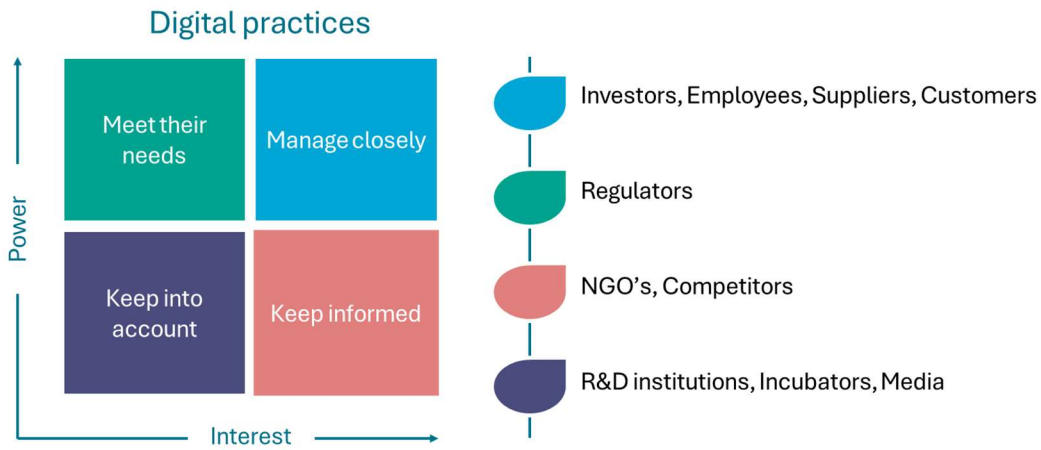

Figure 15: Power-interest grid digital practices

Stakeholders for digital practices and strategy have been mapped, as illustrated in Figure 15. Building software is costly, so getting financial resources from investors is crucial. Well-performing digital tools generate more profit, which significantly interests investors. Employees are directly involved in implementing the digital strategy, ensuring software quality, customer service, and client onboarding.

Unlike sustainable strategic practices, suppliers have significant power and interest in shaping the digital practices of startups. The level of digital infrastructure means that incomplete digital development by suppliers can hinder strategic actions like scaling or enhancing software quality. Customers also have significant power, as their responses directly affect sales, scaling and market presence. Their interest is high because the company's digital strategy shapes user experience and engagement. Regulators impact digital strategy through legislation such as GDPR, but participants did not feel pressure or interest from regulators as long as they met their requirements. NGOs might be interested in the digital strategy for its social and environmental impacts but usually have little power. Competitors are keenly interested in understanding how startups address digital challenges to add value. Finally, while providing valuable resources, incubators and accelerators lack the direct power or interest to influence digital strategy. Similarly, academic and R&D institutions enable startups to build networks and develop products without conflict with their strategic practices.

"In biotech, it's a bit difficult nowadays, in this sense, because the ecosystem is not there. So we need to develop a lot of sub-optimal things so that they can work in the end. And for instance, upscaling, there are not a lot of companies that help us upscale. So we upscale ourselves" [participant 1]

"Of course, we have a patent portfolio, which is interesting for our investors." [participant 2]

"From the investors, they push you to grow, but you may want to do that yourself." [participant 2]

"We also learned people, human behaviour, that if you have a lot of food, they'll just throw everything into it, which is problematic…so that's another way how we involve the users, the necessary stakeholders" [participant 3]

7.2 Interview Comparison

The interview comparison shows whether the different components have been identified. A colour code system is used, where red is marked as not identified, yellow is marked as identified but not/poorly present, and green is marked as extensively present. Appendix E gives an in-depth analysis of which components were identified per participant.

Table 12: Colour-coded interviews comparison

	Extensively present
	Present
	Not/ poorly present

Participant	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Interviewee job role	Co-founder	CEO	Co-founder	Business dev.	Co-founder	Co-founder	CFO	COO	CFO
Experience of participant	Medium	High	Low	Low	Medium	Low	Low	High	High
Industry	Chemis-try	Circular	Recycling	Agriculture	Logistics	Aerospace	Shipping	Renewa-bles	Finance
Size of startup	Small	Big	Small	Medium	Medium	Medium	Small	Big	Big
Founding year	2020	2010	2019	2018	2021	2021	2018	2016	2013
Resources									
Financial									
Social									
Human									
Intellectual									
Organisational									
Physical									
Innovation									
External pressures									
Coercive pressures									
Mimetic pressures									
Normative pressures									
Digital Orientation									
Digital curiosity									
Digital alertness									
Digital openness									
Digital innovation passion									
Social sustainability orientation									
Social innovativeness									
Social Risk-taking									
Social Proactiveness									
Socialness									
Environmental sustainability orientation									
Knowledge									
Practices									
Commitment									
Synergies									
Digital integration and efficiency	✓	✓	✓	✓	✓	✓	✓	✓	✓
Digital practices fostering sus-tainable market awareness			✓			✓	✓		✓
Regulatory synergies				✓	✓	✓	✓	✓	✓
Operational synergies		✓	✓	✓				✓	✓
Networking synergies			✓	✓		✓	✓	✓	
Corporate culture synergies			✓	✓				✓	✓
Trade-offs									
Strategic priorities trade-offs	✓	✓	✓	✓	✓	✓	✓		✓
Regulatory Trade-offs					✓	✓	✓	✓	✓
Resource allocation trade-offs	✓	✓	✓	✓	✓		✓	✓	✓
Operational trade-offs		✓	✓		✓		✓	✓	
Market engagement trade-offs		✓	✓		✓	✓	✓	✓	

– *Size and founding year of the company*

When demographic statistics, like size and founding year, are compared, the oldest startups have the most employees (between 20 and 40). This makes sense, given their duration of operation, market activity and investment in talent acquisition.

The participants identified financial and social resources as crucial for their businesses. Organisational resources are identified as least important, as most focus on something other than corporate culture. Smaller and younger startups primarily concentrate on financial and social resources, utilising financial instruments and incubator networks to facilitate scaling and knowledge adaptation. Older companies attach more value to human resources and their team knowledge and show more organisational and intellectual resources. Older companies (as participants 2, 8, and 9) are also more aware and proactive of regulations and adopt less highly digital practices than younger companies.

All companies, young and old, found a synergy between using digital practices and their efficiency in running their businesses. These practices can be either operational, such as automating the translation of their website, or essential for their primary products, like providing digital customer support or conducting data analytics. Furthermore, older companies have a higher identification of operational synergies, such as sourcing with European suppliers who meet ethical standards. Nonetheless, regardless of size and age, they still need resource allocation problems. Furthermore, smaller companies are identifying fewer regulatory compliance trade-offs, potentially due to their flexibility and limited resources. Bigger and older companies have identified more social risk-taking activities within technical regulatory compliance (participants 2, 8, and 9). Despite this notice, the identified categories depend on the main activity, product, or service delivered. While almost all participants focus on creating an environmentally friendly product or service, participant 9 stands out in their SSO due to their core goal of battling poverty in developing countries.

“We try to take those more calculated risks. So that means that we also have an agenda for when we are fully up and running and what we are going to do afterwards. ”[participant 2]

“That regulation is now under development, but two years ago we were hopelessly stuck in it, and yes, then I also made a plea we really have to do something about this; we then lobbied a bit in the House of Representatives” [participant 2]

“So we try not to be into a process that takes too much time to be certified or to have regulation compliance. Of course, we want to be a regulation compliance for everything, but we try to go in ways that they do not need all the regulation, all the things.” [participant 6]

"We can just, we can just be the best in the class, so to speak, do everything exactly by the book, then we don't go, we don't test, we don't fly, we don't develop, so every now and then you have to take a shortcut, you consciously take risks" [participant 8]

– *Industry*

The industry in which they operate significantly impacts resource availability and external incentives. Newer industries like chemistry, renewables, and sustainable logistics are identifying more normative and coercive pressures, particularly in legislation, and providing industry examples. For participants 5 and 8, the regulations often need to be tailored to their products or services, causing confusion and vagueness. These industry leaders must identify mimetic pressures due to a lack of competitors. The startups, which operate across several industries (finance, environmental monitoring, and supply chain), also identified more compliance with legislation. Furthermore, startups operating in already sustainable industries, like circularity, recycling, and renewables, are more environmentally friendly-oriented compared to other sectors, like chemistry and agriculture. The more traditional industries also tend to focus less on digital practices, possibly due to the more conventional nature of their business models, a lack of digital infrastructure in their industry, and clients who are not well digitally and sustainably educated.

"Yes, look, the hardest thing in the sector is actually the sector itself, and sustainability is important, but look, sustainability is still understated by shipping companies." [participant 6]

"The biggest barrier to entry into the market at the moment is regulation. And what kind of system is it? Is it a drone? Is the plane? What is it really just? And is it allowed here? " [participant 8]

7.3 Relational analysis

This subchapter delves deeper into the interrelationships among the various components, utilising the conceptual framework as a guide. Two co-occurrence analyses (see Appendix F1 and F2), interview comparison, and descriptive analysis helped us identify potential relationships between the elements. These c-coefficients indicate where there could be a possible relationship with 0 no co-occurrences and one fully co-occurred.

Eventually, the relational analysis answers sub-questions 2, 3 and 4, explaining the relationships between the orientations and their practices and the moderating role of resources and incentives on these relationships as described in the conceptual framework. Table 13 gives an overview of the orientations (1) which influence certain specific practices (2) and who the moderators (3) are between the relationships. The graphical representations of the relationships can be found in Appendix F3.

Table 13: Relational analysis overview

	Trade-off/synergy	Orientation influencing (1)		Influenced practices (2)	Moderators (3)
Trade-offs	**Strategic priorities trade-offs**	ESO and Socialness	→	Focus on sustainable impact	Normative and coercive pressures
		Digital openness, digital curiosity	→	Focus on validation	Coercive and normative pressures
		ESO	→	Focus on R&D	Intellectual resources
		Digital curiosity, digital openness	→	Focus on scaling	Coercive pressures
	Resource allocation trade-offs	Sustainable knowledge and practices, SSO	→	Focus on in-house knowledge instead of patents and technical talent over workforce equality.	Human resources and normative pressures
	Regulatory trade-offs	Digital alertness	→	Better compliance with technical regulations	Coercive pressures
	Operational trade-off	Sustainable practices	→	Focus on internal sustainable impact	Financial resources
Synergies	**Regulatory synergies**	Digital commitment and alertness	→	Focus on new market opportunities due to stricter regulations	Coercive pressures
	Digital integration and efficiency	DO	→	Focus on user experience and operational efficiency, enhancing trust and transparency	Physical and human resources
	Operational synergies	Sustainable Practices and SSO		Choosing for European standard suppliers	Financial and organisational resources
	Digital practices fostering sustainable market awareness	DO	→	Creating more sustainable awareness and market acceptance	Normative pressure
	Networking synergies	Digital openness	→	More partnerships and data exchange	Social and physical resources
	Corporate culture synergies	SSO		Better corporate culture	Human and organisational resources, normative pressures

– *Strategic priorities trade-offs*

The analysis found that ESO and socialness directly impact the strategic focus on sustainable impact. The more the startup is environmentally oriented, the more it will focus on sustainable impact. The socialness dimension also incorporates an environmental focus and influences their focus on sustainable impact. Normative and coercive pressure moderate this relationship, guiding the company's rules and expectations toward making a sustainable impact. If customer expectations are met and there is enough sustainable awareness, this positively influences the relationship and focus on sustainable impact.

Secondly, digitally open and curious startups focus more on quick scaling. If the startup is more interested in digital tools, it is more likely to invest in the digital ecosystem and, therefore, be digitally ready to scale. However, as participant 5 mentioned, scaling too fast could worsen customer experience. The openness allows for better scaling options because they can leverage external infrastructure opportunities. This relationship is enforced by pressure from investors and customer expectations for excellent customer experience. Furthermore, the level of validation focus is also directly influenced by their digital openness and curiosity. Startups tend to have more customer awareness and an open attitude in client engagement and activity control when exchanging data and product feedback from their clients. This results in enhanced validation.

Lastly, the level of strategic focus on R&D is influenced by their environmental orientation. The higher the knowledge and understanding of environmental challenges, the higher the investment in R&D. This relationship is fostered by social and intellectual resources. The number of networks influences the strength of how much startups collaborate with R&D institutions, and intellectual property can enhance R&D protection. However, intellectual property can also decline the strength of their digital openness due to the protective nature of intellectual property.

"Along these product lines, we can create an ecosystem of different products that we can give to customers and clients." [participant 3]

“A lot of customers can't use the software yet. So they come, find it interesting. But then again, they haven't had any training at all.” [participant 5]

“A startup is defined only by rapid growth. Yeah, so we feel a big pressure to grow from the investors.” [participant 6]

– *Resource allocation trade-offs*

At first, the resource allocation trade-offs are influenced by their level of environmental knowledge and internal sustainable practices. Startups with more technical knowledge focus more on in-house knowledge than patents. Furthermore, the level of social orientation influences their choice of workforce equality over technical talent. The available human resources moderate this relationship, such as the availability of female technical talent and normative pressures for ethical standards and good corporate culture.

“Yes. But it's really, really hard because, yes, if you put out a tech job, then 90% of the people who are interested are just men.” [participant 4]

– *Regulatory trade-offs and synergies*

The regulatory trade-offs and synergies are directly influenced by the level of digital alertness and the synergies by their sustainable commitment. Startups more aware of technical and sustainable regulatory changes anticipate better opportunities given by stricter sustainable regulations. Furthermore, their digital alertness and curiosity can also help them comply with specific regulatory technical regulations and not choose to work around those regulations instead. For example, participant 9 employs AI to expand their EU platform and ensure compliance with local regulations.
On the other hand, the results show that digital alertness can enforce regulatory trade-offs, as it promotes digital readiness and improves detection of consumer trends. Digital-alert startups focus

more on adapting to market demands and R&D than complying with regulations. These relationships are moderated by coercive pressures from regulatory bodies in the form of sustainable and technical regulations.

“Our technology aligns well with the legislation in that it significantly lowers the barrier for growers to adopt our technology. […] Simply put, your market potential will expand as regulations become more compulsory.” [participant 4]

“The biggest barrier to entry into the market right now is regulation." "Because we don't exist yet, and in fact, are seen as another category of energy.” [participant 8]

– *Operational trade-offs*

Their operational trade-off entails the lack of internal sustainable practice focus, such as e-waste and energy consumption of data centres, and a lack of privacy awareness. Most startups recognise the need for internal sustainable practices but do not incorporate this into their daily operations. Furthermore, more digitally oriented startups are getting a more remote working environment, facing challenges in manufacturing due to fewer people on the factory floor. Financial resources moderate the intention to focus on more sustainable practices over cheaper alternatives. The more financial resources they have, the more room there could be to partner with local sustainable partnerships.

"So on the one hand, that's a limited budget, so I think that's the biggest constraint for internal investments in sustainability." [participant 5]

“Of course, we are concerned with where we buy our stuff and what it is made of. Only, yes, it always remains true that money stuff plays a role in it. The more expensive components come especially from Europe. And they were made under slightly different circumstances. Anyway, sometimes you can't avoid getting things from China or Azia.” [participant 7]

– *Operational synergies*

Sustainable practices and SSO, such as collaboration with sustainable suppliers, can directly influence operational synergies, meeting high environmental standards, improving product quality, and meeting ethical standards. This relationship is moderated by the available financial resources to collaborate with suppliers as they are more expensive. Furthermore, an organisational culture encouraging employee participation in sustainability initiatives leads to collective sustainable internal practices, such as alternative travel to work or a vegetarian meal plan.

"So that's what we're working with now. It is under European management. So there is a certain quality standard. Just say that employees are treated in a good way. The fabrics we use to produce the kites are European fabrics. So they come from Europe. And they are sourced for environmental friendliness but are more expensive than the competition." [participant 8]

– *Digital practices fostering sustainable market awareness*

The relational analysis shows us that digital-oriented startups create more sustainable awareness through their digital tools to their clients and create more market acceptance. They do this by using digital dashboards and providing real-time data analytics about the sustainable performance of their products. Normative pressure of client expectations does moderate this relationship. The more expectations there are from customers, the more these dashboards are of added value, thus creating more awareness and market acceptance.

“But we do know that it is possible to get the AI good enough to actually sort of waste better, but people wanted yesterday.” [participant 3]

“The key factor for us, whether it's digital applications or the hardware we produce, is awareness. In some cases, we opt to indicate things through light, while in others, we use force or vibration. However, a digital dashboard is crucial for a comprehensive system understanding.” [participant 7]

"When I look at my sales conversations, I do see that 50 to 75 per cent of the time it's about the efficient experience and what I just said, sometimes it's experiencing efficient because it's green and it's bold, and sometimes it's just what it's about money." [participant 7]

– *Digital integration and efficiency*

Using digital tools and practices enhances customer support, supply chain management, and business data analysis. Digitally oriented startups leverage digital tools better and benefit more from this synergy. For example, Using cloud-based data platforms helps the startup integrate with other existing infrastructure, eventually leveraging these partnerships for better product delivery and operational efficiency. Their digital curiosity to use blockchain technology ensures transparency and trust in their systems.

Physical and human resources moderate the level of efficiency and synergy in startups. Human resources such as technical teams are better equipped to leverage innovative tools effectively. The digital infrastructure available to startups is crucial, enabling the efficient exchange of knowledge and data. Conversely, lacking this infrastructure can lead to inefficiencies, forcing startups to focus on non-core activities.

"We use the talent within the team. We have an AI engineer. We have two circuit PCB designers and a hardware designer, which is also me. I have another one who deals with the annotation" [participant 3]

"In terms of our digital strategy, it's really about leveraging technology to enhance system performance and efficiency. We're constantly developing and integrating various tech elements, such as algorithmic simulations and software." [participant 8]

– *Networking synergies*

There is a strong relationship between digital openness and networking synergies. Digitally open startups tend to have more networking synergies and leverage more partnerships with incubators and R&D institutions. Despite the low identification of SSO, there is a correlation between social proactiveness and networking synergies. The number of networks and digital infrastructure moderates this relationship. A lack of social resources and digital infrastructure can moderate this relationship, and this synergy cannot be fully utilised. The better the digital infrastructure, the easier the data exchange and partnerships are. Thus, networking synergies will arise.

"So we would like to always upload our data to existing platforms and then combine it with other data streams, but the infrastructure is lacking." [participant 4]

– *Corporate culture synergies*

A better social orientation fosters corporate culture synergies like talent attraction, a productive work environment, and sustainable internal practices and helps with public funding requirements. This relationship is moderated by human and organisational resources and normative pressures of industry best practices and ethical standards. The better the corporate culture (organisational resources), the more synergies will arise. Human commitment to sustainable and social practices fosters this relationship, together with industry best practices, ethical norms, and values.

"Nowadays, talents are intrinsically motivated to commit to sustainability and circularity. I expect that we will have no difficulty in attracting good people." [participant 2]

"It's something that I personally enjoyed a lot because on the sustainable path if you want to build a good company, I think it's very important that you have people who trust the project." [participant 6]

"As for those public funds, such as grants and subsidies, they're really looking at what we're doing in terms of social and environmental responsibility." [participant 8]

7.4 Overview of the results towards the conceptual framework

After the results and analyses have been conducted, Figure 16 reflects on the conceptual framework. The figure shows an overall overview of the found sustainable and digital practices, resources, and incentives and how they relate.

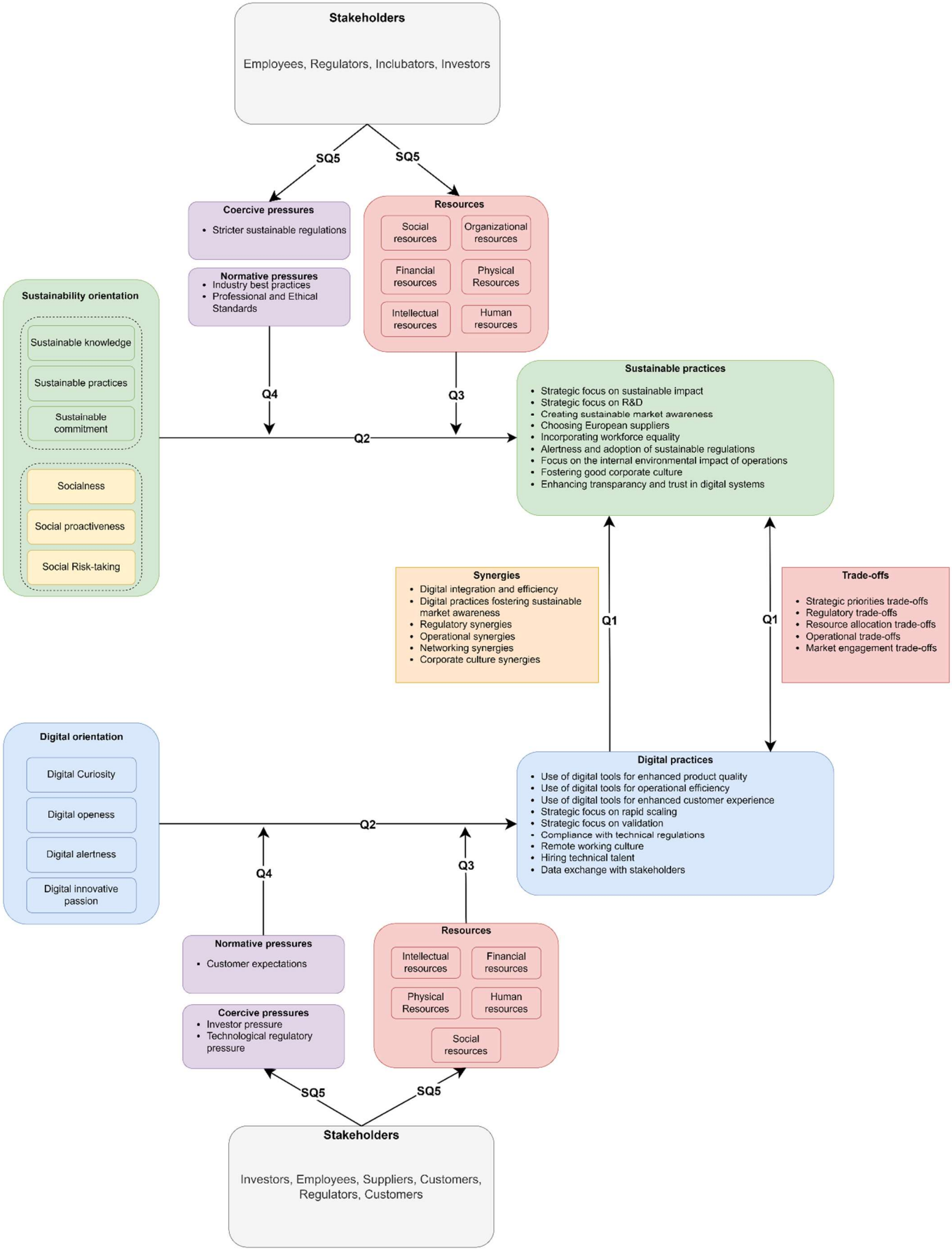

Figure 16: Overview of results within conceptual framework

8. Discussion

Chapter 8.1 discusses the QCA results, answering the sub-questions. Chapter 8.2 reflects on the conceptual framework and how the research reflects the theories and assumptions made in Chapter 3. Finally, in Chapter 8. 3, the findings are compared with the existing literature found in the SLR, reflecting on the societal and scientific relevance and translating the results into implications for cleantech entrepreneurs and policymakers.

8.1 Research insights

8.1.1 SQ1: Identification of trade-offs and synergies between digital and sustainable strategic practices

First, the identified trade-offs and synergies that emerge between digital and sustainable practices are represented, answering sub-question 1: *"What are the trade-offs and synergies that cleantech startups face between digital and sustainable practices?"*

- *Navigating through trade-offs*

  First, startups face challenges in finding the right balance within their strategic focus, particularly in **balancing investments in digital tools to increase profitability and scale with investments in research and development (R&D) to create a sustainable impact**. There are trade-offs between investing in the quality of algorithms and focusing on scalable software, creating profit and validation. The fear of overdeveloping the product further reinforces this trade-off.

  Secondly, **startups carefully balance their resources due to a shortage.** For instance, some startups prefer to keep knowledge in-house to protect information and avoid public exposure through patents. They caution about obtaining external financial resources to avoid dependence on investors, focusing instead on sales and market penetration. While startups claim they can attract new employees, achieving gender equality remains a struggle, leading to a predominantly male workforce. They emphasise that while employees should be interested in sustainability, technical skills are more crucial, emphasising that their corporate culture values technical skills over employees' long-term motivation and commitment.

  There is a trade-off between **pushing innovation boundaries and adhering to current legislation**. Participants find technical regulations particularly challenging as these are often not well described, and their digital innovations are ahead of regulations, potentially slowing down R&D development. Startups emphasise the importance of regulations that drive sustainability, such as mandating recycling in product design, but they acknowledge that market-driven solutions may be faster. As a result, smaller startups are using their flexibility to work around those technical legislations.

  Startups prioritise **external sustainability impacts over implementing internal sustainable practices**, owing to factors such as market demand, the larger-scale impact of their products, the availability of sustainable suppliers, and a lack of corporate culture fostering vegetarian meal plans and alternative travel plans. Lastly, the digitalisation of remote working and international teams introduces operational challenges such as overcoming language barriers with local clients.

- *Leveraging synergies*

  Six synergies are identified, explaining the practices of the startups, focusing on digital and sustainable practices. First, **digital technologies enhance the product's efficiency and quality.** Tools like AI and ML algorithms improve energy efficiency and optimise waste management, eventually increasing sustainable impact. Blockchain improves social performances, **increasing the traceability and transparency of their services and helping startups with regulatory compliance**. Furthermore, digital dashboards create sustainable awareness by giving clients insights into how the products influence their carbon footprint and other environmental metrics. Moreover, digital practices enhance product service by tailoring its products through client data analysis. This feedback is critical for

startups to validate their product in the market, gain credibility, and further develop it to make it more sustainable.

Secondly, **Incubators and university partnerships provide valuable resources and credibility**, supporting immediate and long-term objectives. Institutional partnerships with universities like TU Delft can foster R&D development, helping them with their long-term strategy so the startups can focus on day-to-day operations. Incubators can further enable other resources such as locations, physical resources and new employees. Some startups find being close to their clients useful for interacting better with them. Locations near an academic institution or big corporations enhance talent attraction (e.g., close to the TU Delft or ASML in Eindhoven).

Despite the trade-offs associated with technical regulations, **stricter sustainable regulations allow startups to secure additional funding through grants and subsidies and foster market demand for their products.** The carbon credits system (EU ETS) and stricter pesticide regulations have demonstrated their impact on agriculture, the supply chain, and shipping. Lastly, a solid corporate culture fosters productivity and public funding and attracts talent. Despite the trade-off of remote working, it allows global teams to overcome location barriers. Startups recognise that an ethical orientation on diversity can help secure public funding, which is an increasing criterion for investors and public funds. A positive culture enhances employee satisfaction, innovation, and retention.

8.1.2 SQ2: Influence of strategic orientations on strategic *practices*

To give a concise answer to the second sub-question, we used the results of chapters 6.5 and 6.6 together with the interview comparison and relational analysis to answer sub-question 2: "*What impact does a sustainability and digital orientation have on the sustainable and digital strategic practices of Dutch cleantech startups?"*

- *Relationship between digital orientation and digital practices*

  First, the descriptive analysis identifies four categories: digital curiosity, alertness, innovative passion, and openness. Overall, the startups have a **solid digital focus** by incorporating digital strategies into their business model across four dimensions. They integrate innovative digital strategies to enhance products, streamline operations, and improve customer interactions despite facing challenges in aligning technology with sustainable impact and customer needs. The participants are firmly **committed to enhancing the customer experience** through digital strategies such as AI, chatbots, and sensors, driving innovation and gaining a competitive edge while increasing market awareness and promoting sustainability. Despite the wide variety of social resources, they are still relatively **closed in data exchange.** This could be due to their protective stance towards innovations and the lack of digital infrastructure.

  The relational analysis shows that the DO dimensions influence their digital practices heavily**. Digitally oriented startups tend to use more digital technologies within their product and operations**, enhancing product quality, scalability, client experience, and transparency of their product. Furthermore, **digital alertness and curiosity foster faster technical compliance and leverage new market opportunities** as they are more aware of regulatory changes and use innovative technologies to create new revenue streams**.** On the other hand, their curiosity and alertness push them to focus more on scaling their business rapidly**,** resulting in less focus on sustainable impact. Furthermore, digitally oriented startups focus **more on hiring technical talent and remote working,** bringing up previously discussed trade-off synergies about remote working.

- *Relationship between sustainability orientation and sustainable practices*

  All the participants identified environmental orientation based on three dimensions: knowledge, practices, and commitment. The startups demonstrate **a strong commitment and knowledge of environmental sustainability,** adapting strategies to address climate change and specific industry-related issues and sustainable regulations. Despite this, internal sustainable and operational practices such as using clean energy and recycled materials are lacking. They argue that the impact of their products significantly overcompensates their own carbon footprint. As for the social dimensions, **there is a clear lack of social orientation.** The participants recognise the urge for social practices, such as

corporate culture and workforce equality. However, due to a lack of attention and human resources, they are challenged to implement a social strategic focus.

An environmental orientation fosters the focus on the sustainable impact of their product. Furthermore, this orientation enhances a focus on validation and investments in R&D. The higher the knowledge and understanding of environmental challenges, the higher the investment in R&D. However, a strong focus on sustainable internal practices such as partnerships with sustainable suppliers often requires higher investment costs, training, and new equipment. The more sustainable practices there are, the more startups partner with European suppliers, enabling the operational synergy of meeting ethical standards and improving trust. Lastly, social orientation influences their sustainable practices, too. For example, social proactiveness positively influences networking and operational synergies by fostering a culture encouraging employee participation in sustainable practices such as vegetarian meal plans. **More socially oriented startups choose European suppliers, promoting ethical and sustainable production** over cheaper partnerships, and can satisfy the social requirements of public funding, resulting in more financial resources.

8.1.3 SQ3: Availability of resources as moderator towards strategic practices

This subchapter discusses the moderating effect of the resources on the relationships between strategic orientation and strategic practices, providing an answer to sub-question 3.

– *Resources moderating relationship sustainability orientation and sustainable practices*
The results show that most **moderating roles of resources come from social, financial, human, organisational, intellectual, and physical resources**. First, Financial resources have an extensive moderating role in different relationships. The results found that financial resources moderate how strongly the participants strategically focus on profit. The more diverse these financial resources are, the less dependency on investors and thus focus on creating profit. Furthermore, financial resources, organisational and human resources influence the focus on sustainable partnerships, fostering corporate culture, and focus on internal sustainable practices, creating more social and environmental impact. Intellectual and social resources mediate the strength of their environmental orientation with a focus on R&D, improving the quality of their products. At last, human and organisational resources influence the relationship between social orientation and corporate culture synergies as the values of employees push startups toward social practices.

– *Resources moderating the relationship between digital orientation and digital practices*
The results and analysis show that **financial, intellectual, physical, social and human resources moderate the relationships between DO and digital practices**. First, as the participants mentioned, developing and maintaining software is extremely expensive. Therefore, many strategic choices are based on the number of financial resources. Social resources, including networks and partnerships with institutions, could enable startups to exchange data and gain access to new technologies and ideas. It would strengthen the power of their digital openness, as they have more opportunities to collaborate and share digital data. On the other hand, intellectual resources reduce the strength of digital openness, bringing a more protective strategy and disabling data exchange with partners. Social and physical foster more partnerships and data exchange. However, a lack of digital infrastructure moderates this relationship. The better the digital infrastructure, the easier the data exchange and partnering will be and getting customer feedback. Finally, human resources, such as the team's expertise and capabilities, can effectively translate their digital orientation into practice.

8.1.4 SQ4: External incentives pushing towards strategic practices

The descriptive results showed that coercive and normative pressures dominated the incentives. There is a lack of mimetic pressures as most participants were first-movers in their industry and had no competition. Therefore, the focus is on normative and coercive pressures. Technical regulations and investor pressure are the main components of coercive pressure. Industry best practices and customer expectations result in normative pressures.

– *Normative and coercive pressures as moderators within sustainable practices*
  First, **coercive pressures from investors heavily influence their strategic choice**, focusing more on scaling and profit instead of sustainable impact. The coercive pressures from sustainable regulations foster sustainable awareness and market demand. **Normative pressures like customer and ethical expectations also moderate social and sustainable awareness.** Fostering a good corporate culture creates synergies around better talent attraction, public funding and a productive work environment.

– *Normative and coercive pressures as moderators within digital practices*
  The investor pressures push the startups towards investment in digital practices to scale faster and enhance the validation of their product. **Technical compliances moderate the focus towards digital practices** as stricter technical regulations force startups to focus more on digital compliance. However, compliance pressure towards privacy concerns and data management was not found. **Normative pressures, such as customer expectations, improve the adoption and effectiveness** of digital practices. For instance, when customers demand transparency and real-time data, startups are more likely to implement digital dashboards and data analytics tools. This further improves market acceptance, validation, and customer feedback and increases awareness of their sustainability efforts.

8.1.5 SQ5: Stakeholder enabling resources and external incentives

The various stakeholders shape the availability and influence of external incentives and resources on cleantech startups' strategic decisions and practices. First, **investors serve as the primary source of financial support,** particularly in early-stage companies still conducting extensive research and development and need to validate their products on the market. Furthermore, only two parties (incubators and suppliers) facilitate using physical resources such as offices and digital infrastructure. **Only two stakeholders, investors and regulators, set the coercive pressures.** These are, therefore, essential to keep in close contact with. The findings from the power interest grid show that investors and shareholders in both areas have strong power from their financial resource capabilities. Nevertheless, they are more interested in digital practices than sustainable ones. **Customers must also be managed closely due to their high power and interest** in sustainable and digital practices and their power of customer expectations. Furthermore, R&D institutions remain sustainably interested but have little power over these practices. Regulators have much power but focus more on sustainability practices than digital ones. This is reflected in the lack of digital compliance concerns within the startups.

8.2 Reflection on the Conceptual Framework

The conceptual framework shows us the interactions between different components. Reflecting on this framework is essential to addressing limitations and potential future research directions.

The framework integrates multiple theoretical perspectives, including the RBV and institutional theory. This allows for a holistic problem view and ensures a socio-technical analysis. By recognising resources and external incentives as moderators, the framework provides insights into how startups translate strategic intentions into actionable practices. It highlights the dynamic nature of the orientations and the fact that the relationship towards the practices is not static. However, assumptions were made that the DO, ESO, and SSO scales are different, making them difficult to compare. Furthermore, some predefined categories overlapped between orientations, for example, within the socialness category (SSO), which also incorporates environmental aspects. This limitation is because this research is built on established scales.

Moreover, the results show that incentives and resources influence each other directly. For example, within financial resources, adhering to investors' expectations (Institutional Theory) can build trust and attract investment, supporting more financial resources (RBV). Another example was found in their social resources, where startups with robust connections with regulators can lobby with regulatory bodies (as seen with participant 2) and are better positioned to understand and mediate for regulations, enhancing compliance. Furthermore, it can be seen that newer industries, which have more social resources, such as incubator networks, are facing more normative pressures and adhere more to professional and ethical codes. This shows that besides their complementary role, they also overlap. Therefore, a double-ended arrow between incentives and resources can potentially be drawn (red arrow).

The results imply a relationship between their strategic practices influencing the availability of resources directly and synergies and trade-offs enabling resources. This is seen in the networking synergy, where social resources enable other resources, such as physical knowledge exchange and talent acquisition, or human resources enable corporate culture, resulting in achieving the social requirement of public funders (green arrows). Lastly, a double-ended arrow was drawn in the initial conceptual framework for the synergies between digital and sustainable practices. However, the results show that only digital practices enable synergies with sustainable practices, not vice versa (blue arrow). For the trade-offs, the double-ended arrow stands valid as the practices influence each other in both ways. Based on the reflection, figure 17 shows the extra relationship found during the research, which should be considered in future research.

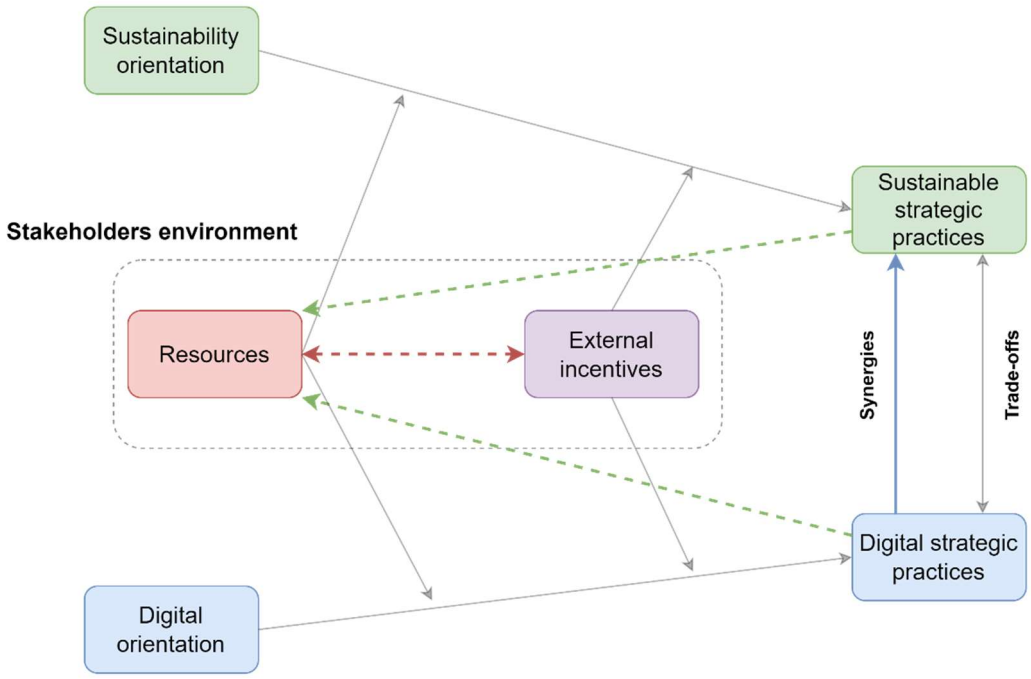

Figure 17: Reflected conceptual framework

8.3 Societal and Scientific Relevance

8.3.1 Scientific Relevance

The research aims to contribute to academic research by addressing several research gaps in the literature. Therefore, it compares the findings of the literature with the results from the research.

– *Contribution to the RBV theory and resources within Dutch cleantech startups*

  First, the gap in identifying the resources of Dutch cleantech startups was filled. Barney's (1991) Resource-Based View (RBV) theory was adopted to gain insights into how Dutch Cleantech startups use resources to gain a competitive advantage, identify resource shortages, and understand how these resources shape strategic practices. Both literature and results emphasised the significant scarcity of financial resources within startups. Furthermore, similarities were found in the literature on human and intellectual resources, which are essential for cleantech startups. However, the results emphasised the dependency on subsidies and grants. Furthermore, the study emphasises social networks more than the literature does. These social resources are essential for Dutch cleantech startups to create validation and exchange other resources. One possible explanation is the extensive incubator network in the Netherlands, which Dutch startups use.

  The RBV theory is extended by incorporating the natural and social RBV views (Tate and Bals, 2018), looking at which resources create economic, sustainable and social value. There is a shared understanding of environmental concerns and capabilities, such as product stewardship and pollution prevention. However, the results did not uncover how to use resources to address social concerns such as gender equality, corporate culture, and ethical practices. Therefore, further research is needed on how to enhance social performance within cleantech startups.

- *Contribution to institutional theory and identify external incentives*
  The research extends the literature on institutional theory toward sustainable and digital entrepreneurship, identifying the pressures within the Dutch cleantech environment. Comparing the literature review, normative pressures in the form of customer expectations are more prevalent than previously reported in the literature. However, no digital industry expectations, ethical standards, or mimetic pressures were found contrary to previous literature.

  The literature and results confirm both the positive and negative effects of coercive pressures, leading to new market opportunities as clients are compelled to comply with sustainable regulations. Startups strongly feel the pressure of shareholders and investors, resulting in a greater focus on financial performance rather than sustainable and social performance.

- *Contribution to strategic orientation research*
  Both orientations were identified and seen how these interact with each other and are translated into actual practices, which is not done yet in literature. The research builds on the recommendations of Ardito et al. (2021) to further investigate the relationship between digital and sustainability orientation. Furthermore, the study provides insights into the qualitative applicability of DO, ESO, and SSO measurement scales. The study revealed that ESO and DO are dominant within cleantech startups and that social entrepreneurship is not their main priority.

- *Contribution to exploring trade-offs and synergies between digital and sustainable practices*
  The research confirms different challenges and opportunities from the literature, such as digital tools enhancing productivity, product quality, and decision-making based on customer data. Furthermore, the balancing dilemma between profit and sustainability and the Valley of Death phenomenon can also be confirmed in the Dutch cleantech environment. The results add further insights into increasing transparency and trust using digital technologies. Furthermore, regulatory, operational, networking, and corporate culture synergies emerged that were not found earlier in the literature. New trade-offs regarding validation, R&D, scaling operational, and regulatory trade-offs were exposed that had not yet been identified in the literature.

  Contrary to the literature, the results have not found any evidence of flexibility or improvements to their SDG KPIs through digital practices. There are no internal energy efficiency improvements, information asymmetry improvements, or a workload decline through digitalisation. The workload even increased as the startups used digitisation to scale faster and take on more volume.

8.3.2 Implication for cleantech entrepreneurs

Entrepreneurs can use the research to address their company's trade-offs and synergies. By comparing their experience with the empirical data, they can identify best practices, leverage synergies, and understand the influence of trade-offs. Understanding the trade-offs helps them make informed decisions aligning with short- and long-term goals. They can use the identified digital tools, which have proven efficient and enable synergies. Entrepreneurs can use the emphasised importance of social network insights to build more partnerships, leveraging their network to create new synergies. The identification of essential stakeholders is helpful for startups to know which stakeholders are critical and manage closely. These stakeholders are those who either provide a significant amount of resources or are the sole providers of a specific resource. Startups that use the insights better understand the landscape of external incentives and resource availability. Furthermore, awareness of the regulatory landscape is critical, especially for fast-paced environments, which must comply with complex technical regulations. This research eventually helps startups allocate their resources and attention better, helping them to create a competitive advantage and make as much sustainable an impact as possible.

8.3.3 Implications for Policymakers

Policymakers can use the insights to foster innovation ecosystems by enhancing collaboration between startups, research institutions, and incubators, encouraging knowledge exchange, improving infrastructure development, and leveraging networking synergies. Addressing the issue of vague technical regulations that slow R&D by focusing more on high-tech policies can foster innovation, increase product quality, and enhance the sustainable impact of startups. Moreover, there is a need for improved digital infrastructure, especially in conservative industries like agriculture, chemistry and the supply chain. Furthermore, regulators need to apply more sustainable regulations, resulting in increased incentives, awareness, and commitment to choose sustainable products. There is a need for more comprehensive product and culture stewardship towards startups, ensuring that regulations and grant requirements consider startups' internal sustainability footprints and social aspects. Financial resources are crucial for startups, highlighting the need for grants and subsidies for R&D. Providing this support in tax reduction, early-stage funding, and facilitating public-private partnerships can further assist startups in their R&D and scaling.

Overall, by understanding the lack of specific resources, pressures, trade-offs, and synergies, policymakers can design and adjust their behaviour and regulations to the needs of startups, securing the full potential of digital technologies and creating sustainable impact.

9. Conclusion

The final chapter summarises the entire research, answers the research question, identifies the limitations of the research, and recommends future research.

9.1 Research objectives and main research question

The main goal of the research was to identify trade-offs and synergies between digital and sustainable strategic practices, as well as their underlying dynamics within Dutch cleantech startups. A systematic literature review was conducted to map existing literature and identify research gaps. The literature review exposed that despite the need for clean technologies and the rising implementation of digital technologies such as AI, machine learning, and IoT, cleantech startups are still facing challenges and missing opportunities to leverage the potential of digital technologies in a sustainable context. Challenges include the rise of e-waste, energy consumption, privacy issues, and technological unemployment. Missed opportunities are found to boost productivity, improve knowledge exchange, and reduce waste. Therefore, based on the scarcity of resources that startups have, entrepreneurs still need to make choices and miss potential synergies. However, these trade-offs and synergies were not identified in the literature before this research. Surprisingly, despite acknowledging the technical requirements, there is a lack of literature viewing digital implementations from a socio-technical perspective, including social, economic, and institutional dimensions.

The study used existing definitions and frameworks on digital and sustainable strategic orientations in emerging markets to identify these trade-offs and synergies and their underlying dynamics. The study interprets orientation as a guideline for startups' commitment to specific behaviours. The resource-based view from Barney (1991) is grounded in the definitions and frameworks that focus on how available resources create a competitive advantage. As resource scarcity is present within startups, this theory is even more suited for startups. To secure a sociotechnical analysis that includes institutional and stakeholder influences, the RBV theory has been complemented by the institutional theory by DiMaggio and Powell (1983). This theory addresses the coercive, mimetic and normative pressures from the external environment. Based on these theories and frameworks found in the literature, the conceptual framework shows the direct relationship between orientations and their actual practices, the moderating role of resources and external incentives and the stakeholders enabling the availability of resources and external pressures.

An explorative qualitative content analysis was conducted to identify the different components and explore the trade-offs and synergies between digital and sustainable orientations. This approach gives room for more contextual insights and is ideal for exploring and analysing complex phenomena that are challenging to quantify, such as behaviour. Eventually, nine Dutch cleantech startups from various industries were interviewed using semi-structured interviews. The components were identified using an inductive and deductive approach, followed by a descriptive, stakeholder, relational analysis and interview comparison. Ultimately, the answers to the sub-question are used to provide a structured response to the main research question, which is stated as follows:

"How do Dutch cleantech startups navigate the synergies and trade-offs between digital and sustainable practices, and what are the underlying dynamics shaping these interactions?"

Dutch cleantech startups face trade-offs when balancing sustainable practices with digital practices. They need to balance allocating investment funding for digital tools to improve profitability and scalability against investing in R&D for sustainable impact. Startups identified a trade-off between releasing a product quickly to meet customer demand and taking the time to enhance the accuracy and functionality of their products. However, the fear of overdeveloping products and rising financial investor pressure pushes them more towards a scaling and profit-oriented strategy. Due to the ambiguity of new technical regulations, startups face challenges in meeting technical regulatory compliance. Moreover, the startups prioritise external sustainability impacts driven by market demand and the larger-scale impact of their products over internal

sustainable practices. Lastly, the startups face trade-offs in attracting technical talent while also focusing on workforce equality.

Synergies arise using AI, machine learning, dashboards, and blockchain, enhancing product quality, operational efficiency, customer experience and fostering sustainable awareness among clients. These technologies also improve technical regulatory compliance through transparency and traceability. Partnerships with universities and incubators provide valuable R&D and operational support resources, helping startups align their long-term strategies with day-to-day operations and attracting talent and organisational resources. Stricter sustainable regulations can secure additional funding, increase awareness, and market demand for clean technologies.

The underlying dynamics reflected the strategic orientations that startups have, the availability of resources, external incentives and the stakeholders enabling these incentives and resources. Startups with a solid digital orientation integrate digital strategies across operations, enhancing product quality, efficiency, and customer experience. However, they still prioritise rapid scaling over sustainability. The startups are well committed to environmental sustainability, focusing on product impact and R&D, but struggle with implementing internal sustainable practices and overall social-oriented practices due to scarce financial resources, lack of digital infrastructure and focus on corporate culture.

Financial resources influence the balance between profit focus and sustainable investments, with public funding encouraging sustainability more than investor funding. Technical knowledge and intellectual property protection enhance digital capabilities. At the same time, social resources like networks and partnerships foster collaboration and R&D. However, they do not guarantee data exchange, as most startups protect their data and lack digital infrastructure.

Normative pressures from customer expectations drive the adoption of digital practices that align with sustainability goals. Coercive pressures from investors and regulatory bodies heavily influence startups' strategic focus, often prioritising rapid scaling and compliance. Mimetic pressures were insignificant since these startups are often the first movers in their industry and face little competition. Investors and shareholders have a strong influence due to their unique financial position, primarily focusing on digital practices. The lack of sustainable awareness within industries lets consumers still choose digital innovations rather than sustainable ones due to enhanced customer service by digital technologies. Contrarily, regulators push more for sustainable practices, emphasising more compliance on sustainability over digital innovation.

9.2 Limitations

Every research project may face limitations that require attention. First, because the research is qualitative, there is a solid subjective personal bias from the author. The author's personal experiences, skills, and perspectives unconsciously shaped the research, including the literature review, participant selection, data collection, coding and interpretation of quotes, and analysis. Furthermore, we made several assumptions to maintain the study's quality within the constraints of time and resources.

The purpose of the research is based on established scales and definitions and not on scale development, so the scales have different dimensions. It is, therefore, hard to compare the orientations. The choice of other definitions and scales can, therefore, heavily influence the results of further research. The theories used also have some limitations, such as theoretical compatibility problems, which were partially discussed in the reflection of the conceptual framework, such as the internal relationship between resources and the influence of incentives on the resources and vice versa. Furthermore, the RBV theory is relatively static, not addressing how resources evolve and are evaluated over time. The research did not look at synergies emerging from combining resources and incentives. The institutional theory also has its limitations as it is firmly context-specific, and the fact that the theory is seen as deterministic suggests that the startups have little control and are primarily shaped by external pressures. This overlooks the capacity of startups to act strategically and independently. Both theories have potential compatibility problems, such as different units of analysis, with the RBV theory being firm-level focused (resources of firms) and the institutional theory taking a macro-level perspective.

Several boundaries were set for the data collection units, such as age, industry, and country. The findings might not apply to startups in different regions or industries with varying regulatory, economic, and cultural environments. Furthermore, a qualitative content analysis has limitations. It cannot quantify the data, so it is hard to generalise the findings and extrapolate the results to other (cleantech) startups. The participant's input is based on subjective observations, which could influence the results. Furthermore, with nearly all startups operating in different industries, confirming the findings through more industry-focused research is crucial. At last, the fast-evolving nature of digital technologies and regulations means that the findings might quickly become outdated.

9.3 Recommendations for Future Research

Because this research is exploratory, it opens more doors than closes. First, strategic orientations and behaviours can be defined in various ways. As a result, additional research is needed to determine whether other definitions, theories and measurement scales identify the same trade-offs and synergies or even more synergies and trade-offs. As the research builds on established ESO and SSO scales and the scales were not harmonised, future research is needed to explore if these scales can be harmonised, which makes comparison possible. Based on the limitations of the theories and conceptual framework highlighted in Chapter 8.2, future research is needed on the causal effect of external incentives directly on resources and the effect of practices directly on the availability of resources. Furthermore, more research is needed in the compatibility problems of using both institutional and RBV theory.

Furthermore, as only few digital technologies were identified, more research is needed to compare different technologies and determine how these relate to strategic behaviour. For example, blockchain technology promotes trust and transparency, whereas AI does the opposite, as it is primarily a black-box technology that only highly technical people fully comprehend. Understanding the potential and limitations of these technologies can guide their strategic use. Furthermore, more research is needed on dealing with investor influence and the distinctions between different types of investors, such as impact investors and traditional venture capitalists. Examining and exploring the dynamics between different stakeholders (e.g. public-private partnerships) can help startups manage stakeholders' relationships more effectively,

At last, future research should include a more extensive and diverse sample of cleantech startups from different regions and countries. This helps generalise the findings. A longitudinal study could help observe how strategies, resources and pressures evolve, tackling the static limitations of the RBV and institutional theory.

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Appendices

Appendix A: Systematic Literature review

A1: Overview of databases, search terms and filters

Table 14: Databases, Search terms and filters

Database	Search items	Global Filters	No. of Searches
Scopus	(TITLE-ABS-KEY (digital AND orientation, AND sustainability AND orientation AND performance) OR TITLE-ABS-KEY (digitainability)) AND (LIMIT-TO (LANGUAGE, "English")) AND (LIMIT-TO (OA, "all"))	- No sources older than 2010 - Language: Dutch, English - Free full text, Open Access via TU Delft license - Contain search terms in abstract, keywords, or title.	28
ScienceDirect	"Digital Orientation" OR "Sustainability Orientation" AND “SME Performance” OR AI AND "Sustainability Orientation"		72
Web of Science	“Digital Orientation” AND “Sustainability Orientation” OR “Digital transformation” AND Sustainability Performance”		239

A2: Overview of qualitative research methods

Figure 18: Overview of qualitative research methods

A2: Literature overview

Table 15: Literature review

Article	Type of Study	Qualitative (QL) or quantitative (Qn)	Focus on sustainability orientation			Focus on digital orientation	Antecedents of strategic orientation	Challenges and opportunities of Digital technologies within sustainable strategy	Research on dual strategy use within a startup environment	Identification of trade-offs and synergies between digital and sustainable practices within Dutch cleantech startups
			Environmental	Social	Economic					
Definition of orientations and measurement methods										
(Emamisaleh and Rahmani, 2017)	Survey	QN	✓	✓	✓		✓			
(Quinton et al., 2018)	Literature study	QL				✓	✓			
(Kraus et al., 2017)	Delphi study	QL		✓						
(Dantsoho et al., 2020)	Survey	QN				✓	✓			
(Roxas and Coetzer, 2012)	Survey	QN	✓		✓		✓			
Relationship between digital and sustainability entrepreneurship										
(Timmermans et al., 2023)	Literature study	QL		✓	✓			✓		
(Ardito et al., 2021)	Survey	QN	✓		✓	✓		✓	✓	
(Brenner and Hartl, 2021)	Survey	QN	✓	✓	✓					
(Denicolai et al., 2021)	Survey	QN	✓					✓		
(Rupeika-Apoga and Petrovska, 2022)	Survey	QN	✓			✓		✓	✓	
(Lichtenthaler, 2021)	Literature review	QL	✓	✓						
(Isensee et al., 2020)	Literature review	QL	✓				✓		✓	
(Rosário and Dias, 2023)	Literature review	QL	✓	✓				✓		
(Tick et al., 2022)	Survey	QN	✓		✓	✓		✓	✓	
(Saáry et al., 2022)	Survey	QN	✓		✓					
Our research	Content analysis	QL	✓	✓	✓	✓	✓	✓	✓	✓

Appendix B: Deductive Codebook

B1: Codebook Resources

Table 16: Codebook Resources

Core Concept	Rationale	Definition	First order themes	Description
Innovation	RBV, Dynamic Capabilities Framework	Resources that distinguish startups from competitors. This includes new products, services, or processes that contribute to sustainable development. Cleantech startups often focus on disruptive technologies to create market opportunities.	Product innovation	Focuses on the development of new cleantech products, from ideation to market launch.
			Service innovation	Pertains to the creation of new services or the enhancement of existing ones, often involving customer engagement and service delivery.
			Process innovation	Relates to the improvement of internal processes to increase efficiency, reduce costs, or improve product quality.
Social	Social Capital theory / and relational capital	The relationships and networks that the startup builds with various stakeholders, including customers, partners, communities, and regulatory bodies. These relationships can facilitate market access, foster collaborations, and enhance reputation.	Community Outreach	Activities aimed at building relationships with the local community, including educational programs and environmental initiatives.
			Stakeholder engagement	Involves interactions with investors, customers, partners, and regulatory bodies to build support and secure resources.
			Networking and alliances	Involves interactions with investors, customers, partners, and regulatory bodies to build support and secure resources.
Human	Human Capital Theory	Refer to the talent and skills of the startup's team, including their experience, expertise, and creativity. This is critical in a high-tech industry where the knowledge and capabilities of the team can drive innovation and growth.	Talent Acquisition	Attracting and hiring individuals with the necessary skills and expertise.
			Team Knowledge	Knowledge and experience from the team
			Training and development	Programs designed to improve the skills and knowledge of existing employees, ensuring that the workforce evolves with the startup's technological needs.
			Social equality	Focus on policies and values to ensure social equality within the startup.
			Workforce composition	Look at the overall makeup of the startup's personnel, including the balance of full-time, part-time, and contract workers, as well as the diversity of the workforce.
Physical	Physical Resource Theory, Transaction Cost Economics	Includes the tangible assets of a startup, such as its technology, machinery, facilities, and any other physical capital required to develop and deliver cleantech solutions.	Operational assets	The acquisition, maintenance, and utilisation of physical assets like manufacturing equipment, laboratories, and office spaces.
			Environmental impact	technologies and systems used to minimise the environmental impact of the startup's operations, such as waste management systems, energy-efficient equipment, and water purification systems.
			Infrastructural environment	the basic physical systems of a business, region, or nation and often involves the use of public goods or production processes.
Intellectual		Intellectual resources cover the intangible assets of the firm, such as patents, trademarks,	Intellectual property	The management and strategic use of patents and trademarks to protect innovations and gain a competitive edge.

	Theory of Intellectual Capital, Knowledge-based view	proprietary knowledge, and other intellectual property that can be leveraged for competitive advantage.	R&D Development	The allocation of resources towards research and development to foster innovation and new technology development.
			Knowledge management	The processes of capturing, distributing, and effectively using the knowledge within the organisation.
Organisational	Organisational Theory, Corporate Social Responsibility, Dynamic Capabilities Framework	Organisational resources encompass the startup's structured systems and processes, including its management structure, culture, and internal networks, which enable it to function effectively and adapt to changes.	Corporate Culture	The shared values, beliefs, and practices that influence the behaviour of individuals within the organisation.
			Change management	The ability of the organisation to adapt to market changes, technological advancements, and internal challenges.
Financial	Financial Theory	Concerns the capital and financial strategies that support the startup's operations, growth, and scalability, including investments, revenues, and funding	Funding strategies	The approaches to securing financial resources, including venture capital, grants, and loans.
			Revenue Generation	The strategies and activities that contribute to the generation of income, such as sales, licensing deals, and service offerings.
			Cost Management	The practices involved in controlling and reducing operational costs to maximise profitability.

B2: Codebook External Incentives

Table 17: Codebook External Incentives

Core concept	Rationale	Definition	First order themes	Description
Coercive Pressures	Institutional Theory	Political influence and lack of legitimacy (DiMaggio and Powell, 1983), like government regulations or requirements from larger companies in the supply chain.	Regulation Compliance	Captures the firm's efforts to comply with environmental, social, and digital regulations and standards and comply with local government standards.
			Market Access Requirements	Requirements set by larger corporations or international markets for sustainable practices and certifications
			Investor and Financial Constraints	The conditions set by investors or grant programs that require adherence to specific environmental or sustainability criteria can pressure entrepreneurs to align their ventures accordingly
			Parent Company Demands	Reflects the demands from the parent company for the adoption of sustainable and digital initiatives
Mimetic Pressures	Institutional Theory	Refers to responses of uncertainty by the competitors and occurs when startups imitate practices from competitors.	Industry Leadership and Example	how leading companies in the industry set examples by implementing environmental and digital solutions and obtaining competitive advantages, which motivates other startups to follow suit
			Competitive Advantage Through Digital and sustainable solutions	Leading companies gaining competitive advantages by adopting digital and sustainable solutions

			Participation in Accelerators and Incubators	Engagement with cleantech-specific accelerators and incubators that promote certain successful strategies or technologies for startups to adopt
Normative Pressures	Institutional Theory	formed by the expectations associated with professionalisation, such as rules that the company must comply with (political and social norms and rules)	Industry Expectations	Reflects the basic requirement of being sustainable and digitally responsible and the expectations from NGOs, Labor unions and employees for the firm to implement sustainable and digital solutions
			Perception of added value by customers	Represents how customers perceive the usefulness of economic, environmental, and social initiatives made by major competitors.
			Professional and Ethical Standards	Expectations about ethical behaviour and professional conduct within an industry or profession
			Industry Best Practices	Adoption of methods or techniques that are widely considered the most effective within an industry

B3: Codebook Digital Orientation

Table 18: Codebook Digital orientation

Core Concepts	Definition	First order themes	Description
Digital Curiosity	Focuses on a firm's desire to explore and understand new ideas and technologies in the digital ecosystem, driving innovation and creative problem-solving.	Strategic Digital Technology Investment	The organisation rationally invest in the digital ecosystem to increase entrepreneurial activity
		Innovation Search	The organisation continuously search for new ideas to update its digital products and services.
		Customer Complexity Understanding	The organisation understand the complexity of customers' demand in the digital ecosystem
		Creativity Challenges	The organisation face the tough situation with creativity
		Technical Risk Concern	Digital risks are firm's greater concern in the digital entrepreneurial ecosystem
		Digital Adoption Leadership	The organisation is among the first to try new digital technologies
Digital alertness	This aspect deals with the firm's awareness and responsiveness to changes and opportunities in the digital landscape. It emphasises quick detection and reaction to potential threats and entrepreneurial opportunities.	Learning from competitors	The organisation learn from its rivals to augment its value-offering operations.
		Responding to regulations	The organisation respond to changing regulations in the digital ecosystem as quickly as possible.
		Awareness of ecosystem sophistication	The organisation is aware of the increasing sophistication of the digital ecosystem.
		Detection of consumer trends	The organisation quickly detects shifting consumer trends in the digital ecosystem.
		Promoting digital readiness	The organisation promote digital preparedness' to respond to ever-changing customers' demands.
		Quicker advantage of digital opportunity	The organisation accurately interpret new digital opportunities sooner than competitors
		Digital Awareness	The organisation is digitally aware of ever-changing consumer demand.
		Monitoring information flow	The organisation monitor information flow on its digital platform.
Digital openness	Refers to a firm's willingness to engage with digital platforms, share information, and collaborate. It highlights the	Strategic partnership building	The organisation focus on building a trusting and collaborative relationship with partners.
		Community engagement	The organisation increases members' access and participation in the platform.
		Social value creation	The organisation's digital platform accommodates all relevant channel members in value creation activities.

	importance of adaptability and openness to digital changes and innovations.	Collaboration openness	The organisation channel members have access to information on product and services.
		Activity Control	The organisation has a control on what channel members can do on the cause of value creation activities.
Digital innovative passion	Represents the intense positive feelings and motivation towards digital innovation. It reflects the entrepreneurial spirit and commitment towards implementing and investing in new digital technologies	Tech Investment	The organisation invest in new technologies to increase its digital presence.
		Resource Allocation	The organisation is willing to commit a large amount of resource to obtain new digital technologies.
		Capability Development	The organization continuously develop capabilities to compete in the digital ecosystem.
		Innovation Invention	Inventing new digital solutions is one of the bases of our digital presences.
		Client Experience	The organisation is committed to providing an exceptional digital experience to clients.
		Business Model Innovation	The organisation search for a new digital breakthrough to innovate its business model.

B4: Codebook Social sustainability orientation

Table 19: Codebook Social sustainability orientation

Core Concept	Definition	First order themes	Description
Social innovativeness	Refers to an organisation's focus on creating new solutions or approaches to address social problems. It encompasses the willingness to experiment and innovate to serve beneficiaries more effectively and to solve social issues in creative and impactful ways.	Emphasis on Novel Solutions	Social innovation is important for the company
		Investment in Social Impact	The company invests heavily in developing new ways to increase our social impact or to serve our beneficiaries.
		Frequent Idea Generation	In the company, new ideas to solve social problems come up very frequently.
Social Risk-taking	Involves the willingness of an organization to engage in actions that entail significant uncertainty to achieve its social mission. This dimension highlights the readiness to take substantial risks for the sake of creating social value, even when outcomes are uncertain.	Risk Embrace for Social Good	The company is not afraid to take substantial risks when serving our social purpose.
		Necessity for Bold Actions	Bold action is necessary to achieve our company's social mission.
		Avoidance of Over-caution	The company avoids the cautious line of action if social opportunities might be lost that way.
Social Proactiveness	Refers to the organisation's forward-looking perspective, characterised by seizing opportunities to create social value ahead of competitors. It involves actively pursuing new opportunities to serve social needs and being the first to act on these opportunities.	Leadership in Social Change	The company aims at being at the forefront of making the world a better place.
		Pre-emptive Social Actions	The organisation has a strong tendency to be ahead of others in addressing its social mission.
		Forward-Looking Social Strategy	The company typically initiates actions which other social enterprises/social entrepreneurs copy.
Socialness	The degree to which an organisation focuses on creating social value and addressing social problems is its primary objective. It reflects the organisation's commitment to its social mission, guiding its strategy and operations.	The primacy of Social Mission	The objective to accomplish the social mission precedes the objective to generate a profit.
		Strategic Partnerships for Impact	The company places a strong focus on partnerships with other organizations and/or governments to ensure a greater and accelerated accomplishment of the social mission.
		Sustainability as a Strategic Core	The company sets ambitious goals regarding sustainability and incorporates them in all strategic decisions.

B5: Codebook Environmental Sustainability Orientation

Table 20: Codebook Environmental Sustainability Orientation

Core Concept	Definition	First order themes	Description
Knowledge	Awareness and understanding within the firm about various environmental challenges and the impact of business operations on the environment and to which firms are informed about climate change, waste management issues, the role of businesses in environmental protection, and available environmental protection programs	Climate Change Recognition	Acknowledgement of climate change
		Environmental Knowledge Implementation	Knowledge of environmental protection programs
Practice	Captures the actual environmental management practices implemented by a firm. It includes activities such as recycling, training on environmental awareness, participation in environmental programs, adoption of low-impact manufacturing technologies and communication with customers about environmental efforts.	Environmental Awareness Training	Training of staff on environmental awareness
		Active Environmental Program Participation	Participation in environmental programs
		Sustainable Manufacturing Adoption	Use of low-impact manufacturing technology
		Green Supplier Engagement	Deal with environment-friendly suppliers
		Eco-Friendly Customer Communication	Communication with customers/buyers about environmental performances
		Regulatory Environmental Compliance	The company is applying environmental regulations
		Carbon Footprint Management	Management of products' carbon footprint
		Sustainability Metrics Integration	Use sustainable metrics for business performance.
Commitment	Represents the company's dedication and pledge to pursuing long-term environmental sustainability. Such as the belief that environmental protection is an integral part of doing business, sustainable practices are beneficial for the business and the ability to attract more customers through environmental efforts.	Business Visibility through Sustainability	Sustainability is crucial for the high visibility of the business
		Sustainability-Centric Decision Making	Sustainability in every business decision
		Regulatory Change Responsiveness	The company is dedicated and aware of changes in regulations
		Community-Based Business Operations	The company does business with the local community

Appendix C: Inductive Codebook

C1: Codebook Synergies

Table 21: Codebook Synergies

Subcodes	Grounded	Themes	Example quotes
Remote working for talent attraction	1	Corporate culture synergies	*"So we work 80% remotely, actually, and the 20% is when we come together to actually put the bins together. As a result, we have team members from all over the world who help attract people." [participant 3]* *"Yes, then, of course, we are affiliated with YESDelft. And yes, that's very nice in the sense of, of course, you're really next to TU Delft. So that's very easy if you want to attract new people" [participant 4]* *"And, of course, the most important resource is really just the team. So basically, the team, we're just trying to do day and night. "[participant 8]*
Talent acquisition through the incubator	2		
Customer data for improvement of algorithm	3	Networking Synergies	*"We do pilots with the customers. They use the machines. We get the data, we train it, and it gets better." [participant 3]* *"I think the incubators, the programs are very important for us to learn how to better build a company. The biotech and sustainability area is very new, and people don't exactly know how to better build a company." [participant 1]* *"We also learned people, human behaviour, that if you have a lot of food, they'll just throw everything into it, which is problematic...so that's another way how we involve the users, the necessary stakeholders" [participant 3]* *"Socially, we are affiliated with an incubator like YESDelft...Within that network, there is a lot of attention to sustainability" [participant 4]* *"They trusted us at the beginning...so we can say that we worked with ESA, which was very valuable when we wanted to engage with people because nobody knew, and still nobody knows our name." [participant 6]* *"We don't develop that satellite. We take raw measurements of different satellites and models and run samples- everything we can take. And then we build a model on top" [participant 6]* *"When you have an idea with a startup, you also need to be flexible because you need to understand and discuss with the client what their needs are and their challenge. You need to understand and listen to their challenge. And then the idea changed a bit. And right now, we're still iterating every week on small features and small things that could be more relevant." [participant 6]* *We got a substantial grant from USAID to improve automation/digitisation [participant 9]*
Customer feedback for validation	3		
Incubator synergy	3		
Leveraging academic and research collaboration	2		
Networking and Incubation as Growth Levers	2		
Utilising external data sources and technologies to enhance product capabilities	1		
Validation through networking	2		
Centralised data collection	2	Operational synergies	*"If we run that factory, we will avoid X kilotons of CO2 emissions. So that's really serious, 100 kilotons of CO2 emissions" [participant 2]* *"So we have a dashboard that tracks all the information that is connected from the devices. So you can have that also as a set." [participant 3]* *"And that is also very much in line with what I said, of course, with the location next to the Westland, next to the greenhouses." [participant 4]*
Economies of Scale	1		
Incorporation of sustainable practices in daily operations	2		
Location synergy with customer feedback	1		

Sustainable sourcing and supply chain	1		*“So that's what we're working with now. It is under European management. So there is a certain quality standard. Just say that employees are treated in a good way. The fabrics we use to produce the kites are European fabrics. So they come from Europe. And they are sourced for environmental friendliness but are more expensive than the competition." [participant 8]*
digital tools enabling reporting and compliance	1	Regulatory synergies	*“Finally, changes in regulation allowed us to do things we weren't allowed to do previously and hence triggered developing a certain automation solution.” [participant 9]* *"We benefit a lot from all kinds of grants and all kinds of schemes that we can use to finance the company" [participant 8]* *"What does play a role is that European legislation sees a lot of strict laws coming up around the use of chemicals, i.e. for the control of pests and diseases. Our technology can respond well to this and thus avoid the need to use a lot of chemicals. So actually, our technology is really in line with that legislation in that respect." [participant 4]* *"You have for us what is very important, which is what has been through it last year or a few months ago, eh, and that you can't just say that he is something sustainable if you can't prove it..." [participant 5]*
Flexible strategy of regulatory landscapes to speed up R&D	1		
Impact of regulations on market dynamics	1		
Positive Impact of regulatory changes on practices	1		
Regulatory Compliance and Market Adaptation	1		
Regulatory pressure on sustainability claims	1		
Strategic Use of Quality European Components	1		
Subsidy and European funding	1		
Accuracy and sustainability	2	Digital practices fostering sustainable awareness	*“So the system that we use, so when you have an AI model, it has a certain, let's say, the size of the model, the bigger the model, the more accurate it is, but on the other hand, it is more energy consuming, but the benefit of accuracy outweighs this extra consumption" [participant 3]* *“We take a raw measurement of different satellites, but also models, also run samples, everything we can take. Then, we build the model on top. So we don't just deliver, let's say, aggregated data. We make sure that we train, we calculate, and we provide some extra work on it. So that's our added value, and these insights have a sustainable impact” [participant 6]* *"We want to make sure that our data sets are used for real applications that have a positive impact. For example, we're also trying to target a bit of ESG. But we want to be there in a way that we actually provide things." [participant 6]* *“You have to be impactful, but you also have to be sustainable. You also have to be a sustainable business in a way that makes sure you make money. You have a real business model. And then if you have a machine that is working, you can have at the same time, financial money that's coming and positive impact." [participant 6]* *“We do pilots with them. They use the machines. We get the data, we train it, and it gets better.” [participant 3]* *“You just have to create that awareness. It's a constant process, so we do this with the dashboards.” [participant 4]* *“For example, we're also trying to target a bit of ESG. But we want to be there in a way that we actually provide things. Right now, people are a bit sceptical about ESG.” [participant 6]*
Adaptive Product Development in Response to Market and Client Needs:	1		
Balancing Commercial Growth and Sustainability	1		
Balancing Innovation with Market Acceptance	3		
Integration of sustainable metrics into business practices	1		
Leveraging digital solutions for environmental impact	5		
Use of AI for better waste management	1		
Use of digital tools for carbon footprint measurement	1		
Use of digital tools for validation through carbon accounting and labelling	2		
Data integration for improved agricultural outcomes	1	Digital integration and efficiency	*“Also some employees have been pushing the automation agenda significantly.”[participant 9]*

Digital dashboards for waste management monitoring	1		*"Yeah, I guess, but yeah. So the system that we use, so when you have an AI model, it has a certain, let's say, the size of the model, the bigger the model, the more accurate it is." [participant 3]* *"But if you really want to have insight into your system, it is very important that you have a kind of digital dashboard for that and that you gain insight into what can your ship do, what does your ship do and how it should behave..." [participant 7]* *"So [company name] is more data science, more aerospace. And then what we do is an environmental data set, understanding of carbon biomass, understanding about how to reach carbon neutrality on many levels." [participant 6]* *"So we are going to link those links with blockchain technology. We can link that link. We received a subsidy for this. We have algorithms that we build to predict those gaps..." [participant 5]* *"So we would like to always upload our data to existing platforms and then combine it with other data streams, but the infrastructure is lacking." [participant 4]* *"We use a flight path, so to speak. Then you have flying on the side, I guess, flying in a certain way, kind of rushes, some up. And in it, the robot can control the kite autonomously..." [participant 8]*
Digital tools for enhanced decision-making	1		
Digital practices for product development	4		
Digital tools for HR	2		
Employees pushing towards digital practices	1		
Digital tools for scaling	2		
Incorporating digital tools for operational efficiency	1		
Machine Learning and AI for waste identification	1		
Optimising Energy usage through digital technologies	1		
Data Analytics	3		
Digital tools for ecosystems integration	1		
Use of blockchain for sustainability data verification	2		

C2: Codebook Trade-offs

Table 22: Codebook Trade-offs

Subcodes	Grounded	Themes	Example quotes
Competition	5	Market engagement trade-off	*"We could have been accurate faster at a quicker pace, but then the user experience goes down. So that's a bit of a trade-off there."[participant 3]* *"The customers are willing to pay for accuracy, but they will get complaints about the time "[participant 3]* *"What we do know is that it is possible to get the AI good enough to actually sort of waste better, but people wanted yesterday." [participant 3]* *"So sometimes you take risks saying that you can develop this capability, and you don't know yet." [participant 6]* *"A lot of customers can't use the software yet. So they come, they find it interesting." [participant 5]* *"We price more based on the value that we bring on the interaction" [participant 6]* *"Our product can be technologically possible, it can already do a lot more, but you have to deal with a certain acceptance by the market" [participant 5]*
Customer demand	6		
Market Dynamics and Hype Cycles	5		
Price competitive vs Quality	1		
User experience vs accuracy of digital software	5		
User experience vs Scaling	2		

Assumptions in sustainability metrics	2	Operational trade-offs	*"If we run that factory, we will avoid X kilotons of CO2 emissions. So that's really serious, 100 kilotons of CO2 emissions. You can keep that to translate home, etc. That is, that impact is so great that everything we do, whether or not we travel to the office by train and buy green energy for us, is great. All of that pale into insignificance." [participant 2]* *"Until the moment that you sail a ship more sustainably over us for a day, then we can make handles for another year, so to speak." [participant 7]* *"My partner, John, is capable of doing it, and so is the one in Hungary capable of doing it. But he's landlocked. So it would be kind of weird to sort of get a replacement from someone there." [participant 3]* *"Yes, actually, we don't do much with that. Also, because we do have it there, I've looked at how well we score now. So you also have those scoring bars that you say to yourself how green your website is? We don't do much with that ourselves now. But also if you, yes, well, that's something we actually, yes, as we get a bit bigger, we have to do as well. And what kind of impact is that going to have? Yes, you know, the impact now is mainly that we help our customers to make a different choice." [participant 5]* *"So actually, the supply chain is mainly, almost entirely, Europe. So there is a certain quality standard. Just say that employees are treated in a good way. The fabrics we use to produce the kites there are European fabrics. And they are sourced for environmental friendliness. Okay. Just saying. So basically, they're recyclable." [participant 8]* *"One client decided to opt out as their products, supposedly sustainable items shipped from China, began to result worse in our analysis. They wanted better marketing scores, but we couldn't compromise on accuracy. This led to end the relationship." [participant 5]* *"A blind spot for people who can speak Dutch. If you are dealing with people who only speak English in your team, who want to reach out, and like if you send an email in English, they won't respond to you. As soon as they send them Dutch, they respond to you. It's very, very over it with that." [participant 3]* *"Of course, we are concerned with where we buy our stuff and what it is made of. Only, yes, it always remains true that money stuff plays a role in it. The more expensive components come especially from Europe. And they were made under slightly different circumstances. Anyway, sometimes you can't avoid getting things from China or Azia." [participant 7]*
Ethical trade-off	1		
Internal vs external social impact	8		
Remote working and efficiency	2		
Resource Intensiveness of Digital Technologies	3		
Supply chain and strategic material Sourcing	3		
Regulatory and Market Readiness	5	Regulatory trade-offs	*"Yes, and I think that we, as the Netherlands, have always taken the lead there, We have to keep that going. So if I had a concern, that would be one of the concerns. Is yes, who is going to pull that within the EU in a moment?"[participant 2]* *"So when you talk about innovations and new technologies in the direction of sustainability, you actually see that the regulations follow what the companies are doing" [participant 2]* *"As a startup, you need to go fast. And if you cannot go fast, you die. So we try to not be into a process that takes too much time to be certified, or to have regulation compliance. Of course, we want to be a regulation compliance for everything, but we try to go in ways that they do not need all the regulation, all the things." [participant 6]* *"The biggest barrier to entry into the market at the moment is regulation. And what kind of system is it? Is it a drone? Is the plane? What is it really just? And is it allowed here?"[participant 8]* *"Let's say when you are within different laws and lawmakers, and this thing takes time, it's complicated. We try to if you start up, you need to go fast. And if you cannot go fast, you die. So we try to not be into a process that takes too much time to be certified, or to have regulation compliance. Of course, we want to be a regulation compliance for everything, but we try to go in ways that they don't need all the regulation, all the things." [participant 6]* *"The system has to be reliable, and I mean, that's one of the big challenges that's going on in the sector right now is, okay, it all has to be sustainable, and we all have to set goals for 2050, but well, the technology that will soon comply with the 2050 legislation, it's not there yet."[participant 7]*
Regulatory compliance vs R&D	7		
Regulatory VS impact	6		
Reliability and regulatory compliance	1		
Time VS Regulations	2		

			“Well that's technically related in the first place, to install at least on seagoing vessels you have to have certification, so you have to have a certain type of approval and that's a fairly complex process. ”[participant 7]
Educational background and knowledge using for business	1	Resource allocation trade-offs	*"Anything that doesn't have to do with your core technology, you just have to enter into partnerships for it." [participant 2]* *"It's much better to just put knowhow in a good team and just be clear with each other, because we're going to share this and we're not going to share this, and then deal with that as much as you can." [participant 2]* *“We used our social capital, and knowing people there, they allowed us to make a prototype, our first one there." [participant 3]* *“So we really do try to create diversity and male-female. Yes. But it's really, really hard because, yes, if you put out a tech job, then 90% of the people who are interested are just men.” [participant 4]*
Financing of R&D	2		
In-house knowledge vs patenting (outsourcing	2		
Resource Allocation	10		
Risk and investment	2		
Talent acquisition	4		
Impact vs Profit	10	Strategic Priorities trade-offs	*"Oh, there's sustainability, but the thing about sustainability is sustainability doesn't make a business, you need to make a business case by itself, you need to return the money, and the rate of return needs to be as high as you would get outside the market."[participant 1]* *“Our shareholder ABN AMRO Sustainable Impact Fund "forces" us to work together with the Impact Institute to calculate the monetary equivalent for the impact created each year. Another shareholder, INCO, from France, negotiated that we explicitly include impact targets in our shareholder agreement and report on them each year ”[participant 9]* *"There's sustainability, but the thing about sustainability is sustainability doesn't make a business, you need to make a business case by itself, you need to return the money, and the rate of return needs to be as high as you would get outside the market."[participant 1]* *“Today it's really only about one thing, is that we get enough speed and now funding that we're going to get this ball rolling.” [participant 2]* *“What I was very worried about a few years ago, is now that is actually all pretty much solved. Today it's really only about one thing, is that we get enough speed and now funding that we're going to get this ball rolling” [participant 2]* *"Most of the time it's all about how can we save money using this machine? [participant 3]* *“We do know that the holy grail is if we can have zero delay time between object discard and object in the sorted. But the technology for that is difficult and quite complicated. ”[participant 3]* *“When I look at my sales conversations, I do see that 50 to 75 per cent of the time it's about the efficient experience and what I just said, sometimes it's experiencing efficient because it's green and it's bold and sometimes it's just what it's about money.” [participant 7]* *"Sustainability comes out from two sides, which is, on the one hand, it is imposed by legislation, on the other hand, it is used as marketing to attract young people like us and show that you are thinking about the future of the planet." [participant 5]* *“You have to also have to be a sustainable business in a way that you have to make sure you make money.” [participant 6]*
quality and quantity of the digital tool	4		
R&D vs scaling	7		
Scaling vs Impact	7		
Validation vs Impact	3		
Validation Vs R&D	3		
Validation vs scaling	9		

			“The risk that we're taking over time is we over-developing our tech. Are we over-developing products and data? ”[participant 6}

C3: Inductive codebook tree

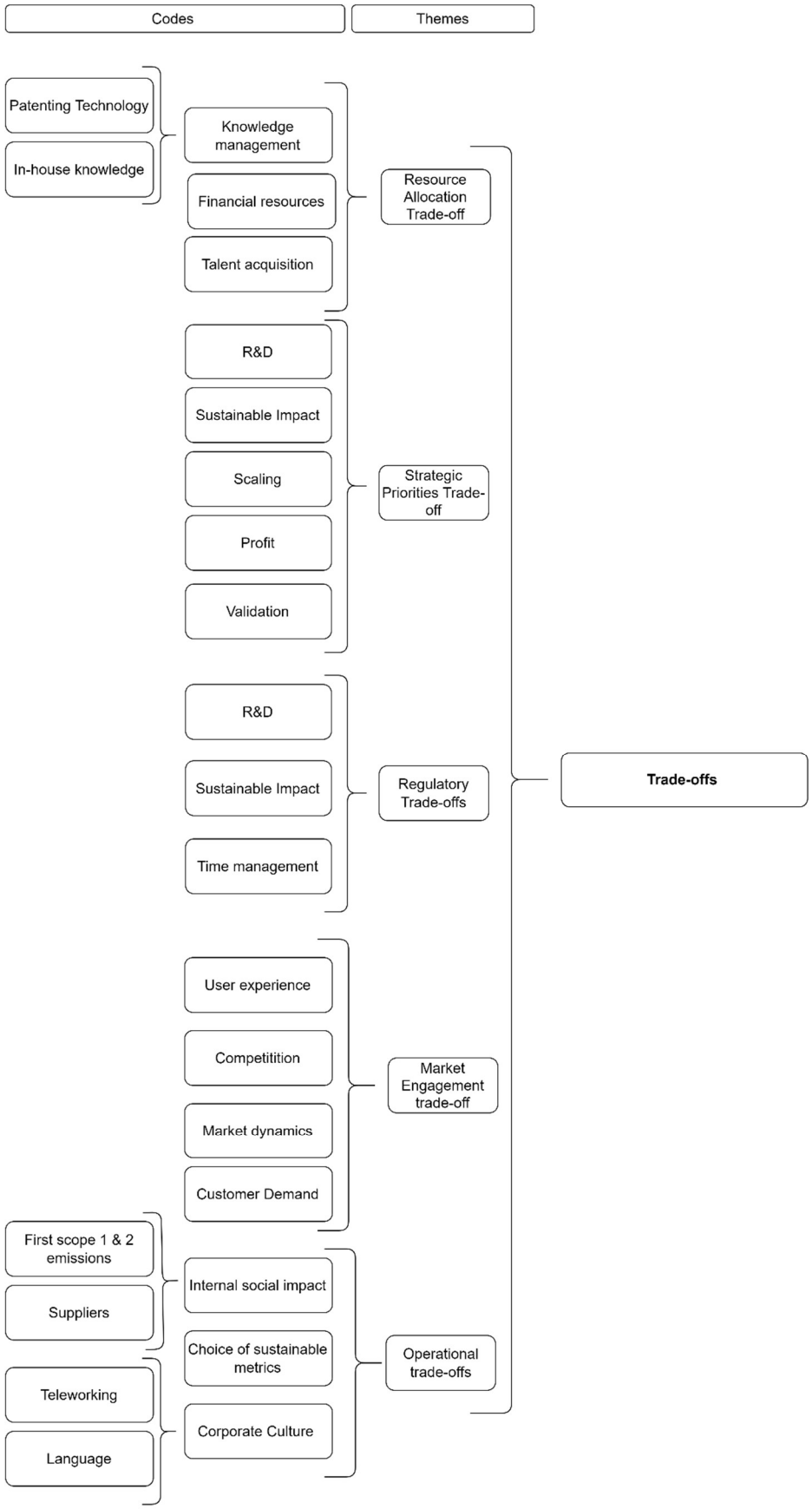

Figure 19: Inductive codebook tree trade-offs

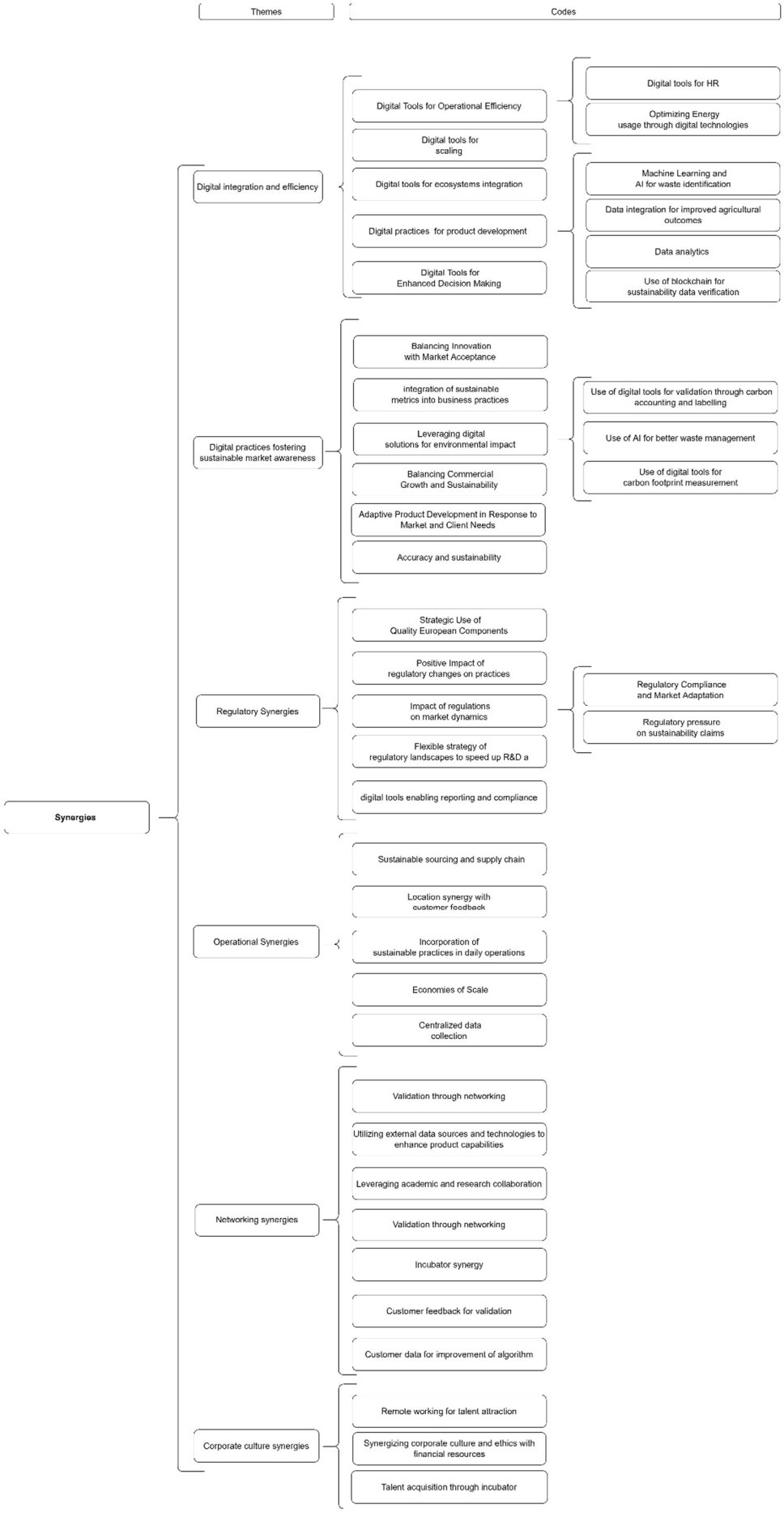

Figure 20: Inductive codebook tree synergies

Appendix D: Quote overview

D1: Quotes Definition sustainable and digital entrepreneurship

Table 23: Definitions of participants

Participant	Definition of sustainable entrepreneurship and strategy
1	*"For me, sustainability means bringing something to the market that has the potential to enhance various aspects of societal well-being. You could think of it in terms of the Sustainable Development Goals (SDGs), which offer a broader perspective. So, essentially, it involves developing products or services that contribute to achieving one or more of the 17 SDGs."*
2	*"My definition of sustainability is ensuring that our actions don't harm the environment. This involves using resources responsibly and giving back in balance. If we fail to do so, sustainability cannot be maintained. To me, sustainability is infinite. Acknowledging our past impact and the need to compensate means we may need a slight overshoot to correct our course."*
3	*"So sustainability for us is a way of creating a business that cannot impact future generations negatively in such a way that the resources that are used are self-generative and allow for more resources to continue to be used without it harming the planet, without making things more difficult for any other future generation. And in terms of sustainable entrepreneurship, basically that definition, but just in terms of finances, so whatever entrepreneurship you do, you can continue to do that entrepreneurship within that field."*
4	*[No clear definition]*
5	*"Sustainability, to me, means focusing primarily on environmental impact factors while acknowledging the need to expand towards social aspects. We're not just looking at CO2 emissions but at all significant factors like land use and toxicity. As these considerations become more standardised globally, it's evident that businesses must bear the responsibility for climate-related costs, eventually passing them on to consumers or others in the supply chain. Our goal is to understand and mitigate the impact businesses have on these factors."*
6	*"Sustainable. I don't know. We try to have a practice that our product aligns with what we want, and we don't want to have projects with an oil and gas company. We want to make sure that our data sets are used for real applications that have a positive impact. For example, we're also trying to target a bit of ESG. But we want to be there in a way that we actually provide things. Right now, people are a bit sceptical about ESG. They find it a bit bullshit. So if we deliver data here, we want to make sure that it's to solve this kind of issue where people don't trust it enough."* .... *"We're striving to ensure that generating a positive impact is one of our primary motivations. While financial incentives are certainly a consideration, they hold equal importance alongside our commitment to creating positive outcomes."*
7	*"Well, I must admit, I don't have a standardised definition for sustainability to rely on. In the maritime sector, sustainability often feels more like a requirement rather than a genuine commitment. It's imposed by regulations and utilised as a marketing tool to appeal to younger generations, showing concern for the planet's future. However, in practice, financial considerations still dominate. While we may promote our products as contributing to sustainable practices, the primary concern is typically cost savings rather than CO2 reduction. It would be promising if CO2 savings translated directly into financial gains, but without substantial subsidies, adopting alternative fuels isn't economically viable."*
8	*"Sustainability is basically about longevity, being able to last a long time. And lasting a long time essentially means being sustainable. It's about optimising efficiency and minimising waste, damage, and pollution. So, my definition of sustainability would essentially exist with as little negative impact on the environment as possible."* ... *"and the strategy is essentially the same because sustainability is about longevity. Strategy also looks ahead not just to tomorrow but to years ahead. So, essentially, every strategy should be sustainable. Sustainability is always a strategy, as we're always looking towards the future. And how we navigate that future is the essence of this company."*
9	*"You speak about creating a positive impact, which improves user well-being while simultaneously generating revenue. This ensures that you are not dependent on subsidies. Sustainability and social impact are related to enhancing equality, addressing both gender issues and developmental aspects."*
Definition of digital entrepreneurship	
1	*[No clear definition]*
2	*[No clear definition]*
3	*"What we tried to do is we want to use what we have and take as much out of it as possible and turn that into different revenue streams, be that digital or not."* ... *"Along these product lines, we can create an ecosystem of different products that we can give to customers and clients"* ... *"So we have a dashboard that tracks all the information that is connected from the devices. So you can have that also as a set. We try to use that as a central point for every data point as well. This also falls within our digital strategy . The strategy, essentially, is the blueprint for navigating your business digitally from point A to point B."*

4	*"I think it's mainly about applying technology, in companies, people's lives to make more efficient choices and improve processes and thereby create value for your customer."*
5	*"There are different streams in that regard. Our ultimate goal is to be product-led by using digital tools. That's what we're primarily focusing on now. It's about enabling users to utilize it themselves. Digitalization also enhances scalability."*
6	*[No clear definition]*
7	*"The key factor for us, whether it's digital applications or the hardware we produce, is awareness. In some cases, we opt to indicate things through light, while in others, we use force or vibration. However, for a comprehensive understanding of the system, having a digital dashboard is crucial. It allows you to gain insights into your ship's capabilities, its current behaviour, and how it should ideally perform. From there, you can make informed decisions. Maybe actually a step further than digitalization, but that does not only contain data collection but also data analysis. You set expectations for your ship and then assess how to meet them, identifying areas for potential improvement through digital applications."*
8	*"In terms of our digital strategy, it's really about leveraging technology to enhance system performance and efficiency. We're constantly developing and integrating various tech elements, such as algorithmic simulations and software. Using agile methodologies like Scrum, we're always refining our hardware, embedded software, simulations, data analysis, and user interfaces. Additionally, we're actively exploring new technologies and collaborating with external partners to integrate [...] models and geographical data, ensuring smoother operation and compliance with regulations."*
9	*[No clear Definition]*

D2 : Important quotes : resources & external incentives

Table 24: Quotes resources and external incentives

	Subcategory	Quote	participant
Resources			
Financial	Funding strategies	*"Subsidy programmes are essential. I hope, therefore, that the EU will act much more as an EU than any country on its own."*	**2**
	Funding strategies	*"companies with the primary goal of being sustainable is way too risky for private equity firms."*	**2**
	Cost management	*"Our main cost is just the people that we have in the team,"*	**6**
	Funding strategies	*"Regarding subsidies, it remains challenging... I don't think they align well with what we do."*	**5**
	Cost management	*"Investment is necessary to build software, but building software is extremely expensive.*	**5**
	Revenue Generation	*"We can provide a machine that can sort the waste, so that can save money for the customer afterwards"*	**3**
	Cost management	*"Yes, we are now investing heavily in creating the dashboards and that is in both the infrastructure in terms of hardware and online,"*	**7**
Social	Networking and alliances	*"the incubators and programs are very important to us to learn how to better build a company [...]the incubators help because they help us to connect to people"*	**1**
	Community outreach	*"We do as much engineering in-house as possible[...] you have to keep the technology in control all by yourself."*	**2**
	Community outreach	*"So we were interviewing people and asking them what they thought of it. Was it easy? Is it clear? [...] So we compile all of that into a list and then we now have a list of different things to do, to improve on, to fix, make it a bit smaller, change the lights a bit, etc.."*	**3**
	Networking and alliances / Stakeholder engagement	*"The fact that there is a lot of interaction between [...] as a company with the aim of bringing a product to the market and TU Delft with the aim of producing research [...] So we are not concerned with the strategy in 10, 15, 20 years. That's what TU Delft does. We are really thinking about the next five years. And that's nice and complementary."*	**8**
Innovation	Product innovation	*" This focuses on the innovative use of waste streams to produce lactic acid, indicating a commitment to product innovation using biotechnology."*	**1**
	Process innovation	*"In terms of the actual production of the bin, we then went to a different company who can deliver higher quality acrylic sheets."*	**3**
	Product innovation	*"We really try to focus on making the ship more efficient and that's what sets us apart."*	**4**
	Service innovation	*"What we are ultimately working towards is that we want to be product led. So that, yes. And that's actually the most important thing we're working towards right now. So that users can use it themselves. That also makes the scalability."*	**5**
	Service innovation	*"That's why we can't handle more customers at this stage. So we started doing all of that on a sized. And in the meantime, we're all creating digital content. To be able to do that increasingly hands-off."*	**5**

	Product innovation	*"We bring a new class of renewables to the market.[...]"Our positioning is mainly portability. So basically that this system is mobile. You can pick it up, put it somewhere, and go flying. This is not the case with solar neither solar panels. The system should really be plug-and-play. That's actually the difference between solar and traditional wind."*	**8**
Human	Team Knowledge	*"It's something that I personally enjoyed a lot because on the sustainable, let's say, path, if you want to build a good company, I think it's very important that you have people that trust the project."*	**6**
	Team Knowledge	*"We look at HR; we don't have a dedicated person who is actually working on sustainability all the time."*	**3**
	Talent Acquisition	*"Nowadays, talents are intrinsically motivated to commit to sustainability and circularity. I expect that we will have no difficulty in attracting good people."*	**2**
	Workforce composition	*"And, of course, the most important resource is really just the team. So basically, the team with which we just try to get the company a step further day and night."*	**8**
	Team knowledge	*"And, of course, the most important resource is really just the team. So basically, the team with which we just try to get the company a step further day and night."*	**8**
	Social Equality	*"So we really do try to create diversity and male-female. Yes. But it's really, really hard because, yes, if you put out a technical job, then 90% of your people who are interested are just men."*	**4**
	Training and development	*"As I said again, from our background in engineering, we need support in business and commercial. And it came from investors that helped us and coach, rated to that."*	**6**
Physical	Infrastructural environment	*"We are located at YESDelft. And yes, that's very nice in the sense that you're really next to TU Delft. So that's very easy if you want to attract new people and engineering talent. We always have a lot of people who would like to work on this. YESDelft builds itself in terms of rent, facilities, and things, which is really ideal. There is quite a lot of service around it and quite an inspiring space."*	**4**
	Infrastructural environment / Operational asset	*"It is very important to us that our location is in the Westland with many greenhouses around us, and therefore also many customers. We have a lot of greenhouses where we can test our technology. where we can get input and feedback from the end users. That makes it even more ideal in Delft"*	**4**
	Infrastructural environment	*"the ecosystem is not there"*	**1**
	Environmental Impact	*"we tried to make sure that they were 100% recycled"*	**8**
	Infrastructural environment / Operational asset	*"What is also very important to us, is that our location next to the Westland. The important customers and agriculture are there. We have a lot of greenhouses where we can test our technology. Where we can get feedback and input from the end users"*	**4**
Intellectual	Knowledge management	*"We do as much engineering in-house as possible"*	**2**
	Intellectual property	*" I myself have much more value for knowhow than for patents, because patents are public and so you can copy them and then you can work around them, moreover, patents in certain regions, are hardly enforceable."*	**2**
	Knowledge management	*"So we would like to always upload our data to existing platforms and then combine it with other data streams, but the infrastructure is lacking." [participant 4]*	**4**
	Knowledge management R&D development	*"That there is a lot of interaction between [....] as a company with the aim of bringing a product to the market and TU Delft with the aim of producing research."*	**8**
Organisational	Change management	*"But what we do want is that this technology simply does not remain available only for the Netherlands, it must be able to be used worldwide"*	**2**
	Corporate culture	*"As for those public funds, such as grants and subsidies, they're really looking at what we're doing in terms of social and environmental responsibility. It's not just about our products or profits; they want to see that we're doing good things for people and the planet."*	**8**
	Change management	*"So we try to not be into a process that takes too much time to be certified"*	**6**
	Change management	*"So when I said about whether the market is ready or not, for example, this company needs to be compliant. So we started last year, but it will be compliant end of this year."*	**6**
	Change management	*"Our technology aligns well with the legislation; in that it significantly lowers the barrier for growers to adopt our technology. [...] Simply put, your market potential will expand as regulations become more compulsory."*	**6**
External incentives			

Normative	Industry expectations	*“Yes, there are always some customers that will be aware of this and some that won't. It depends on which area you're talking about”*	**1**
	Industry expectations	*"We're trying to make sure that it has a positive impact. One of the motives is this. It's not financial incentive."*	**6**
	Professional and ethical standards	*"But I think someone else will buy those ships again and sail them anyway if they can deliver it cheaper,"*	**7**
Coercive	Investor and Financial Pressure	*“The thing about sustainability is sustainability doesn't make a business; you need to make a business case around it, you need to return the money, and the rate of return needs to be as high as you would get outside the market. So it is a requirement, and once you get this, then the sustainability should be there as well, depending on which type of investment you have.”*	**1**
	Regulation Compliance	*“you actually see that the regulations follow what the companies are doing; for example, with a green deal and everything, of course, we try to steer, but then you constantly run into things, and they have to be arranged, and so that is very clearly slowing us down.”*	**2**
	Regulation Compliance	*“It's just, your sales market is just going to get bigger, because the legislation is making them stricter.”*	**4**
	Investor and Financial Pressure	*"So our investors are very, very chill."*	**4**
Mimetic	Industry Leadership and Example	*“If you want to stay ahead of the curve with your technology and therefore always have the most attractive technology, you have to continuously invest in technology.”*	**2**
	Participation in Accelerators and Incubators	*“But ESA, we don't feel a lot of pressure for them. We feel more ideas rather than strong things.”*	**6**
	Competitive Advantage Through Digital and sustainable solutions	*“So we price more based on the value that we bring on the interaction.”*	**6**
	Competitive Advantage Through Digital and sustainable solutions	*"We start a company, and immediately there is someone who says, here is a big bag of money, we'll take you over. But that doesn't work at all because then you'll notice your own sustainability claims."*	**5**

Appendix E: In-depth Interview results

E1: Interview comparison: Resources

Table 25: Interview comparison : Resources

#	Financial	Social	Human	Intellectual	Organisational	Physical	Innovation
1	Banks, VC, Angel investors, Focus on cost reduction	Outreach through incubators	High focus on sustainability-oriented talent	Patents for securing technology and recouping investments	N/A	Need for ecosystem and infrastructure	Product innovation through state-of-the-art lactic acid production
2	Cost management is crucial, VC, debt, and subsidies	Networking and alliances are formed with various stakeholders (suppliers and engineer contractors) Encourages sharing and open use of technology rather than restricting /licensing	Talent acquisition strategies aim to attract people who are committed to sustainability and circularity.	No Patents In-house knowledge R&D development through certification programs (ICC)	Focus on corporate culture and environmental protection	focus on reducing CO2 emissions Infrastructure adjustments to follow regulatory requirements Infrastructure adjustments to follow regulatory requirements	willingness to pivot from established industry norms
3	Grants and competition awards. Revenue generation: Machines that sort waste to reduce costs for customers.	Winning awards and engaged in community testing for feedback	Diverse skills: The team includes AI engineers, PCB designers, and marketers.	Plans to patent the sorting system. Learning from prototype performance to improve technology.	N/A	Using recycled materials for the product	Developing state-of-the-art waste sorting system
4	Informal investors and sector entrepreneurs Governmental subsidies obtained	YESDelft of great value for the participant (talent acquisition, R&D, Location, testing)	Good Talent acquisition Barrier to strive for social equality	N/A	N/A	Focus on knowledge management instead of patents. Location is key to their R&D strategy and talent acquisition	Creating awareness among customers.
5	Utilises a mix of personal funds, loans, and innovation-oriented subsidies Emphasises the high cost of software development	Development of operational assets like a footprint engine and potentially a recognition engine. Focuses on environmental impact factors, not limited to CO2.	Technical background, building enterprises for larger organisations, lacking programming skills, thus hiring a developer team. Emphasises training and development through collaborations	Collaboration with TU Delft on methodology, providing technological advice, using algorithms to fill data gaps,	Importance of making scalable decision-making for expansion Making choices that sometimes conflict with commercial interests in Favor of ethical considerations Strives to be product-led and service-centric.	Use of algorithms to predict environmental impact factors Developing a footprint engine and possibly a recognition engine	Utilises development sprints for iterative software updates and focuses on flawless algorithm operation.

6	Identifies lack of a strong business or financial plan; engineering-focused. Prioritises the efficiency of the team to manage costs.	Participation in the European Space Agency Incubation Programme for networking and validation. Avoids working with oil and gas companies; instead, focuses on forming positive-impact relationships.	Gained validation and training through the ESA Incubation Program. Founded by an engineer with an aerospace and robotics background. Values hiring individuals who align with the company's sustainable path and mission.	No reliance on patents, instead focusing on developing their infrastructure and business.	Prioritising sustainable impact over profit Aiming for a streamlined process without excessive regulation compliance Aims for regulation compliance in a way that is time-efficient and suitable for the company's stage of development.	Using cloud-based infrastructure for their operations.	Focus on understanding and discussing client needs to iterate on product features.
7	Customers pay for new features without exclusivity. Focus on reducing the cost price for electronics and overall cost-conscious operations.	Involvement in a Eurostar project, affiliations with incubators like YESDelft and Port XL, networking for sustainability and efficiency.	Efforts to source resources locally	Emphasis on certifications and approvals for products.	N/A	Sourcing from nearby regions is part of their infrastructure strategy.	Internal brainstorming sessions to drive innovation. Customer feedback is integrated to improve services.
8	The challenge of securing funds in a pre-revenue phase and making the product market-validated for investors.	Ongoing interactions with universities, particularly TU Delft as the main stakeholder Collaboration with large energy utilities like RWE in Ireland.	Shift from a student-based team to more professional hires with industry experience. Software team management, operational team handling, and utilisation of agile methodology with sprints	R&D with TU Delft on renewable energy and long-term strategy Ownership of four patents.	Mentions criteria of funding based on equality and sustainability goals Supply chain mainly in Europe due to reliability and quality	Use of a test field for their technology, which also counts as infrastructure	N/A
9	Investment fund from ABN Amro, no other investors Partnerships with USAID for social impact investment	Collaboration with projects in developing countries, investing in development projects to impact equality. Partnerships with USAID for social impact investment	A skilled team tries to enhance equality in workforce	N/A	Corporate Culture is very present within the company,	N/A	Using AI for live translation of their website, but also regulation compliance within the EU.

E2: Interview comparison: External Incentives

Table 26: Interview comparison : external incentives

#	Coercive Pressures	Mimetic Pressures	Normative Pressures
1	Experience investor pressure to deliver sustainable products that also generate a return on investment.	N/A	Recycling is seen as an easier compliance route for industry best practices Awareness of sustainability varies by industry sector and company progress in sustainability efforts.
2	Regulations often follow the initiatives of companies ICC certifications impact their operational practices	Proves the viability of technology on an industrial scale to maintain industry leadership.	The expectation that intrinsic motivation for sustainability will attract talent, reflecting professional and ethical standards.

		Developed a unique product, setting an industry example and leadership since entering the market.	
3	No real sustainable pressures from investors; more about Financial metrics No pressure from environmental regulations, only from CE certifications for electronics	Faces the challenge of balancing digital efficiency with customer expectations, emphasising the competitive advantage through digital innovation. Recognises the need to differentiate their sorting technology from less effective market alternatives.	Trade-off between accuracy and user impatience suggests tension between innovating and meeting customer expectations.
4	Aware of upcoming stringent European regulations on the use of chemicals, positively impacting product deployment strategies.	Strives to combine data with existing platforms to create more value and gain a competitive advantage. Do not feel significant pressure from their incubator Utilises unique selling points related to their location and industry partnerships for competitive advantage.	Acknowledgement of equality within workforce, but do seem to have struggled in finding the men-women balance within the technical field
5	Experience pressure to scale solutions in response to regulations like the Green Deal Emphasise the difficulties in data collection for compliance with sustainability reporting	N/A	Pressure to deliver added value to customers influences feature development and service enhancements. Client inquiries about sustainability drive the need to measure and improve, indicating a market-driven approach to innovation.
6		While part of the ESA ecosystem, it feels more ideational support than direct pressure from the ESA.	Strives for technological validation in the market without overdeveloping products Focus on creating data sets for applications with a positive impact, targeting ESG norms, and aligning with industry expectations from NGOs.
7	Face regulatory compliance pressures from legislation that mandates sustainability measures. Discuss the challenges of keeping up with upcoming legislation	Competes with traditional trade builders using software/hardware tools, leveraging their competitive advantage through digital practices and data analytics	Technological potential is sometimes limited by market acceptance and perceived value.
8	Pressure related to environmental regulations due to their unique technology positioning. Recognise the regulatory barriers to market entry as a significant hurdle due to the novelty of their system	N/A	Commitment to sustainable practices, such as eco-friendly travel incentives and vegetarian meals. Identification of including social criteria for getting grants and loans. Supply chain focussing on usage and recycling of eco-friendly materials for production of their product, enabling circular practices
9	Pressure related to compliance for financial transactions. Regulations are a barrier to investing in different developed countries and expanding their services within the EU	Takes industry leadership in the Netherlands by primarily focusing on social projects to enhance gender equality and help poverty. Compete with other competitors based on the social impact of their collaborations with local entrepreneurs.	N/A

E3: Interview comparison: Digital Orientation

Table 27: Interview comparison: Digital Orientation

#	Digital Curiosity	Digital Alertness	Digital Openness	Digital innovative Passion	Important quotes related to DO
1	Awareness varies among customers. Recognises the importance of understanding customer complexity.	The focused efficiency of digital platforms in developed ecosystems.	Emphasises learning from incubators and programs. Difficulty of scaling without external support due to an underdeveloped ecosystem and infrastructure	Highlights innovation in using waste streams for production to reduce costs.	*"I think the incubators, the programs are very important for us to learn how to better build a company."* *"It's a bit difficult nowadays, in this sense, because the ecosystem is not there. So we need to develop a lot of things that are sub-optimal so that it can work in the end."*
2	Acknowledges the difficulty of scaling without external support due to an underdeveloped ecosystem. Acknowledges the difficulty of scaling without external support due to an underdeveloped ecosystem. Reflects on technological risks of scaling and market acceptance	Learning from competitors and quickly taking advantage of digital opportunities.	Openness to share certain know-how while keeping core competencies in-house Benefit of open collaboration with partners and the building of strategic partnerships.	Speaks on the European Union's role in subsidising innovation, seeing it as an opportunity for growth.	*"But we have to be realistic, the competition just doesn't sit still. So we can wait a very long time with the next plant habit."* *"That regulation is now under development, but two years ago, we were hopelessly stuck in it."* *"I think when you scale up the technology, then you can very clearly see somewhere a step from pilot slash demo to industrial skill and then the capex, so the investment amount just goes up X all at once."*
3	Technical risk is a concern, especially when machinery breaks down or does not perform as expected, leading to lost investment. Understanding customer complexity is crucial, as demonstrated by the trade-off between accuracy and user experience.	A dashboard is utilised to monitor information flow between client and data tools Awareness of consumer trends, particularly noting that people's behaviour can impact how their products are used and the subsequent feedback.	Openness to trial and error is shown through pilot testing, where they collect data to improve their machines and learn from breakdowns. They show a willingness to engage with a wide range of stakeholders to gather feedback and improve the user experience.	Leveraging digital practices to create multiple revenue streams and innovate with what they have Commitment to capability development is demonstrated by the company's approach to working remotely but coming together for crucial collaboration when needed	*"Along these product lines, we can create an ecosystem of different products that we can give to customers and clients."* *"They are willing to pay for accuracy, but they will get complaints about the time. So you have people in the finance department who look at the numbers at the end of the day and how much they spend. They for sure wanted to not make any mistakes. But people at the canteen are going to be like, yes, we want accuracy and speed. Other people at the canteen are going to be like, oh, I don't want to wait. I don't want to wait."*
4	They use software to perform specific functions on their systems, such as taking photographs and analysing them for relevant metrics, which are then shared immediately. Acknowledges the challenge of balancing quick fixes against fully refined, automated solutions and recognises this as an ongoing dilemma, particularly for startups.	Strategy to upload data to existing platforms and combine it with other data streams to create added value, showing an awareness of the digital ecosystem. Awareness of regulatory changes, especially European legislation, which opens a new customer market	Need for continuous creation of awareness, suggesting an ongoing and active process of engagement.	Importance of client experience and the validation it provides for the company, which seems to be a driving force behind their technological solutions	*"You just have to create that awareness, so to speak. It's a constant process."* *"So we would like to always upload our data to existing platforms and then combine it with other data streams, but the infrastructure is lacking."* *"So actually, our technology in that itself is really part of that legislation,"* *"Sure. In principle, which is often a challenge... In other words, um, whether it's quality or quantity, of course. That you have to make that decision all the time."*

5	Recognising the problem of incomplete customer data, they have focused on developing algorithms to fill in the gaps.	Recognition of a lack of data in making sustainability claims and how they plan to bridge this gap using algorithms.	Collaboration with TU Delft was critical for the development of their first prototypes.	Underpins the importance of having access to data across all points of the product lifecycle and using blockchain to predict data gaps.	*"A lot of customers can't use the software yet. So they come, they find it interesting. But then again, they haven't had any training at all."* *"That's going to be very difficult with compliance. So how reliable is that data, and who is responsible for it, et cetera."* *"So to be able to build software. Building software is just super expensive. So that's what we need."*
6	Seeks understanding and alignment with customer requirements Iterating products to ensure they are relevant and valuable to customers	Aware of the market dynamics and the necessity of pivoting quickly to capitalise on digital opportunities Recognition of the competitive landscape and regulatory environment to stay ahead and respond appropriately	Embraces collaboration and strategic partnerships with entities like ESA and values the dynamic nature of tech and environmental data. AWS credits enabled fast development without the need for patent protection, fostering an open development environment	Risk of overdeveloping tech that might not align with market demand, thus focusing on resource allocation and innovation that meets client needs	*"So sometimes you take risks saying that you can develop this capability, and you don't know yet. I think that what we did for some projects that we got and sometimes it's perfect because we developed it. Sometimes, it's a bit trickier because we cannot develop."* *"But the more we grow, the more resources we have, the more we can go into it and make sure that could be also a competitive advantage to make sure that we are certified,"* *"We're so happy to be part of everything that accomplishes ESA and the image that they have"*
7	Embraces software development as a core function. Focuses on creating user-friendly digital interfaces (Human-digital interfaces)	Focusing on certification and product viability.	Partner with incubators and connect with industry contacts for strategic growth.	Aims to provide digital tools that offer real-time insights into the health and efficiency of ships integrates digital dashboards to enhance ship infrastructure management	*"And we really try to talk to the skipper, to the shipyard, to the owner to see how we can... make the ship more efficient."* *"We also have some subsidies, which are some regional subsidies that we have used for this. These are more innovation-oriented subsidies, not necessarily green."*
8	Technical risks involved with initial costs in R&D and high CAPEX. Exploring the integration of advanced weather modelling systems to enhance system functionality and accuracy.	Monitors market movements and learns from competitors.	Open channel for activity control and partnership building. (0-5 years) In-house short-term strategy and outsourcing long-term strategy (+10 years)	Developed technology and roadmap independently, leveraging close ties with research institutions like TU Delft for long-term strategy.	*"And I think there's also quite a lot, yes, all that R&D, of course; those initial costs are just very high."* *"Of course, we can deliver very well what TU Delft is already doing. Because it is already looking so far ahead, so to speak."*
9	N/A	Using AI to create a competitive advantage for faster compliance with regulations in other countries. Uses digital tools for marketing, such as podcasts and Google ads. Awareness of their customers and who to target for marketing	N/A	Recent investments in their platform. Tries to focus on transparency towards their client, enhancing client experience.	*"We have now put some things in place to turn the tide and are going to use financial technology, such as algorithmic lending, to make this happen."*

E4: Interview comparison: Environmental Sustainability Orientation

Table 28: Interview comparison : Environmental Sustainability Orientation

#	Knowledge	Practices	Commitment	Important quotes related to environmental sustainability orientation

1	Recognises the importance of climate impact in business operations. Understanding that customer awareness is different per industry Recognises the industry shift towards recycling and bioplastics and the need for infrastructure support towards a circular economy	Companies ensure that sustainability is part of every employee's educational background and profile.	Emphasising the importance of sustainability as a core value for attracting investors and the necessity of balancing it with a viable business model	*"Sustainability doesn't make a business; you need to make a business case by itself, you need to return the money, and the rate of return needs to be as high as you would get outside the market."*
2	Recognises the need for globally applicable sustainability technologies and leading by example in the Netherlands	Managing the extraction and utilisation of energy and natural resources efficient and sustainable Prioritizing the establishment of partnerships with suppliers that share a commitment to sustainability. Acknowledging the complexities in defining and quantifying sustainable practices in monetary terms.	Advocacy for updated regulations to define waste as a raw material Highlights the importance of balancing sustainability efforts with business growth and profitability.	*"But what we do want is that this technology simply does not remain available only for the Netherlands, it must be able to be used worldwide."* *"Subsidy programmes are essential. I hope, therefore, that the EU will act much more as an EU than any country on its own."* *"And then the most important thing is, or the hardest thing is, how do you quantify a sustainable prospect? How do you translate that into money?*
3	Mentions the importance of sustainable ecosystems and infrastructure, particularly in the recycling industry Knowledge sharing about environmental regulations or standards, which may include researching and staying updated on EU regulations	Involvement in community-based programs, such as impact investors and climate tech competitions. Contracted with green suppliers to source sustainable materials and services, emphasising the use of recycled materials and sustainable production methods	Commitment to producing a sustainable product, helping customers with more efficient waste recycling, being more sustainable and cutting costs at the same time. Regular feedback sessions with clients and users.	*"While growing up on the island, there were always issues with sustainability and environmental issues... This was actually one of my main motivations because I wanted to study something in the field of technology and sustainability."* *"Then, from there, the idea pivoted to a bin that could identify different plastic waste and tell different companies where the waste is being generated so that they can improve location-based marketing. So we started to shift a little bit to a B2B focus."*
4	Indicates a deep understanding of the challenges in sustainability, including awareness creation as a constant process.	Supplier choice is mainly based on costs, reliability, ease and replaceability	Shows that sustainable practices in agriculture come from regulations.	*"Sustainable production of our product is not a conscious focus in our development strategy."* *"Creating awareness is an ongoing process that requires focus and is necessary for sustainable development."*
5	Recognises the importance of comprehensive environmental factors, not just CO2, in assessing sustainability. Focus on using data analytics and blockchain towards sustainable compliance of clients its supply chain	Awareness of regulations. Mentions the gap in the definition of regulations. No clear definitions to comply with certain regulations There is no clear use of current sustainable metrics, green suppliers, and internal carbon footprint methods. Do mention it if resources are available.	Dedication to creating scalable sustainability solutions in line with evolving regulations and corporate responsibility. The product is focused on being able to make sustainability claims in the supply chain, reflecting a commitment to transparency and regulatory compliance.	*"We haven't really focused much on assessing how 'green' our operations are, such as using scoring systems to measure our environmental impact. Although I have looked into it and considered how our website performs on sustainability scales, we haven't actively engaged with these measures. However, I recognise that as we grow, it will become increasingly important to evaluate and communicate our sustainability more formally. The real impact we're making right now is in helping our customers make more sustainable choices."*
6	possesses an in-depth understanding of carbon biomass, aerospace, and strategies to reach carbon neutrality	N/A	They maintain a balance between having a viable business model and making a sustainable, positive impact A community-based approach to business operations is key, focusing on trust and viability	*"So we try to figure out where we can have the most impact, where we can grow, but also, yeah, we can reconcile it, kind of growth, sustainable, positive impact."* *"It's something that I personally enjoyed a lot because on the sustainable path if you want to build a good company, I think it's very important that you have people who trust the project."*

7	Recognised the lack of a standard definition for sustainability within the maritime sector, noting that sustainability is often imposed by legislation	Complies with sustainability standards and stay ahead of regulatory changes	expressing a commitment to regulatory responsiveness and preparing for the future where ships must comply with 2050 environmental legislation.	*"At least, sustainability comes out from two sides, which is, on the one hand, it is imposed by legislation."* *"On the other hand, it is used as marketing to attract young people like us and show that you are thinking about the future of the planet and not just the current lifespan of yourself, so to speak."*
8	Contributing to SDG such as affordable and clean energy, decent work, and economic growth.	Supply chain is primarily European, with one supplier in Sri Lanka under European management, ensuring quality and environmentally friendly materials. Internal processes are also targeted to be as sustainable as possible (sustainable transportation, Vegetarian meal plans)	strong commitment to the energy transition and introducing a new class of renewables Commitment to long-term sustainable production of renewable energy in cooperation with the TU Delft. Recognition of compliance difficulties due to the novelty of renewable energy.	*"Durable is long-lasting. Strategy is also about not tomorrow but in a number of years. So basically, any strategy should be sustainable."* *"The biggest barrier to entry into the market right now is regulation." "Because we don't exist yet, and in fact, are seen as another category of energy, there is also very little regulation." -* *"We have implemented that within our company. That we say okay, we. Are trying to travel sustainably. As much as we can, we take the train instead of the plane.*
9	Contributing to the SDG goals, more focus on social equality and poverty	No compensation for internal platform emissions Focus on internal sustainable practices such as sustainable transportation. It is not really clear how they measure their sustainable impact	Commitment towards sustainable practices, Clear overview of sustainable impact of investments in development countries and entrepreneurs. Very engaged with the community, focusing on visibility through their uniqueness in investing in social impact projects.	*"We facilitate the crowdfunding, not only on social projects but also on environmentally friendly projects, such as installation of solar panels and biogas digesters in development countries."*

E5: Interview comparison: Social Sustainability Orientation

Table 29: Interview comparisson: Social Sustainability Orientation

#	Social innovativeness	Social Risk-Taking	Social Proactiveness	Socialness	Important quotes related to Social sustainability orientation
1	N/A	Prioritises securing patents to protect innovations and to ensure financial return on investment	N/A	Commitment to hiring individuals with a sustainability background.	"The ecosystem is not there. So, these accelerators help us to think about what needs to be achieved before we are successful. Because it's not only about us, but we also cannot be successful alone."
2	N/A	Embraces the inherent risks of entrepreneurship, which involves creating something from nothing, as necessary for making impactful social change.	Recognises the need for action and learning from current practices to advance sustainability Highlights a change in what motivates talent to work for a cleantech startup	The belief that sustainability involves both utilising resources and giving back to society	"So entrepreneurship, in that sense, is just creating something out of nothing. So that's just always a high risk because you don't know if it's going to go well."
3	Works on educational campaigns and community involvement to improve recycling practices.	Highlights the need for speed in bringing a sorting machine to market to maintain a competitive edge	N/A	A focus on both profitability and environmental consciousness, presenting cost-saving as a benefit of better waste management.	"Then, so this was the main motivation, the fact that there were issues in terms of the field of recycling and sustainability that was intrinsically motivating to me that I wanted to do something in that field."

4	N/A	N/A	N/A	Hiring technical staff and the advantage of using English as the company language to attract diverse talents	“So we really do try to create diversity and male-female. Yes. But it's really, really hard because, yes, if you put out a tech job, then 90% of the people who are interested are just men.”
5	Questions and investigates the sustainability practices of potential business partners and suppliers.	Considers significant risks in business decisions, such as responding to acquisition offers, emphasising the importance of maintaining independence to ensure credibility and avoid marketing biases	Reflects on the shifting costs of social impact from society to businesses and potentially to consumers.	The need for independence in sustainability calculations to avoid them becoming mere marketing tools	"We often receive questions about whether we can be acquired; numerous parties have expressed interest, particularly in the packaging sector, with remarks like, 'We'd like to acquire you.' However, what I've realised is that sustainability claims on carbon footprint are only truly meaningful when you're an independent entity. Otherwise, it quickly becomes just a marketing stunt, which is misleading people.”
6	N/A	Willing to present their startup as more capable than currently verified to access new markets, reflecting a strategic risk to expand their influence and operational scope.	Trust is valued within the project team and is considered essential for company growth.	N/A	“That's the main thing. Also, sometimes, when you have new, you try to go to a new market or new people, and sometimes you need to explain that you are bigger than you are. So sometimes you take risks saying that you can develop this capability, and you don't know yet.”
7	N/A	N/A	N/A	N/A	N/A
8	Discusses the influence of public funding and grants on addressing questions of diversity and sustainability within the company.	Takes shortcuts in testing and development processes to accelerate innovation, accepting the risks associated with less conventional methods.	N/A	Supply chain mostly within Europe, securing ethical manufacturing	"We can just, we can just be the best in the class, so to speak, do everything exactly by the book, then we don't go, we don't test, we don't fly, we don't develop, so every now and then you have to take a shortcut, you consciously take risks."
9	One of the first European crowdfunding platforms primarily focussing social impact in developed countries	Taking on too many projects which evaluated on wrong focus and development of product	Use of SDG and primary goals to invest in social projects	Engaged with the community and unique in investing in social impact projects.	"Our mission is to fight poverty in emerging countries by investing in people and businesses."

Appendix F: Relational analysis

F1:Co-occurrence deductive coding

Table 30: Co-occurrence matrix deductive codes

Coercive Pressures	0,00	0,28	0,12	0,10	0,02	0,00	0,07	0,00	0,00	0,07	0,06	0,07	0,14	0,04	0,03	0,19	0,04	0,05	0,01	0,04	0,08
Commitment	0,28	0,00	0,16	0,12	0,05	0,07	0,04	0,03	0,06	0,06	0,14	0,11	0,21	0,11	0,06	0,28	0,05	0,11	0,06	0,08	0,14
Digital Alertness	0,12	0,16	0,00	0,22	0,19	0,12	0,03	0,00	0,13	0,10	0,09	0,12	0,12	0,03	0,10	0,10	0,04	0,05	0,06	0,04	0,03
Digital Curiosity	0,11	0,12	0,22	0,00	0,30	0,10	0,08	0,02	0,11	0,10	0,11	0,09	0,14	0,03	0,10	0,05	0,05	0,06	0,02	0,05	0,01
Digital innovative Passion	0,02	0,05	0,19	0,30	0,00	0,14	0,06	0,02	0,17	0,11	0,05	0,06	0,06	0,03	0,10	0,01	0,06	0,04	0,03	0,03	0,02
Digital Openess	0,00	0,07	0,12	0,10	0,14	0,00	0,06	0,01	0,09	0,10	0,06	0,04	0,03	0,02	0,05	0,08	0,02	0,01	0,15	0,05	0,09
Financial Resources	0,07	0,04	0,03	0,08	0,06	0,06	0,00	0,01	0,02	0,02	0,01	0,02	0,01	0,01	0,03	0,07	0,03	0,00	0,02	0,03	0,02
Human resources	0,00	0,03	0,00	0,02	0,02	0,01	0,01	0,00	0,00	0,01	0,03	0,03	0,05	0,06	0,02	0,03	0,02	0,12	0,05	0,00	0,09
Innovation Resources	0,00	0,06	0,13	0,11	0,17	0,09	0,02	0,00	0,00	0,14	0,04	0,06	0,04	0,02	0,09	0,03	0,08	0,00	0,07	0,04	0,02
Intellectual resources	0,07	0,06	0,10	0,10	0,11	0,10	0,02	0,01	0,14	0,00	0,01	0,02	0,06	0,06	0,08	0,05	0,11	0,00	0,10	0,04	0,05
Knowledge	0,06	0,14	0,09	0,11	0,05	0,06	0,01	0,03	0,04	0,01	0,00	0,06	0,24	0,11	0,04	0,08	0,05	0,16	0,01	0,13	0,15
Mimetic Pressures	0,07	0,11	0,12	0,09	0,06	0,04	0,02	0,03	0,06	0,02	0,06	0,00	0,13	0,02	0,02	0,09	0,06	0,12	0,07	0,04	0,13
Normative Pressures	0,14	0,21	0,12	0,14	0,06	0,03	0,01	0,05	0,04	0,06	0,24	0,13	0,00	0,12	0,04	0,18	0,05	0,15	0,02	0,09	0,13
Organizational resources	0,04	0,11	0,03	0,03	0,03	0,02	0,01	0,06	0,02	0,06	0,11	0,02	0,12	0,00	0,03	0,08	0,07	0,12	0,01	0,09	0,15
Physical resources	0,03	0,06	0,10	0,10	0,10	0,05	0,03	0,02	0,09	0,08	0,04	0,02	0,04	0,03	0,00	0,10	0,01	0,04	0,02	0,01	0,04
Practices	0,19	0,28	0,10	0,05	0,01	0,08	0,07	0,03	0,03	0,05	0,08	0,09	0,18	0,08	0,10	0,00	0,06	0,10	0,13	0,10	0,17
Social Innovativeness	0,04	0,05	0,04	0,05	0,06	0,02	0,03	0,02	0,08	0,11	0,05	0,06	0,05	0,07	0,01	0,06	0,00	0,11	0,02	0,05	0,04
Social Proactiveness	0,05	0,11	0,05	0,06	0,04	0,01	0,00	0,12	0,00	0,00	0,16	0,12	0,15	0,12	0,04	0,10	0,11	0,00	0,01	0,08	0,12
Social resources	0,01	0,06	0,06	0,02	0,03	0,15	0,02	0,05	0,07	0,10	0,01	0,07	0,02	0,01	0,02	0,13	0,02	0,01	0,00	0,00	0,14
Social Risk-taking	0,04	0,08	0,04	0,05	0,03	0,05	0,03	0,00	0,04	0,04	0,13	0,04	0,09	0,09	0,01	0,10	0,05	0,08	0,00	0,00	0,06
Socialness	0,08	0,14	0,03	0,01	0,02	0,09	0,02	0,09	0,02	0,05	0,15	0,13	0,13	0,15	0,04	0,17	0,04	0,12	0,14	0,06	0,00

F2: Co-occurrence inductive with deductive categories

Table 31: Co-occurrence matrix deductive with inductive categories

	Synergies							Trade-offs				
	Corporate culture synergies	Networking Synergies	Operational synergies	Regulatory synergies	Digital practices fostering market awareness	Digital integration and efficiency	**Synergies**	Operational trade-offs	Regulatory trade-offs	Resource allocation trade-offs	Strategic Priorities trade-offs	**Trade-offs**
Coercive Pressures	0,00	0,01	0,00	0,14	0,01	0,01	**0,12**	0,01	0,24	0,05	0,15	**0,19**
Commitment	0,02	0,06	0,02	0,07	0,03	0,01	**0,13**	0,06	0,15	0,05	0,21	**0,28**
Digital Alertness	0,00	0,05	0,04	0,11	0,03	0,18	**0,25**	0,01	0,13	0,09	0,15	**0,23**
Digital Curiosity	0,00	0,02	0,02	0,05	0,07	0,12	**0,19**	0,02	0,09	0,08	0,25	**0,29**
Digital innovative Passion	0,02	0,03	0,06	0,00	0,07	0,14	**0,20**	0,02	0,00	0,03	0,14	**0,13**
Digital Openess	0,00	0,04	0,00	0,00	0,04	0,13	**0,15**	0,00	0,00	0,08	0,09	**0,14**
Financial Resources	0,00	0,02	0,00	0,03	0,00	0,05	**0,13**	0,03	0,00	0,15	0,06	**0,14**
Human resources	0,15	0,12	0,00	0,00	0,02	0,02	**0,08**	0,02	0,00	0,06	0,00	**0,04**
Innovation Resources	0,00	0,10	0,06	0,00	0,05	0,09	**0,14**	0,07	0,00	0,03	0,11	**0,12**
Intellectual resources	0,02	0,15	0,04	0,06	0,04	0,12	**0,27**	0,02	0,05	0,12	0,11	**0,14**
Knowledge	0,00	0,02	0,00	0,00	0,05	0,02	**0,07**	0,02	0,07	0,10	0,19	**0,18**
Mimetic Pressures	0,03	0,09	0,05	0,02	0,00	0,04	**0,14**	0,00	0,00	0,03	0,09	**0,10**
Normative Pressures	0,01	0,01	0,04	0,06	0,04	0,03	**0,12**	0,06	0,08	0,08	0,21	**0,29**
Organizational resources	0,11	0,03	0,07	0,03	0,06	0,03	**0,13**	0,14	0,03	0,06	0,07	**0,12**
Physical resources	0,04	0,05	0,04	0,05	0,07	0,18	**0,23**	0,10	0,05	0,08	0,08	**0,14**
Practices	0,03	0,05	0,06	0,04	0,03	0,05	**0,21**	0,17	0,11	0,14	0,16	**0,32**
Social Innovativeness	0,04	0,03	0,00	0,04	0,00	0,00	**0,06**	0,00	0,03	0,04	0,03	**0,04**
Social Proactiveness	0,03	0,00	0,00	0,03	0,02	0,02	**0,03**	0,02	0,00	0,09	0,05	**0,09**
Social resources	0,07	0,30	0,04	0,00	0,00	0,05	**0,35**	0,03	0,00	0,14	0,02	**0,09**
Social Risk-taking	0,04	0,03	0,00	0,07	0,03	0,00	**0,06**	0,12	0,06	0,06	0,18	**0,15**
Socialness	0,03	0,12	0,05	0,02	0,02	0,09	**0,27**	0,06	0,04	0,12	0,18	**0,17**

F3: Relational analysis: Visualisation of relational analysis

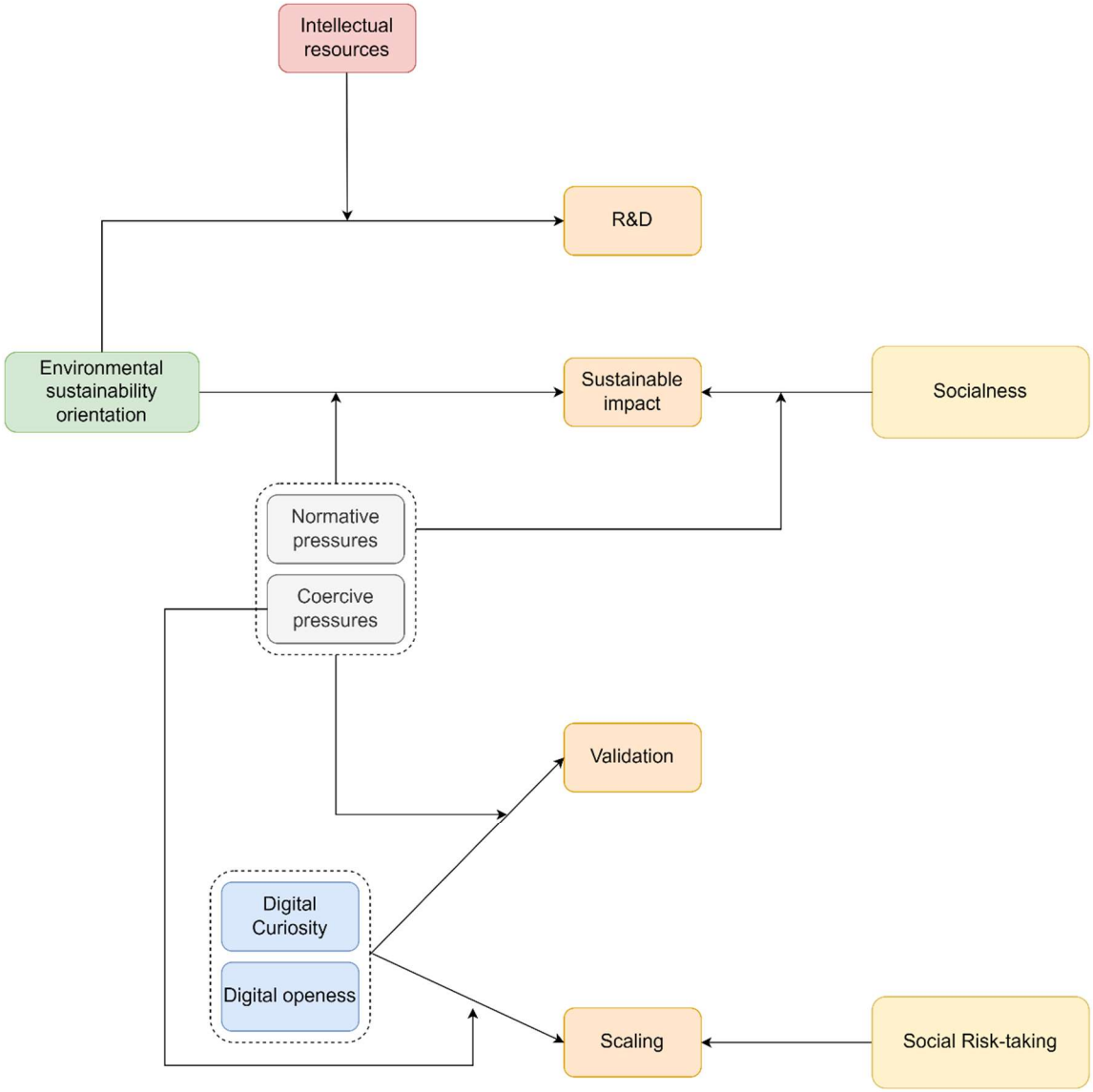

Figure 21: Relational analysis strategic trade-offs

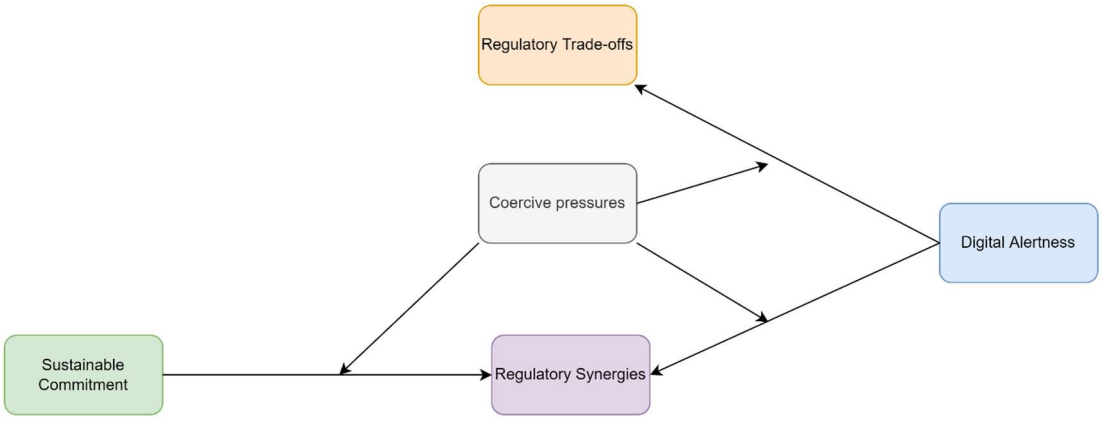

Figure 22: Relational analysis regulatory trade-offs and synergies

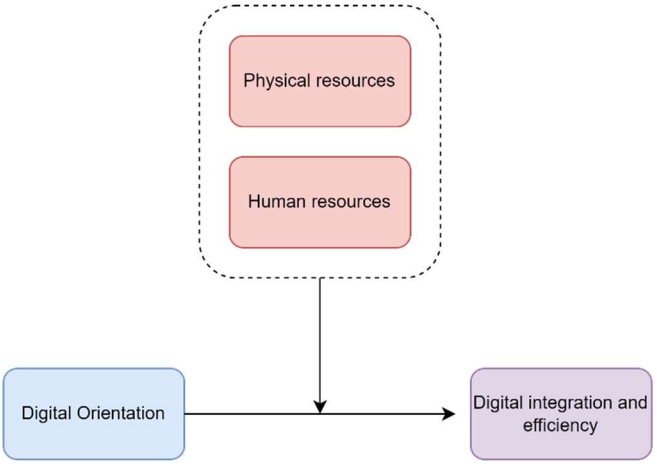

Figure 26: Relational analysis digital integration and efficiency

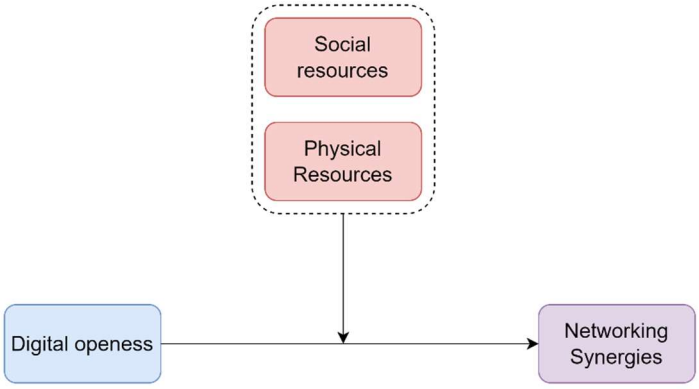

Figure 25: Relational analysis networking synergies

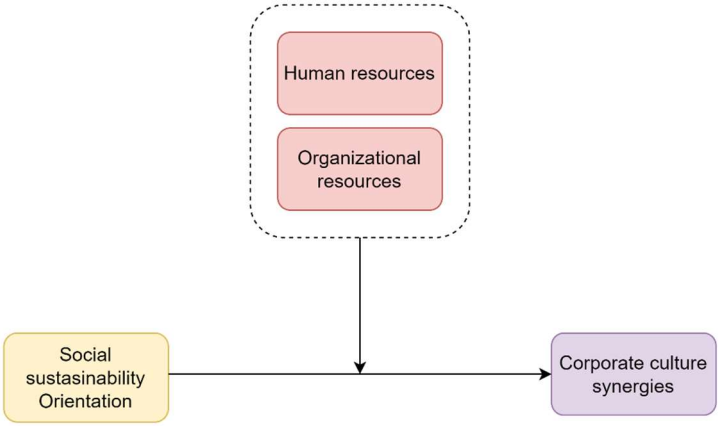

Figure 24: Relational analysis corporate culture synergies

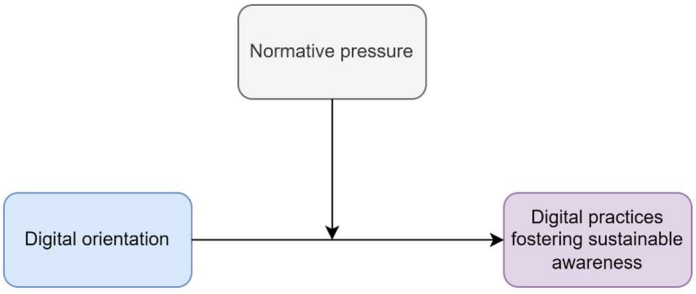

Figure 23: Relational analysis digital practices fostering sustainable awareness

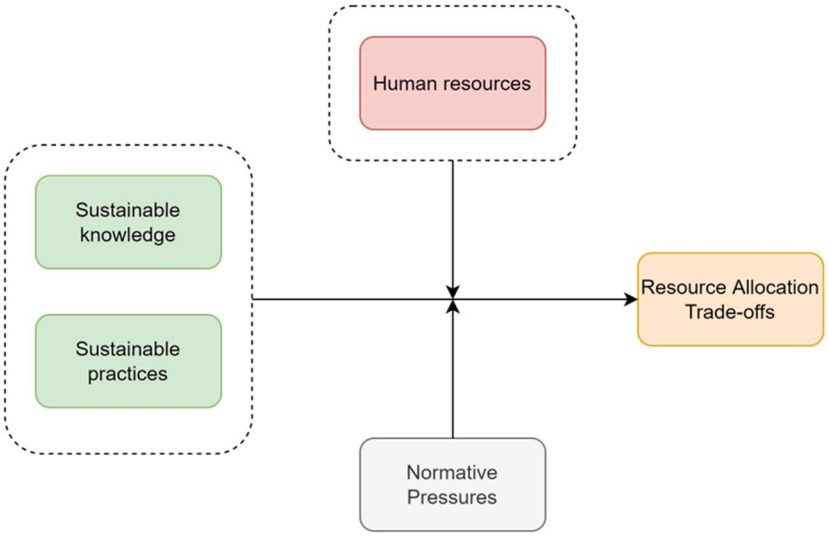

Figure 27: Relational analysis resource allocation trade-offs

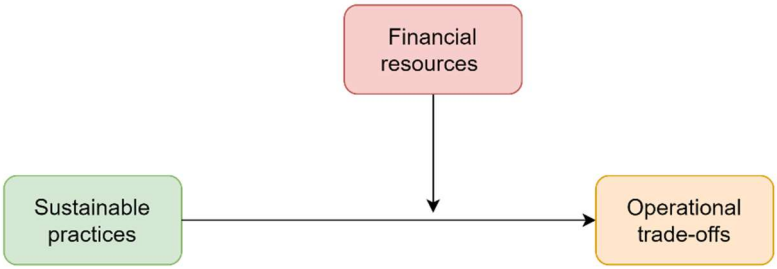

Figure 28: Relational analysis operational trade-offs

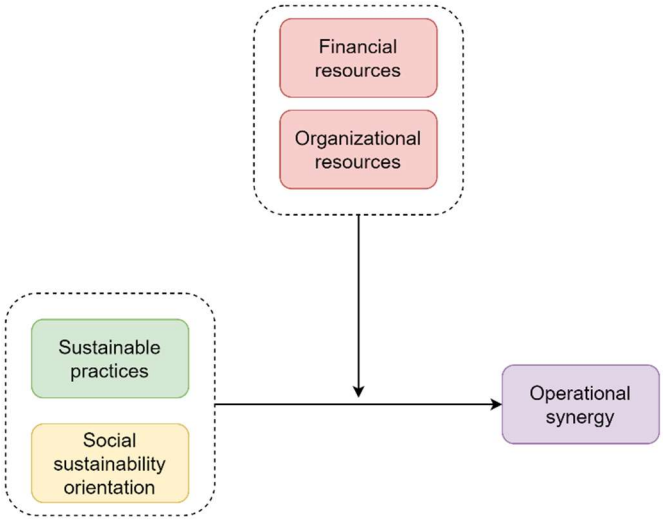

Figure 29: Relational analysis operational synergies

Appendix G: Consent form

Delft University of Technology
INFORMED CONSENT FORM

Master Thesis Alexander van Grotenhuis
Open statement (EN)

You are being invited to participate in a research study titled "The interplay between digital and sustainability strategy orientation within Dutch Cleantech startups". This study is being done by Alexander van Grotenhuis van Onstein, Complex Systems Engineering and Management student from the TU Delft and is part of a MSc thesis.

The purpose of this research study is to explore the different trade-offs and synergies that emerge when using digital solutions and strategies combined with sustainable strategies and products. Therefore, we are interested in the business strategies of Dutch Cleantech startups and how digital implementation foster environmental decisions within a company its strategy. We are interested in different trade-offs and synergies that startups have when implementing a digital and sustainability strategy at the same time. We are investigating how cleantech startups allocate their resources and how they interact with their external environment to create a competitive sustainable and digital advantage. The interview will take about 45min and will consist of the following different topics:

1. Introduction from both parties
2. Getting deeper into sustainability strategy orientation of the startup and what drives the startup in sustainable entrepreneurship
3. Learning about digital solutions and transformations that drives the startups innovation performance
4. Exploring possible trade-offs, synergies, and barriers in adopting digital solutions together with sustainable entrepreneurship

As with any research project that uses data the risk of a breach is always possible. To the best of our ability your answers in this study will remain confidential. We will minimize any risks by anonymising the gathered data and controlling access to data, data archiving and reuse.

Your participation in this study is entirely voluntary and you can withdraw at any time. You are free to omit any questions.
The contact details of the corresponding and Responsible Researcher are the following:

- Corresponding Researcher: Alexander van Grotenhuis
- Responsible Researcher: Johannes Gartner

Appendix H: Interview guideline

Introduction: Can you introduce yourself, highlighting your role and motivation for starting this startup?"

Resources: Can you elaborate on the key resources your startup utilizes to execute your strategy and to achieve your digital and sustainable goals? How do you measure these goals?

Sustainability Orientation:

Definition: What is your definition of sustainability and sustainable entrepreneurship?

Social/sustainable innovativeness:

- How do you encourage and foster a culture of innovation within your team or organization when it comes to creating social impact?
- How do new ideas within the process come into place and how are they implemented, (iterations, verification, and validation)

Social Risk-Taking:

- Describe a situation where you had to make a decision that involved taking a risk to achieve a social goal. What factors did you consider before taking that risk?

Social proactiveness & Knowledge:

- How do you think you are positioned within your market?
- Are you striving to be a primeur in the sustainable solution or are you, for example, make it more affordable?

Core operations & Practices :

- Do you think that accomplishing sustainable is more important than generating profit in the present phase of the startup?
- Do you deal with environmentally friendly suppliers, and do you use low impact manufacturing technologies?
- How do you commit to sustainable regulations, are there any you have to comply with.
- Do you measure the carbon footprint of the service/ product delivered

Community & Commitment:

- In what way do you take inclusivity (gender, elderly people, disability) into your startup?
- In what ways are you cooperating with partnerships and/or governments in order to accomplish a sustainable advantage or to create environmental awareness

Digital Orientation

Definition: What is your definition of digitalization and digital entrepreneurship?

Digital Curiosity:

- How does your startup actively seek and integrate new digital ideas into its business model?
- How frequently does your company review and update its digital processes products and services to ensure they remain competitive and relevant?

Digital Alertness

- How has your company recently responded to a significant digital opportunity or challenge in the market? And how where you informed by this opportunity/challenge?

Digital Openness

- How does your company involve relevant stakeholders, like customers, collaborative relationships, and shareholders, in its digital initiatives and value creation processes?

Digital Innovative Passion

- What recent investments in digital technologies has your company made, and how do these align with your long-term strategic goals?"
- Could you share examples of how your startup is committed to providing exceptional digital experiences to its clients?

Incentives & Stakeholders

- Are there any other stakeholders, which are not mentioned before, and which you are working with related to the resources or to achieve a certain goal?
- Do you feel some kind of pressure from them the stakeholders/environment?

Trade-offs between digital and sustainable practices

- How do you prioritize and address challenges in balancing digital transformation with sustainability performance?
- Are there any external pressures from institutional, regulatory, financial or incubators that pushes in choosing a different strategy/focus? Did you ever choose for a certain direction?
- In what ways has your startup's digital capabilities enhanced its approach to sustainability?
- Do your employees feel some kind of pressure related to digital and sustainable performance within the company?
- How has your dual focus on digital innovation and sustainability impacted your brand's market position?
- Do your customers are more price sensitive or more focused on the sustainable impact of the product?
- What are the key human resource challenges in driving both digital and sustainable objectives in your startup?

Other questions

- Are there any other challenges/synergies you encountered in implementing digital and sustainable solutions within your business, and vice versa?
- Do you want to add anything else? Do you feel there is something important that should be said on these topics?


TU Delft