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Master Thesis

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Exploring the Interplay Between Digitalization and Sustainability in the Maritime Industry

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ABSTRACT

The following Master thesis investigates the interplay between two of the current important and pervasive trends: digitalization and sustainability. The academic literature shows how these trends impact business separately but not together. However, as digitalization and sustainability share some common goals, and the business side provides evidence that these trends are developed together, we investigate whether such interconnection exists and what is the nature of it. As theoretical lenses, we choose the Activity-Based view, Resource-Based view, and Institutional theory. An inductive multiple case study is the most suitable research method. The marine industry was chosen because it currently experiences the influence of both trends.

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INTRODUCTION

One of the factors for staying competitive in the market is the ability of a firm to keep up with external business trends (Eisenhardt & Martin, 2000; March, 1991). Digitalization and sustainability affect all businesses. The academic literature provides rich background on how digitalization and sustainability separately make an impact on the business, but there is a reason to expect an interplay between the two trends.

Digitalization, which primarily means the increasing reliance on digital technologies, has been developing during the last 40 years and contributed to making business of larger scale and scope through better connectivity, big data analysis, and transparency of operations (Heilig et al., 2017; Verhoef et al., 2021). One of the most significant results of digitalization is the higher velocity of environment and restructuring of the organizations. Under digital transformation, firms change the fit among activities to produce goods or services, and most importantly, often change value propositions towards more knowledge- and information-intensive options (Teece, 2010; Verhoef et al., 2021). One of the commonly used examples is Uber, where the actors get information about the customers and available drivers through the app and choose the most efficient options for commuting (Teece, 2018).

The sustainability stream has developed at the same time and gained a lot of attention in the last decade. By sustainability, scholars mean the capacity to sustain long-term survival given the limits of resources and habitat boundaries (Brundtland, 1987). In the context of businesses, organisations have to consider contributions to societal well-being and impact on the environment in addition to profit-seeking when devising business models and making strategic decisions (Elkington, 1998). While there are different levels of sustainability initiatives, the primary target of firms is to produce less waste and use resources more efficiently. Uber can also be used to illustrate how sustainability is implemented: through the app, Uber can regulate the optimal number of drivers and cars needed and because drivers use their own cars, the life of the vehicles is longer thanks to the better attitude of the driver (Yun et al., 2020).

The Uber example shows that digitalization and sustainability trends are not separate from each other. As business needs to address both trends together, it may

be possible to create synergies among respective initiatives taken to address them. Another example from the business side is Kone, an engineering and service company (www.kone.com). Kone has integrated an AI technology into elevators, its conventional product offering. In-built digital sensors provide all the information about the elevator: in case of some deviations in functioning, sensors send a message directly to Kone's service technician with the information of which parts should be fixed. Consequently, this digital transformation stimulated Kone to change the product offerings to service ones. At the same time, predictive maintenance is a more sustainable way of operations as it allows to use less resources to fix the issue: the problem is fixed before the elevator is broken, less waiting time and resources are needed for fixing the breakage, and no inconvenience for customers (especially when elevators are used in hospitals and other emergency establishments).

However, academic literature does not provide research on the interplay of digitalization and sustainability. One of the main reasons is the newness of both trends. This master thesis aims at filling this gap by answering the question:

What is the potential interplay between digitalization
and sustainability in the marine industry?

We have chosen to use the marine industry as our empirical context because it currently undergoes changes under both trends: digitalization projects have been high on the agenda for the biggest players, and the problem of natural contamination started to be a problem for marine life and biosustainability overall. Additionally, we have access to data as one of the thesis partners is employed by one of the dominant players in the maritime industry. A multiple descriptive case study was chosen as a research method because it allows to deeply examine the phenomenon and reveal complex interrelations among the objects and events.

The remainder of the paper is structured as follows. First, the academic literature research on digitalization and sustainability is presented, followed by literature analysis of why the potential interconnection between the two trends may exist. This analysis is conducted based on three theoretical lenses: activity-based view with business model theory extension, resource-based view, and institutional theory. Next, the research method, case selection criteria and methodological considerations are presented, followed by case description and findings. Finally,

we present the discussion part together with implications, limitations, and suggestions for future research.

LITERATURE REVIEW

DIGITALIZATION

In academic literature, there is still no unified definition of digitalization: the scope of the term may vary. Some authors define digitalization as the process of higher reliance on digital technologies and the transformation of created value in the Internet-compatible data packages (Banalieva & Dhanaraj, 2019; Rachinger et al., 2019). On the contrary, digitalization could also be defined as the organizational changes that the firm may undergo because of digital technology use (Westerman et al., 2011). In our Master thesis, we will refer to digitalization as the process of increasing usage of digital technologies, while the changes in organizational business model will be defined by digital transformation.

Verhoef et al. (2021) defined three phases of digitalization that companies undergo. The first one is characterised by paperless procedures as the result of the transition from analogue to digital information. The second stage implies automatization of production which helps to optimize business processes, save costs, and use resources more efficiently. These two stages demand changes in firm's resources but do not change the logic of value configuration (Stabell and Fjeldstad, 1998). On the contrary, at the third stage, the organization changes the logic of its business model towards "product as a service" or similar options as it starts to implement smart technologies and provide more information- and knowledge-based offerings.

Digitalization is clearly more than merely technical evolution but the trend that alters all the activities and resource configurations in the organization (Bharadwaj et al., 2013). With changing the fit among activities, the firm alters the mechanism of the value creation and value capture processes and develops absolutely new ways of product and service propositions that can disrupt the market (Chesbrough, 2010; Fjeldstad & Haanæs, 2018; Parviainen & Tihinen, 2017). Thus, digitalization is not only a way of increasing the efficiency of operation through better control of activities but also an opportunity to improve the overall effectiveness of the firm through the innovation of business models.

SUSTAINABILITY

Sustainability within organizations has been studied through several perspectives, such as *corporate social responsibility* and *corporate sustainability*, both of which were applied with an arbitrary focus on doing good, profit-seeking, and legitimization (Aguinis & Glavas, 2012; van Marrewijk, 2003). Despite a plethora of sustainability conceptualizations tailored to particular fields, the Brundtland report (1987) presents the most widely accepted definition of "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Geissdoerfer et al., 2017). Sustainability contains three key pillars of economic viability, social equity and environmental resilience (Elkington, 1998). Different sustainability substreams, such as circular economy, corporate social responsibility, and environmental strategy, may prioritise some pillars over the others or treat all of them in an equal manner (Geissdoerfer et al., 2017; Sharma, 2000). The prevalence of profit over societal goods in sustainability and vice versa could be regarded as anthropocentric and ecocentric views in sustainability (Borland et al., 2016).

Sustainability has reshaped business management in three major ways. First, sustainability has been grounded in environmental legislation, the introduction of which was motivated by overproduction and overexploitation of limited natural resources. Companies have to comply with local regulations in order to be legitimate and earn credit from external stakeholders (Bansal, 2005). However, sustainability expectations from companies do not necessarily have to be cost-increasing barriers; in fact, firms may benefit from embracing sustainability as part of their operations, resource configurations, and organisational culture (Bansal, 2005; Haugh & Talwar, 2010; Sharma, 2000). That is why the second point refers to insights from circular economy and digitalization that have provided strong support for cost-efficient operations as a result of environmental and social concerns at the core of the business (Kristoffersen et al., 2020). Last, sustainability is also realised through novel business models and new products and services. As an example, switching to "product as a service" value propositions allows selling the use of the products rather than a product itself; this transformation allows product-sharing and a higher and more sustainable exploitation rate of the maximum product life cycle. Nevertheless, in practice, companies still find the integration of sustainability into their business models to be challenging due to the

complexity and omnipresence of sustainability opportunities within every stage of the business model (Hahn, 2013).

Concluding, sustainability is one of the most significant trends aimed at creating conditions for the long-term endurance of the biosystem, which includes human societies and business organizations as well. There are multiple factors of sustainability influence upon organisations. At the same time, the full integration of sustainability has not been achieved in most organizations at the moment, and, thus, further investigations of the successful practices of sustainability implementation should be conducted.

THE IMPORTANCE OF THE INTERPLAY

As it was already mentioned, so far, digitalization and sustainability have been studied separately. However, there are some reasons to assume that these trends are interconnected and that firms may be able to achieve synergies in the actions taken to tackle them. First of all, both digitalization and sustainability changes share common aims, among which are to save costs, use resources more efficiently, and optimize operations (Carter & Rogers, 2008; Verhoef et al., 2021).

Second, academic research provides multiple examples of the positive association between a level of digitalization and a level of environmental sustainability within the firm (Isensee et al., 2020). For example, the Internet of Things enables tracking flows of operations with raw materials and products, providing business analytics to enable circular economy opportunities, such as waste management and predictive maintenance of the equipment (Kristoffersen et al., 2020; Porter & Heppelmann, 2014). Big Data is another digitalization-enabled capability that advances operational transparency in supply chains; the use of digital sensors in the suppliers' chains improves control, monitoring of performance, and customer satisfaction (Parviainen & Tihinen, 2017; Peppard & Rylander, 2006). Thus, there is a potential of digitalization to deliver social and ecological value in the form of environmental and societal externalities.

The topic of interconnection between digitalization and sustainability is important to analyze as it can shed light on how decision-makers should tackle both trends simultaneously. If changes directed to digital transformation and sustainability are considered as separate strategies, the firm may experience a conflict of strategic

priorities and resource allocation. The study by Ardito et al. (2021) shows evidence that firms which were following both trends simultaneously were experiencing weaker product and process innovation performance because the trends required separate resource allocations. If business managers can find how to make synergy between digitalization and sustainability, the firm may not only prevent losses but also save costs and substantially improve its performance. Thus, a deeper investigation of the nature of possible interplay is needed.

We have considered investigating digitalization and sustainability interplay from three theoretical perspectives: activity-based view with its business model extension, resource-based view, and institutional theory. In the next parts, the value of these perspectives is presented.

Activity-based view

As highlighted earlier, the firm which undergoes digital transformation changes the activities of the firm which makes the activity-based perspective necessary to use. Specifically, its extension, business model theory, provide tools to analyze the fit among activities (Zott & Amit, 2008). The most widely used definition of business model was provided by Teece (2010) as the "design or architecture of the value creation, delivery, and capture mechanisms [a firm] employs" (p. 172).

Business models can be divided into three main types: value chain, value shop, and value network (Stabell & Fjeldstad, 1998). The value chain configuration is linear and aimed at product manufacturing with the possible provision of after-sales services. In the value-shop, there is a closed configuration of the model, and thus the next operation cycle depends on the success of the previous one. The purpose of the value shop is service provision aimed at finding the solution for the specific customer problem. Finally, value networks also provide services but in the way of connecting multiple actors of the network. If the company changes the fit among activities, it may stay within its value configuration type or move to another one; these are within- and across-type transitions respectively (Fjeldstad & Snow, 2018). Across-type changes are usually more challenging as they imply a reconfiguration of the whole value creation and value capture logic.

Multiple studies show that firms under digitalization and sustainability trends change their business model towards "product-as-a-service" options (Kastalli &

Van Looy, 2013; Lindström et al., 2018; Verhoef et al., 2021). For instance, customer-orientation of services enables a personalised value proposition, such as treatment for patients at affordable costs based on wearable e-health devices (Bressanelli et al., 2018). Thus, it is reasonable to consider servitization as one of the possible outcomes of trends' interplay.

Originally, servitization was defined by Vandermerwe and Rada (1988) as a change of value offerings towards more customer-oriented bundles of product, services, self-service knowledge, and support. This transition is happening for both product- and service-based firms. The first stage of servitization implies the existence of merely product-based and service-based companies. At the second stage, service providers start to add product offerings and vice versa. Finally, at the third stage, companies add more value through the provision of knowledge (which is know-how), support (in product use), and self-service (to decrease the costs). Consequently, all three types of value configurations can undergo changes towards servitization.

It can be concluded that an activity-based perspective with its extension to business model research can show how the interplay of the trends alters the fit among activities. The more radical changes should be undertaken in digital transformation and sustainability initiatives, the more disruptive the transformation of business models will be.

Resource-based view

Resource-based theory predicates on the assumption of internal resource heterogeneity among companies that allow them to gain competitive advantage (Barney, 1991). Companies which invest in their resources to develop their valuable, rare, inimitable and non-substitutable factors eventually gain a competitive advantage from these properties (Barney, 1991). Not to become obsolete, companies invest in their resource development to meet the expectations from external trends, such as digitalization and sustainability (Russo & Fouts, 1997; Verhoef et al., 2021).

The resource-based view (RBV) is a powerful tool to explain how the accumulation of internal knowledge, physical and intangible assets, and workers' expertise could contribute to greener and more competitive performance, particularly in high-

growing industries (Russo & Fouts, 1997). Dynamic capabilities theory, the RBV extension, has been applied to assess how resource configurations could be altered to meet the needs for sustainability. Managerial dynamic capabilities to *rethink*, *reinvent*, *redesign*, *redirect* and *recover* products and waste will allow developing new internal resources and the configuration of the latter, for instance, by turning a traditional value chain business model into a service (Borland et al., 2016).

At the same time, sustainability-driven reconfigurations of the resources are firmly connected to digital capabilities in a company. Manufacturing companies, for example, may consider 3D-printing or process visualization in their manufacturing process, creation of digital commercial environment or development of new digital services, which augment current resources (Coreynen et al., 2017). All of these digitalization decisions have an impact upon business sustainability by providing resource-efficient technologies and capabilities of identifying new resource configurations with environmental, social and economic benefits. Nevertheless, novel RBV studies of SMEs provide counterintuitive evidence of a negative relationship between company's innovation capabilities and the pursuit of digitalization and environmental orientation simultaneously since both strategy orientations require considerable resource attributions (Ardito et al., 2021).

In summary, the RBV has been successfully applied to determine relationships between business performance, sustainability, and digitalization by analysing firm's resource configurations and dynamic change of the latter. RBV studies of the last years have contrary views of the interplay between digitalization and sustainability; thus, discovering additional factors of this interplay could reconcile this debate.

Institutional theory

When companies undertake organizational changes, they seek to establish or confirm their legitimacy in a society. Similarly, the influence of interconnection between digitalization and sustainability trends demand a company to change its image in the market and secure its legitimacy. Legitimacy is a social acceptance of actions, values and structure by other institutional actors, which include, government, other businesses, professional organizations, and customers (Ashforth & Gibbs, 1990).

Legitimacy of an organization allows securing flows with suppliers and customers as well as compliance with laws and societal expectations on company's operation (Pfeffer & Salancik, 1978). There are two main reasons to investigate institutional influences during organizational changes caused by digitalization and sustainability interplay. First, an introduction of new goods and services may require legitimization from external stakeholders (Carroll & Swaminathan, 1992); otherwise, the new good or service may suffer from discouragements with regards to consumption. In this case, the company pursues proactive legitimization effort through a dialog with external stakeholders and takes marketing and political actions to influence the societal expectations from their product. Second, companies may undertake digitalization or sustainability initiatives to pursue higher social acceptance and maintain their legitimacy overall (Laïfi & Josserand, 2016). Thus, the company simply reacts to new societal requirements and tries to adjust its internal operations to mimic the legitimacy of other actors in the market.

To conclude, institution-based theory has been consequently applied to both digitalization and sustainability research and its ability to show external requirements for societal acceptance for new changes or products may be particularly useful in analysing the interplay of sustainability and digitization initiatives in firms.

METHODOLOGY

In this thesis we intend to explore the following research question: *"Exploring the potential interplay between digitalization and sustainability in the maritime industry"* by a series of interpretive case studies. The maritime industry is a fruitful empirical setting since it is connected to both trends in several ways. First, maritime sector exists in the world ocean which plays a dominant role for logistics: 70% of trade volume is carried by maritime logistics (Rodrigue, 2020). Second, ocean's role in ecology is crucial as it absorbs CO2 and is a habitat for marine life. It covers 70% of our planet's surface and is exposed to an anthropological footprint: coral reefs are being destroyed, oil leakages occur, and the ocean is becoming warmer. Finally, ocean digitalization is in the infancy stage and is possible to speed up in the coming years. There is little Internet penetration in the ocean that causes

increased uncertainty in shipping. This may lead to both financial losses and sustainability harm in societal and ecological aspects.

An inductive case method of research was chosen for several reasons. First, we want to identify relationships between two trends rather than test predeveloped hypotheses. This openness towards not imposing particular frames prior to data collection will allow us to make a less biased picture of the phenomenon. Second, the inductive method is particularly useful for describing processes and hard-to-identify concepts. As Graebner et al. (2012) stated, qualitative data have advantages of "vividness, concreteness, and richness" (p.279), all of which could help in describing abstract ideas. In order to have richer and triangulated data, we investigated several cases. Third, the interplay between digitalization and sustainability is a novel phenomenon with lack of available data that makes case study a suitable option for our research.

Case selection criteria

The following selection criteria were defined:

1. The company should deal with maritime projects; examples of these could be shipping companies, shipbuilding and maintenance companies, staffing companies, and consultancy companies. Thus, despite the fact that consultancy and staffing companies do not belong to the maritime industry per se, they have previous experience and industry knowledge that can be valuable for the purposes of our research;
2. The company should be engaged in digitalization projects;
3. The company should consider sustainability at least at some level of the firm's strategy, e.g. operational (production process), strategic (achievement of long-term goals), or normative (organizational culture) levels, according to the framework by Baumgartner and Rauter (2017). Additionally, we will use corporate commitments to Sustainable Development Goals (SDGs) as a proxy of corporate considerations to sustainability practices within companies.

Methodological considerations

Qualitative research is often criticized for being non-generalizable due to the size of samples. However, this criticism is biasedly connected to statistical

generalizations rather than analytical ones, the logic of which is used in laboratory experiments (Yin, 2014). That is, the generalization comes from a strong explaining power of the theory, which is proposed based on multiple cases, selected on theoretical sampling (Yin, 2014). Thus, analytical generalization is proven through the replication of cases with the same case design. Following this framework for achieving generalizability, our research is planned to be based upon a set of replicated case studies.

Next, validity, reliability and generalizability are additional important issues that have to be clarified beforehand. Given the nature of our research question, we find descriptive multiple case studies to be appropriate for answering the question of what kind of interconnection exists between digitalization and sustainability in the maritime industry. The main reason is that a descriptive case study has an inductive nature with the possibility to establish a rich context around the phenomenon being studied. Additionally, we ensure high reliability through data triangulation within both primary and secondary data. Following the recommendation by Gioia et al. (2013), we ask our respondents to identify the next key informants and thus provide more robust, relevant, and reliable data for further analysis. Besides, secondary data sources, i.e. websites, e-mails, reports and multimedia files, also provide further clarity and another proof of data reliability.

We are also aware of potential interview biases, which could be minimized through the following techniques. First, we recorded our interviews and other oral data to be able to revise what was said in the meeting. Second, the potential discomfort of interviews was minimised: the interviewer used the firm's web-application for the interview, being respective to interviewee's time constraints. Third, we made follow-ups with our key respondents and provide a case description draft in order to confirm that the data were interpreted correctly.

As for ethical considerations, we have anonymised the empirical data to protect sensitive and personal information and to comply with General Data Protection Regulation (GDPR). We have also had our research proposal approved by the Norwegian Research Ethics Committee (Norsk Senter for Forskningsdata, NSD) to ensure the acceptability of our research design from the point of sensitive data protection.

Case Description

We have found three companies that comply with our case selection criteria above. For GDPR and NSD compliance reasons, we have anonymised and codified them as Alpha, Beta and Gamma here and hereafter in the document.

Case 1: Company Alpha

Company Alpha, headquartered in Northern Europe, belongs to one of the biggest holdings in the global shipping industry. As part of this shipping group, Alpha company supplies ships with various kinds of equipment and disposable goods, such as gas cylinders, refrigeration solutions, ropes, lubricants, and others. As one of the market leaders, Alpha undertakes multiple innovative and sustainable initiatives to shape the future of the marine industry. One of these initiatives is an intelligent rope venture, started in 2017. Following the acquisition of a rope manufacturing company, Alpha decided to invest into digitalization of its conventional product offerings. Rope manufacturing has been a very old business with common and well-known customers' pain points, including mooring rope snapping accidents worldwide. These accidents are considered the top three risks in shipping. To tackle the challenge of rope snapping, Alpha created a mooring solution that consists of conventional mooring rope with Internet of Things sensors inserted inside the rope to measure the tension and transfer data-points to the digital software solutions for mooring. The company considers several financing models, where instead of selling meters of rope, Alpha will provide a "product as a service" solution which may bill clients based on the usage of the rope or the time-period agreed. Under the "product as a service" operations, Alpha is responsible for delivering successful mooring results and providing analytics to clients to ensure the safe mooring process from the ship crew side.

The venture started as a feasibility research as a part of digitalization training at Alpha. Together with the clients, the research team made the concept describing the customer needs for a smart mooring solution by Alpha. The research concluded with a board committee to allocate additional financial resources to develop the concept as a new venture outside of the line organization. The venture lasted for years developing the proof of concept and proof of value which included the development of digital as well as engineering solutions from scratch. As of May 2021, the venture has launched the pilot on several vessels and is analysing the most preferred financing model for the smart mooring solution. Alpha considers

the transition from the value-chain logic which is supported by post-sales services towards the value shop logic of providing tailored mooring solutions per vessel.

Case 2: Company Beta

Beta is one of the largest energy companies in the world, primarily operating in Europe and the Americas. A considerable part of its midstream operations is shipping which consists of a time-charted (TC) fleet, which has long contracts and is being operated continuously by Beta, as well as on-spot vessels hired for a single voyage. As an oil and gas company, Beta is required to report its CO2 production in scope one and scope two of GHG Protocol CO2 emissions (ghgprotocol.org) and recently decided to pursue a proactive action in calculating its scope three CO2 pollution. Thus, Beta started a digitalization project for its shipping activities primarily through the development of specialized reporting software tools and deploying it across its ships.

Scope three was not in focus for the oil and gas industry until recently, and, therefore, reporting of shipping transportations heavily relied on manual inputs which led to chaotic data structure. While there is still no legislation or CO2 tax on shipping operations, Beta has started the new venture to take a proactive move and be a leader on sustainability reporting and the most efficient operations in shipping. The venture represents a digital reporting system for the data collection of sustainability-related ship information the main target of which is to revise shipping routes and minimise fuel consumption. The latter has two-fold results. First, digitalization of shipping reporting would allow to decrease fuel consumption in the short run. Second, Beta has publicly admitted its focus on renewable energy sources for its operations, including shipping. It is fair to predict higher initial costs of renewable fuels; that is why having efficient shipping operations will also contribute to the long-term energy transition of Beta.

Case 3: Company Gamma

Gamma company is an international chemical industry company, operating in the shipping paints and coatings business segment. Gamma started a new hull performance-based solution category, which aims at not selling merely ship coatings but combining it with technical services and performance monitoring to

ensure the clean condition of a vessel's hull under the sea water. However, using the antifouling specialised coatings was still not sufficient in keeping the hull clean without additional manually intensive reactive cleanings. The main problem of an uncleaned hull is significant speed loss leading to excessive fuel consumption and migration of invasive species which upsets the marine biosystems in other regions. To tackle this customer's pain point, Gamma started several years ago a new venture to develop a digital robotics solution for superior hull cleaning, operated by Gamma remotely and in tandem with Gamma's specialised coating solutions. The robot, the design of which was inspired by a lawnmower, operates on four magnetic wheels attached to the vessel's hull allowing underwater manipulations when the hull inspection or cleaning are required. Before antifouling operations, every hull's design has to be pre-digitized in order to provide a three-dimensional model for the hull inspection with the help of the robot. Thus, the robotics solution also requires additional advisory services. As of May 2021, this Gamma's offering is in the final verification stage with several pilots conducted on different vessels' designs. Since the solution is centralised around Gamma's digital capabilities, the financing model is a robot lease with a subscription fee that includes a fixed number of inspections and hull cleanings.

Data Collection and Data Analysis

The primary source of data were semi-structured interviews with company representatives who participated in or led the mentioned ventures. The interviews lasted approximately for one hour and were conducted based on the written consent form. We had a pre-developed interview guide which included questions about venture and its development, presence of digitalization trend and sustainability trend, possible interconnection between the trends, and clarifying questions based on three chosen theoretical perspectives. After conducting the first interview per case, we were augmenting our questionnaire with additional clarifying questions to receive richer replies about specific notions in each case. Additionally, we have asked open-ended questions ("Is there anything we should have asked you and we did not do that?" ;"What keeps you up at night?") which appeared to be very fruitful in terms of receiving personal views on the projects and its main challenges.

As this MSc thesis complies with NSD data collection guidelines, all personal data, including names, position titles and company names, were codified and anonymised to secure the anonymity and provide a safe environment for sincere

and honest responses. All the interviews were recorded and fully transcribed. Additionally, all interview reports were sent to the respondents for clarifications and corrections. It helped us revise our interview database and minimise possible misinterpretations.

In total, nine interviews were conducted with several knowledgeable respondents per company during April - May 2021. Following the Gioia et al.'s methodology, we asked our respondents to recommend other knowledgeable agents for the next interviews (2013). Having several interviews per case allowed us to triangulate and compare the received information and have a better overview of each venture. Because of Covid-19 pandemic, all the meetings were conducted digitally via Teams, without any personal visits to company offices or production facilities.

Table 1 Anonymised overview over conducted thesis interviews

Interview	**Company**	**Respondent's role**	**Duration**
A	Alpha	Venture Lead	73 min
B	Alpha	Head of Category Manufacturing	62 min
C	Alpha	Project Manager	45 min
D	Alpha	Venture Lead	50 min
E	Beta	Team Leader	43 min
F	Beta	Engineer	58 min
G	Gamma	Global Category Director	61 min
H	Gamma	Global Digital & Data Director	50 min
I	Gamma	Group Vice President Strategy & Sustainability	75 min

As secondary data sources, we used company official web-cites, social media (primarily, LinkedIn), forums and events, such as Ocean Now 2021 and World Economic Forum 2021, where company representatives were presenting their ventures.

After collecting the data, we were aligning our empirical results with management research theory.

FINDINGS

The Presence of Digitalization and Sustainability Trends in the Cases

All respondents have clearly stated the presence of both digitalization and sustainability trends. For all the companies starting the ventures was a leader move to build capabilities for meeting new future demand of being sustainable and technologically advanced. It is important to highlight that selected companies did not have digital and engineering capabilities, which pushed them to acquire new resources in the form of new employees with data qualifications and build up new partnerships with market leaders in software and technology development. Additionally, all three ventures are very new and are a part of big international corporations.

Now we will provide details from the interview data on how the trends are presented in cases.

Alpha

We have conducted four interviews for the Alpha case. Respondents were exercising venture lead roles at different stages of the project as well as the roles of subject matter experts with deep expertise in rope technology.

Respondents mentioned four main aspects of sustainability which are presented in the venture. First, an intelligent mooring solution provides safe operations because they prevent damaging the ship with such aftermath as oil spills and casualties caused by snapping of mooring ropes. Second, this solution ensures the efficient use of ropes in a way that the rope is replenished just in time. As we heard in interview B, vessels are advised to replace their mooring ropes every four years without clear understanding of the ropes' condition. In the majority of cases, it happens too early just to be on the safe side and not to increase the risk of accidents onboard. On the other hand, there are also instances of overloading the ropes, which leads to premature wearing out of the rope, which is problematic to detect by the rope appearance. However, the solution will assess the tension in the rope and enable rope replacement based on the lifecycle condition but not the time.

Third, as Alpha is planning to transform the financing model towards the service provision instead of selling meters of rope as the disposable product, the company will no longer be interested in maximizing the scale of the manufacturing but

concentrate on the development of the best possible product that will last the longest possible time. Lastly, as a product owner, Alpha can use its competences to recycle the mooring rope by downgrading it for the need of smaller fishing boats.

As for digitalization, three main embodiments were mentioned. First, specific Internet of Things sensors and tailored software solutions have to be developed for digitizing mooring ropes. Second, data points collected through digitization of rope conditions serve as the basis for live analytics during the mooring process. It is designed in a way that crew members can access internal tension analytics through a smartphone or other computer interface on the board. Finally, this solution can also work for predictive maintenance purposes to optimally choose the time for the rope replenishment.

Beta

We have two interviews with a manager of the project as well as a sustainable shipping engineer.

Beta respondents have given us the following conclusion about sustainability. The main aim of this project is to enable CO2 related shipping data points. These data, such as fuel usage and ships' speed, are used to optimize fuel consumption. At the same time, regular digital data flows from ships allows Beta to revise its shipping routes, particularly ballast lag, which is the distance spent in the sea without any cargo on board.

In terms of digitalization, Beta collects data points of weather and ship conditions from multiple sensors installed in the vessel. Thus, digitization is necessary within this project. From this data you can find optimization opportunities such as reduced fuel consumption under the condition of the same wind direction or other external influencers of the ship move. Overall, it allows shipping managers to create instructions on the time of departure and arrival instead of instructions on speed. Additionally, this analytics enables the long-term benefit of route optimization with regards to CO2 exhaustion.

Gamma

We have conducted three interviews with C-level executives who work in different functional areas but have been significantly involved in the joint venture development from the Gamma side. Our interviewees represented data, operations, and business development and sustainability functions.

The sustainability factor was developing gradually and with several key drivers listed below. First, the business concept relied on the cleaned hull condition for economising the fuel usage. In interview G, the respondent has mentioned that an unclean hull on average can cause a speed deviation of 5.9%, which results in an increase in fuel consumption of 17.7%. Thus, the robotic solution that can remotely clean the hull in any location at any time contributes to the vast CO2 emission reduction by preventing the vessel's speed loss.

The second factor is about solving the problem of invasive species. The issue with invasive species is a big ecology-related challenge in shipping as these species attach to the ballast tanks or the hull and fall off in other ecosystems, possibly leading to upsetting the local marine biosystem. As the robotic solution can clean the whole area of the hull, it eliminates the need for additional transportation costs to conduct reactive cleaning with the help of the divers.

Operational and sustainability-related results of this solution are powered by several digitalization steps. First of all, every ship which uses Gamma's robotics hull cleaning has to be 3D modelled through digitization. Second, a lot of the venture's resources was spent on developing the robotics technology and further case-based adjustments are also possible to be required. Third, in addition to the hardware component, Gamma also developed a data management platform used for the purposes of collecting, analysing and documenting the data as well as Gamma's back-end office for operators conducting robot manipulations. Collected video materials about the hull conditions can be used as independent evidence of the satisfactory hull conditions for the port authorities and other relevant stakeholders.

Based on these cases, we can provide the following conclusions about the motivation to develop digitalization and sustainability related projects.

The motivation to comply with sustainability trend:

1. Comply with regulations to stay legitimate in the market:

Interviewees agreed that sustainability initiatives are primarily pushed by new EU legislations to reduce CO2 emissions and environmental footprint in various shipping activities, including cargo transportation, which influences fuel consumption, or the use of nature-friendly chemicals during cleaning procedures onboard. From our interviews, we have heard about particular attention to Carbon Intensity Indicator (CII) and Energy Efficiency Existing Ship Index (EEXI) and their role in MARPOL ("The International Convention for the Prevention of Pollution from Ships") amendments approved by International Maritime Organization (IMO). Additionally, one of the cases was successful in initiating its own ISO standard for measuring hull and propeller performance to calculate energy and cost savings.

2. Meet a new demand from customers to secure a firm's competitiveness:
   Production and service provisions are becoming more transparent, which creates demand for sustainability-related information. Thus, customers may partially base their decision-making upon sustainability considerations and choose the more sustainable product or service provider. It pushes the company to develop more sustainable offerings and become more competitive in the market.
3. To be part of new market development to stay relevant in the market:
   There is also coherence among our respondents' replies that customers are interested in purchasing sustainability-oriented products. It is expected that, in the long run, there will be a clear expectation to firms to be sustainable in their operations and products. Additionally, CEO of one of our case companies made a statement at the Ocean Now 2021 conference that "this decade is considered to be the decade of actions." (oceannow.nor-shipping.com)

It is important to note that several respondents have highlighted the "efficiency-sustainability" dilemma, which posits that abstaining from effective but polluting substances may not be possible without degrading the product efficiency, e.g. cleaning chemicals or hull coatings.

The motivation to comply with digitalization trend:

1. Increase efficiency of work:

Digitalization has been described as the tool to achieve better results given the same amount of resources, including manpower, fuel for ships or the longevity of disposable goods, such as ropes. That is, digitalization improves of current assets in use.

2. Increase effectiveness of work:

   The implementation of digital technologies enables collecting data points from a working tool, be it a vessel, a rope or a robot. Based on the insights from these data, it is possible to improve the future designs of vessels at Beta case or optimise the replenishment time for the ropes in the Alpha case.

3. Gives solutions to undertake more sustainable initiative:

   Ventures explored in this study have opened up opportunities for further sustainability-focused developments, such as providing additional service offerings and advisory on how to improve the sustainability profile of clients further. As it was mentioned in the Gamma case, the robotics cleaning hull solution builds upon 3D model digitization of the hull, conducting cleaning operations, which, in turn, provide historical data for forecasting and prediction modelling. Logically, the experience from Gamma case has also been utilised in several new developments in the same hull performance area. Similar knowledge spillover effects were presented in the other two cases.

The Interplay Between Digitalization and Sustainability Trends

In the following part, we will examine potential interplay between the trends and its nature. Our interview guide contained three questions directed to this topic, namely “In your opinion, is there any kind of connection between digitalization and sustainability in your project?”, “What is the nature of the relation between the trends?”, and “How do you think the connection between digitalization and sustainability will evolve in the future?”

All the respondents have mentioned that there is a clear link between the trends and in some way they influence each other. Below we will present the citations from the interviews that enlightens the reasons and the nature of this interplay.

Table 2 Sample quotes

Case	Citations
Alpha	"*To determine the lifetime and improve the quality of the ropes, we needed data to address the pain points and sustainability aspect of using ropes. Digitalisation has enabled us to install sensors and send, track, and analyse data."* "*My first thought is that digitalisation is an enabler for sustainability. Digitalisation opened up new opportunities for collecting, storing and analysing data and technological advancements. Thinking further, I would say digital technologies could catalyse the focus on sustainability by providing transparency.*" *"Thanks to digitalisation, more sustainable business models come to alignment with our clients' incentives".* "*If you can digitalise such an old product [mooring ropes] to collect data points and make it safer, you could use data and insight to make more sustainable and efficient use of the product.*" "*At the same time, the new demand is put on the industry for reaching sustainability 2030 and 2050 goals ... That is a factor as well when the industry has to adapt, look for new solutions and use digital technologies to meet these demands.*"
Beta	"*I think it is sustainability that pushes the demand for information flows. Sustainability has created more demand for digitalization products, and there are a lot of start-ups for measuring emissions on ships…*" "*Without some digitalization, you would not really know your numbers. CO2 emissions follow fuel consumption directly, and when you have less CO2 on chartered ships, it also means you consume less and pay less for fuel [when operating conventional fuel vessels].*" "*It's sustainability pushing the digitalization.*"

Gamma	"*To me, it [the interplay] is obvious. Unless you can measure what you invest into, you do not know the performance gains. Data is what we need to sell our products, which rely on performance gains and sustainability.*" "*Digitalisation triggers the opportunity for companies to make greener solutions. And these greener solutions and the possibility to get data are opening the door to do more. That is a cycle in some way.*" "*I think both trends exist in parallel, but sustainability pushes digitalisation even further.*" "*Green is profitable and making the right digitalisation initiatives is key from the economic perspective. Digitalisation would be driven in marine by the market demand. On the other hand, sustainability pushes digitalisation even harder; sustainability cannot be that advanced without digitalisation.*"

To sum up, there is a coherence among the respondents concerning the presence of interconnection between digitalization and sustainability trends. The responses, however, vary in describing the connection between the trends depending on the context of the case. We will address that further in the discussion part.

Case Analysis from Three Theoretical Perspectives

In this part, we will analyse our findings with three theoretical perspectives of Activity-based view, Resource-based view, and Institutional theory. Our interview guide contained specific questions devoted to each of the theoretical lenses used in this paper.

Activity-Based View

All three cases have shown an obvious change in the operation activities. There is a long-term focus on selling fewer disposable goods, making products of a higher quality with a longer life-span, and charging a bigger fraction of the total bill for services.

Three cases investigated in this paper have different value configurations. Alpha and Gamma cases were value chain configurations of the business model with ordinary secondary activities, such as post-sale services. Both companies sell mooring ropes and special marine coatings for the hull, respectively. Beta as a shipping unit of an energy company represents a value network configuration since its main offering is logistics services for oil and gas commodities. However, our investigations provided us with evidence of the potential configuration changes in companies' business models.

Three cases have indicated different results. Alpha has undertaken an across-type transition from value chain configuration to value shop one because, instead of selling the conventional product, the firm is going to sell the service with specific adaptation to the customer problems and idiosyncratic technical features of marine vessels. In turn, new operations in the Beta company do not lead to the changes in the value configuration of the business model. At the current phase of the project development, there are no discussions about the structural changes in the value delivery and value creation logics. It also does not influence the most significant value cost and value drivers within the Beta case. Finally, Gamma has started a new value offering, which, in fact, created another business model augmenting the previous business model configuration of Gamma's conventional products.

It is also worth mentioning that changes in value configuration were accompanied by changes in primary value and cost drivers. Initially, when the business models were presented by the value chain, the main cost drivers were scale and capacity utilization. However, after the transition to the value shop, the main cost drivers started to be significant initial capital investments into digitalization and digital capabilities. The changes have also occurred in the value driver component. Specifically, the value of disposable standardized goods has become augmented with the value of tailored services backed by digital technologies. Thus, we observe the presence of a new value driver, namely, company's reputation and that of the partner's companies which were engaged in the venture development. As it was mentioned by Alpha and Gamma respondents, it is getting more challenging to sell premium products in the market segment used to low-cost product offerings, and that is why reputation is the primary asset that makes potential clients more loyal to the new product.

All three companies are striving to provide more than merely products and complementing services. In fact, we may assume a tendency towards the third stage of servitization as described by Vandermerwe and Rada (1988). In the Alpha and Gamma cases, the companies are the owners of the product and have the whole responsibility for maintenance processes. Thus, the firms charge for the results achieved, not for the products and tools used. In detail, it means that the companies provide a whole pack of products and services, starting from logistics and installation up to continuous operations, maintenance and disposal. Below we provide the contextual details to describe each module of the third stage of servitization in greater detail.

Table 3 Break down of Alpha and Gamma cases according to the servitization modules by Vandermerwe and Rada (1988)

Module	**Alpha**	**Gamma**
Goods	Mooring ropes with installed Internet of Things sensors.	Robotics hardware is the main tangible asset in the hull cleaning solution.
Services	Logistics operations and the installation of hardware equipment.	Installation of the hardware onboard and preparation services (3D digitization of a vessel's hull).
Support	Timely replenishment of the mooring ropes combined with the most recent technological improvements in the mooring solution.	Timely replenishment of the hardware combined with the most recent technological improvements in the hull cleaning solution.
Self-service	Software application with live mooring process analytics analysing tension in ropes and	Use of data for additional analyses and as documentation materials for legal arrangements

	warning for accident prevention.	with port authorities and other stakeholders.
Knowledge	Discovering inefficiencies in mooring operations and case-based operational improvements.	Deep knowledge about the hull performance of each vessel and respective improvements in operational efficiency.

In turn, Beta case did not show the features of servitization as the firm is in the stage of collecting big data for making analytics. The scope of the Beta project was comparatively smaller to those of Alpha and Gamma: it primarily focused upon digitization and data analysis activities, not developing a new value offering as the project's aims.

Resource-Based Perspective

Respondents from three cases have claimed that there are two main new types of resources employed: 1) new data- and technician- professionals, and 2) new partnerships with technological companies. All three companies were not technology specialized and were lacking digital competences. Thus, they needed to build up new capabilities for successful venture development backed by digitalization. Below we describe the resources allocated to the ventures in more detail.

Alpha

Alpha case relied upon previously accumulated corporate resources, namely a worldwide network of market players (ports, terminals, regulatory bodies and others) as well as a recently acquired rope manufacturing company. At the same time, all respondents clearly outlined that Alpha was neither technology nor an engineering company. Thus, in the light of digital transformation going internally, Alpha hired new engineers to build a digital team in-house and started new partnerships with technology companies to develop IoT, data processing and sensor capabilities.

Beta

In the Beta case, the main resources employed were new engineering talents as well as deeper collaboration with ship owners for unifying the reporting standards.

Gamma

To develop the robotic hull cleaner solution, Gamma employed more computer and robotics specialists, started partnerships with technological leaders in the maritime industry as well as partnerships with leading shipping companies. Additionally, the company undertook significant transformations in the sales function since it was repeatedly mentioned in the interviews that salespeople have to speak "a new, data language" and translate it into something that customers can understand.

While all three cases were developing their digital technology skills further, we should also mention another observation from the interviews: every venture is owned by big corporations in the maritime industry and has been supported by a high level of management loyalty as well as sufficient financial support. This makes a difference between such ventures and small and medium enterprises (SMEs), which may not have enough resources to develop a venture project for years. Thus, we conclude that, in contrast to findings by (Ardito et al., 2021), we have not identified a conflict in resource allocation for internal digitalization and sustainability initiatives as they are interconnected, according to our respondents.

Institutional Perspective

The third chosen theoretical perspective is the institutional theory. To explore the ventures under the institutional perspective, there were two main questions in the interview guide: 1) "What was the motivation to start the project?" to identify if it was a leader or a follower move and 2) "How did the project affect the market image of the company?"

For all the companies the ventures were a leader move with an internal motivation. It was a forward-looking action as all interviewees have a belief that in several years it will be an obligation for companies to comply with sustainability regulation and legislations. Moreover, there is an expectation that customers will be also more loyal towards more sustainable value offering which will create a competition among market players to provide the greenest solutions. Thus, proactive initiatives from the three cases can secure a strong and competitive position in the market in the future with the possibility to influence this new sustainability-oriented

ecosystem. However, interviewees claimed they see both first-mover competitive advantage and first-mover competitive disadvantage. Below we provide a more detailed explanation of it.

First-mover competitive advantage:

1. The early moves can provide a leader position in the new market. For instance, Beta company expects that by the time when new legislation will come to the market, they will have already had a fuel-efficient and cost-saving solution for the shipping operations.

2. The second advantage is the ability to change the market and create new rules for the ecosystem. For example, in the Alpha case, interviewees have admitted that the new mooring solution can change the rope industry. Additionally, the chosen option for the value capture mechanism may influence the rest of the market players. The venture lead from Alpha told us that the smart mooring technology may be shared with other competitors. That is, Alpha may cease their monopolistic position to supply Alpha's ropes exclusively with IoT sensors and try establishing an ecosystem of smart mooring with several biggest rope producers. It could allow Alpha to scale its service component in smart mooring, which means that their primary focus would be on providing analytics through collected data points from IoT sensors. Nevertheless, the venture lead admitted they are yet to make such a decision as they are not sure that the benefits will outweigh the costs.

   Besides Alpha's findings, Gamma's respondent has expressed their discoveries that their hull cleaner solution has already been replicated by other firms. It leads to the fact that these followers comply with Gamma's newly developed ISO standard and other regulations.

First-mover competitive disadvantage:

1. One of the main disadvantages is the fact that customers usually do not trust new technology and are quite sceptical regarding the efficiency of new solutions. As one of the respondents from Gamma said, "there is always a

big difference between what customers asked beforehand and what is their willingness to use the new technology." The problem is exacerbated by the fact that sustainability initiatives are hard to assess as the business decisions are pushed by profit. Thus, new green solutions should be pushed and marketed as they cannot sell themselves now. On the other hand, expecting demand to pick up the interest because somebody else will be there already.

2. Another disadvantage is that there are higher prices for things that are done for the first time because of uncertainty factors which influence the price. This concern was expressed by Beta and Gamma. Two interviewees from Gamma expressed their concern regarding the ability to sell the new technology.

Finally, depending on the scope and the released impact, the ventures affected the companies market image differently. Alpha has successfully announced its market leader ambition in the newly purchased business segment. Additionally, it was a frequently used venture to promote the new digital image at maritime business events worldwide. Thus, the respondent claimed that smart mooring rope venture allowed Alpha to differentiate themselves from competitors.

Conversely, Beta's image was not affected as the project's scope is small and customers are not yet informed about new CO2 measurement capabilities. Finally, Gamma had a very successful first public appearance: well-known social media, such as BBC and World Economic Forum, as well as other industry specific institutions have paid a particular attention to the potential value of the hull cleaning solution. As a result, all the interviewees highlighted that this venture had a huge impact on the market image and the corporate image of "slowly moving, established, and not super-innovative company" was changed.

To conclude, all three ventures initiated a leader move which is reported to have both first-mover advantage and disadvantage. As for the market impact, the ventures differed in their degree of influence upon the company's image.

DISCUSSION

This master thesis aimed to investigate potential interplay between sustainability and digitalization. Our findings indicate that these two trends are connected and may influence each other. Additionally, undertaking projects that involve digitalization and sustainability aspects affect the fit among firms' activities, resources, and market image.

In the following part, we will interpret our findings and link them to the existing literature. First, we will take further the discussion about the interplay between the trends and then provide a more detailed overview from three chosen theoretical lenses.

The Interplay Between Digitalization and Sustainability Trends

The phenomenon of this interplay started to exist only recently. Despite the fact that sustainability started to be vastly discussed decades ago (Aguinis & Glavas, 2012), the business started to undertake some initiatives and develop business cases only now. The United Nations Global Compact, the world's largest corporate sustainability initiative, has stated in its "Uniting Business in the Decade of Action" Report that 2020-2030 is the Decade of Action that replaces the previous decades of ambition. Now new regulations are to be established and corporations are expected to find new technological solutions to make the production of goods and services greener to contribute to the Ten Principles and reach the SDGs (Sustainable Development Goals) (The United Nations Global Compact & DNV GL, 2020). The idea of the Decade of Action was also supported by multiple CEOs of the largest marine corporations in the Ocean Now 2021 conference.

Regarding the digitalization trend, the third stage of digital transformations, when the new technologies can impact the business logic of value configuration, has also started not a very long time ago (Rachinger et al., 2019; Verhoef et al., 2021). The first scientific articles on digital servitization started to be published only in the second half of 2010s (Cenamor et al., 2019; Kohtamaki et al., 2019). In fact, managers still remain sceptical about the need of the digitalization solutions as they demand big capital investments, involve a lot of risks, and could be treated sceptically by customers. Interviewees from Alpha company have stated that it was quite challenging to convince the steering committee to proceed with smart mooring solutions. Additionally, there are not many initiatives like this. There were

two more ventures in Alpha that are frozen now. As one of the Alpha's interviewees stated, "The managers do not really understand that digitalization is vital for future development … Digitalization becomes a buzzword and you do not really understand by heart what it means." However, as some of the companies start to use digital technologies and gain competitive advantage out of it, it starts to push other market players to undertake digital transformation. Moreover, there is a pull effect from customers towards transition to digital solutions as they become more accustomed to the information flows which are easily available, for example, via smartphones. Thus, as was discussed in the interview with Gamma representative, there is a recently created push from companies and pull from customers to undertake digital initiatives.

This explains why all three cases had an internal motivation to start the ventures. The market of sustainable business solutions backed by digital technologies is only developing now and there are no other market players whose actions and strategies could be copied.

It is also important to note that digitalization and sustainability trends started independently. While digitalization was opening new perspectives after the digitization phase, sustainability was motivated by a better attitude towards natural resources and not deteriorating the state of the Earth. The interplay between the trends, though, has appeared because the development of one trend is dependent upon or pushed by the development of the other one.

Based on the interviews, we identify a two-stage development of the interplay in the actions that firms take with respect to digitalization and sustainability. First, development of sustainability appears to demand the use of digital technologies. The main reason is the importance of being able to measure a firm's performance and get quantifications of greenhouse gas emissions. The firm cannot undertake effective sustainability actions if it does not know which part of its business is using the most natural resources, which business operations emit the most CO2, and others. When the business performance is expressed in numbers, it becomes possible to undertake multiple numerical analyses and decide which part of the business needs action first. For example, Beta company can optimize routes of ballast lag which leads to fuel savings. Additionally, Gamma's respondents stated that if it is possible to measure the firm's CO2 reduction, then customers and other third parties can trust the business solution of this firm. Otherwise, there would be

no sufficient evidence to support such a claim. Thus, it can be concluded that digitalization enables sustainability by providing technological solutions and measuring performance.

In the second stage, we expect that sustainability will push digitalization even further as it makes the business processes more transparent. All the respondents confirmed that the new demand for sustainable solutions is emerging and will develop even further when the customer is able to see the value chain of the goods and its sustainability impact. One of ways to do this is to introduce CO2 intensity measurements for goods that will show the value chain and its greenhouse gas emissions. Though the very first carbon labelling pilots in the 2000s were not accepted and supported by customers, now the sustainability discourse has been successfully pushing such initiatives through legislation for both consumers and companies (Man, 2021). Consequently, it will allow the customer to make more conscious decisions and choose goods that are provided with the optimal sustainability effect. For example, IKEA has an ambition to measure the CO2 impact of every stage within the value chain, including shipping-related emissions (Giles, 2019). Thus, there is an emerging pressure on shipping from its clients' industries. Additionally, this transparency can improve the use of goods and make it more economical. For example, in the Alpha case, such transparency of data and business processes will allow changing the rope only when needed, neither too early nor too late. It will also provide analytics of why the rope could be wearing out too fast in some particular places (for instance, because of not illicit use) which could be eliminated by prevention of high peak loads on the rope or by other means.

However, as Gamma's respondents mentioned, there is a dilemma between the green impact and efficiency of the solutions. For example, there is plastic wrapping used on fruits and vegetables that keeps these highly perishable products fresh for a longer time. Removing these plastic wrapping will not necessarily have a higher sustainability impact. The same example is relevant for the maritime industry. As of now, marine coating may include toxic biocides to control the fouling on the hull. While the possible excessive toxicity has been proven to have significant adverse effects on marine ecology, it does not mean that a hull fouling is good for ecology. That is because the accumulation of fouling leads to increasing fuel consumption by over 20% and, consequently, higher CO2 emissions in the end

(Kalyanaraman, 2020; Kidd, 2017). Thus, as there are few things that are by nature green, firms aim at offering not green, but greener or less damaging solutions, where the balance between efficiency and side-effects is kept.

Thus, there are several main outcomes from the interplay between sustainability and digitalization:

1. The trends have appeared independently;
2. Digitalization enables sustainability by providing new technological solutions and measuring the performance;
3. Sustainability is pushing digitalization even further as it makes the business operations more transparent.

Activity-Based Perspective

The activity-based perspective can shed light on how the interplay of digitalization and sustainability can influence the activities of firms. Specifically, an extension of this theory, business model research, is valuable in terms of understanding changes in the value configuration of business. We have identified three main results from this perspective.

First, sustainability should be integrated in the business model to have an impact on the business operations and on the product in the end. As documented in the "Uniting Business in the Decade of Action" report, companies need to fully embed the SDG targets into business models which are currently being developed by only 37 per cent of companies from the United Nations Global Compact network (The United Nations Global Compact & DNV GL, 2020, p. 14). In fact, for the majority of firms, sustainable goals are not integrated in the business, which could be partially explained by the fact that business and sustainability functions are rarely connected in one role. The interviewee from Gamma company has said that sustainability is usually a part of the Communication or Human Resource department. When sustainability is not included into primary operational activities, it becomes a non-material investment (Khan et al., 2016). To support this idea, all of our interviewees mentioned that one of the successful factors was integrating their sustainability targets into the business model. These new business models will not rely on the quantity of low-cost products sold in the profit maximization formula but on high-quality long-lasting goods as part of the value offering.

It leads us to the second finding that sustainability and digitalization interplay leads to the servitization of business models. Respondents from Alpha and Gamma companies were mentioning that, having developed a new product, they will not sell it, but offer it as "a service with subscription quality-based level," which leads to a new product-as-a-service offering. The respondent from Alpha has claimed that in the long run they plan to make a transition "from selling pure products towards selling pure service" that presupposes a shift "from transaction-based relationship to partnership-based relationships." It will allow them to concentrate more on the specificity of customer's requests and customize the value offering.

Our last finding is that digitalization enforced by sustainability leads to within- or cross-configuration changes of business model. From our cases we see that more radical innovations push businesses to make bigger changes related the fit among activities to keep the consistency between the product development and business model development. For example, Alpha decided to undertake a cross-type value configuration change as it makes the transition from product offering (value chain) towards customized service delivery (value shop). In contrast, Beta's venture does not imply cross-type changes. The company will make operations more efficient through a new reporting system and gather big data to provide analytics about ship performance. These changes in the value configuration will be within the same type as their previously merely shipping operations will be accompanied with reporting about the CO2 emissions and the priority to choose the most sustainable routes.

To sum up, the development of new technology should be supported by an appropriate business model (Fjeldstad & Snow, 2018) and thus, sustainability and digitalization investments may be material only when they are embedded into the core operations. These changes may provoke change in the fit among activities and, consequently, lead to within- or cross-value configuration changes. Finally, our cases have shown evidence of sustainability and digitalization interplay leading to servitization of business models.

Resource-Based Perspective

Our next theoretical perspective is the resource-based view that shows how organizations change their resource base configurations under the sustainability and digitalization trends.

The marine industry is considered as quite an old business with resources that are substantially presented with long-term heavy assets. For example, assets are expected to serve at least for twenty years (Lorange & Fjeldstad, 2010). It makes the marine industry not flexible in terms of fast response to the new business trends. Maritime industry cannot undertake fast changes in its resource configuration as it would demand a considerable amount of time and huge initial capital investments to develop new equipment and rebuild the infrastructure to enable the use of new technology. However, several interviewees have mentioned that the shipping industry has reached its tipping point as sustainability discourse has been developing for the last 20 years and now is pushed by regulations. Thus, all three case companies undertook the change in their resources to enable this transformation toward more sustainable digital solutions. We have identified three main types of resources that are necessary for transformation:

1. Companies need technological partnerships to have access to knowledge and capabilities needed for development of new technology. All three companies were intensively learning and building up new capabilities, as they were lacking digital capabilities.

2. Firms need partnerships with multiple marine companies, like ports, terminals, regulatory bodies and others to develop a seamless technology. New technological solutions should fit in the existing infrastructure, otherwise it will be impossible to use the technology.

3. Finally, companies employed new data- and technology-professionals to enlarge or build from scratch an in-house team. This in-house team will allow to keep the knowledge gained from partnerships within the company and develop digital capabilities further. Thus, technicians will support the operations and enhance digitalization solutions.

From the dynamic capabilities perspective, all three companies undertook transformations with the impact on their ecological footprint. Following Borland et al. (2016), we have seen Alpha and Gamma followed dynamic capabilities of ecological transformational strategies which are characterised by more dramatic changes in the routines and resource base. In the case of Alpha, the company has used their dynamic capabilities to *rethink* the concept of a disposable mooring rope into the safe mooring service, which allows it to deliver the same function in a

more sustainable manner. Additionally, Alpha plans to *redirect* the worn out ropes into the production cycle to reproduce them for less intensive use that will decrease the amount of waste going into nature. Speaking about Gamma, the company has *reinvented* the conventional way of hull cleaning that provides superior performance more sustainably.

In contrast, Beta uses transitional dynamic capabilities, which attempts to offset the aftermath of operations without causing a structural change in resource allocation to deliver an eco-positive impact. More specifically, the digitalization initiative of Beta will eventually contribute to the *reduction* of fuel used through the optimization of routes and speed.

Thus, it is expected that Alpha and Gamma might have a bigger sustainability impact than it is in Beta because of actual changes into their resource configurations. However, this is just a suggestion as the venture has only started to operate and has not yet provided analytics about CO2 reduction efficiency.

Institutional theory

Finally, we use institutional theory for our research that explores the social context in which firms operate. A key aspect of institutionalism is the compliance of organisations with socially accepted legislations, societal rules and cultural peculiarities (Scott, 1987). The deviation from these rules may be fraught with grave consequences for firms since it can threaten their legitimacy up to the firm’s ability to operate in the market and society.

While the maritime industry is global in scope, there are numerous institutional bodies from both governmental and industry sides. The European Union authorities and those of separate states play a significant role in the regulations of shipping activities, primarily through the border entrance and port-specific regulations. Besides, industry authorities, such as the International Maritime Organization, also influences the best practices and standards of shipping activities around the globe. The scope of these influences varies significantly from the requirements to hull coatings up to the prohibition of certain activities onboard. In the light of CO2 pollution, interviewees have mentioned multiple times about CO2 tax on shipping fuels, Carbon Intensity Indicator (CII) and Energy Efficiency Existing Ship Index (EEXI). The last two regulations were already ratified at IMO's 75th Marine

Environment Protection Committee (MEPC 75) in 2020 and will come in effect from 01 January 2023.

Our findings give support to the sustainability in the maritime industry clearly driven by regulations and legislations. While the majority of these legislations are yet to be introduced or developed, our interviewees have undertaken a leadership move due to a strong belief that further regulations in shipping are underway. One of the benefits of a leader move is that it allows a company to influence new regulations and be a "game changer" in the market. For example, Gamma was a key contributor to the development of the new ISO standard which measures the changes in hull and propeller performance. Gamma's immediate benefit is that the standard provides the measurability and the language of communication for vessel stakeholders investing into ship hull performance opportunities. As a result, this new regulation will influence business operations of other market players giving Gamma a superior position.

It is expected that in several years this sustainability discourse will become even more prevalent and be supported by third parties, e g customer. We can anticipate that firms not taking proactive actions right now will take reactive actions in future to be compliant.

We have also found that the venture's ability to survive depends upon its legitimization in established and old markets. It is in line with Carroll and Swaminathan (1992) that entering a market primarily consisting of "generalist" firms constitutes a legitimacy threat for new organisational forms. For example, Gamma is concerned about convincing clients that the new and more expensive solution is more cost-beneficial compared to other conventional low-cost products. The respondents mentioned that the reputation of technology partners and the reputation of Gamma as a premium supplier play a big role in the sales potential for the robotics hull cleaning solution. Alpha has also claimed that its global network of ropes customers is a key value driver for the whole venture. However, is it still the main challenge to persuade them to be the customers of the smart mooring solution.

As a summary, there are two main factors that catalyze the influence of legislation in the marine industry: it is a unified industry with relatively little local specificity combined with a global scale of operations. The market of digital sustainable solutions is forming now and undertaking a leadership move helps companies

impact rules of the game and ensure its superior performance. Additionally, making first steps successfully depends upon one's image in the market.

In summary, we have identified that there is an interconnection between the digitalization and sustainability trends. These trends are reinforcing each other as digitalization enables sustainability and sustainability pushes the development of digitalization even further. The findings from this thesis are applicable for other industries that undergo changes under digitalization and sustainability trends, especially for big corporations as regulations are pushing sustainability initiatives and it also demands digital technologies.

IMPLICATIONS

Implications for Research

Our master thesis has several implications for research. First, we have identified that there is an interplay between sustainability and digitalization. Second, findings have shown that sustainability initiatives are pushed by regulations and the new demand for the products while digitalization provides tools for implementing sustainability initiatives and is an enabler of sustainability in organizations.

Third, the main motivation for the companies to undertake sustainable digital ventures is to comply with the regulations and adapt to the main pain-points of the customers. Finally, it is expected that the next decade 2020-2030 will be quite fruitful in terms of researching the digitalization and sustainability trends as it is claimed that it will be a "Decade of Action" in terms of sustainability initiatives, and as digitalization is also starts to be a necessary element of staying competitive in the market.

Implications for Managers

This research also has implications that can be of value for practitioners. First, we have found evidence that actions taken with respect to digitalization and sustainability reinforce each other and, thus, do not pose a conflict of interest for resource allocation. Specifically, sustainability initiatives heavily rely on digital technologies to achieve meaningful results. In its turn, more developed and mature digital capabilities open up avenues for greater sustainability initiatives. Additionally, to make sustainability actions material, sustainability targets should

be embedded into core operational activities. In other words, sustainability should be integrated into a new business model.

Second, when launching a sustainability-focused project, companies need to think particularly about their market image because, despite sustainability and digitalization being high on the agenda for many market players, customers are still sceptical when trying new products for the first time. Thus, when the company develops new capabilities or enters the new market, it could consider alliances with other companies to compensate for lack of special capabilities and reinforce its market legitimacy.

Third, the leader moves in undertaking sustainable business initiatives backed by digitalization are beneficial right now as they could allow joining the legislation development and affect the new market. Moreover, as sustainability has been cemented in regulations and if not undertake the initiatives now, the firms are to do it later as an adaptation move.

LIMITATIONS

We are aware of several limitations which our research is subjected to. The main factor to consider is that the scope of our research included exclusively multinational corporations that already have sufficient resources to initiate and run long-term projects. Thus, the ventures of such maternity companies do not experience lack of network ties, reputation, and financial support. Small companies that enter the market should seek these resources from other means.

Additionally, the maritime industry chosen for this study is global and unified. However, more local-based industries can have a different attitude and features of this digitalization and sustainability interplay.

Finally, all the ventures in our cases have started only recently and thus, cannot provide quantifiable results of their operations, for example, CO2 intensity reductions and cost-efficiency. There are documented results from the venture trial period of development, but no data exists for the full-scale launch in the market.

SUGGESTIONS FOR FUTURE RESEARCH

We have conducted qualitative case study research in order to explore the connection between sustainability and digitalization trends in an empirically rich environment for the small number of cases. The sample size limits our ability to

draw definitive conclusions. Thus, we see the need for further research, both more cases and also possible large scale quantitative research in order to assess the generalization of our claims about the interplay between two trends. Since our sample has some specific characteristics (e.g. big company size and access to financial resources), we find it necessary to explore the same interplay for more localised industries as well as small and medium enterprises in order to confirm our findings. Finally, sustainability impact is possible to assess through the business model research, particularly the difference between greenwashing and structural changes in the value offering. However, the current state of the research stream is fragmented and underrepresented in top management scientific journals. Consequently, digital sustainability research will benefit from further development of business model literature.

CONCLUSION

This MSc thesis is devoted to exploring the interplay between digitalization and sustainability in the maritime industry conducted using a multiple inductive case study method. Our main finding is the identification of an interplay between digitalization and sustainability; digitalization enables sustainability by providing new technological solutions that are able to measure performance whereas sustainability pushes digitalization even further due to transparency and resource- and cost-efficiency. Thus, firms may benefit from embracing sustainability initiatives backed by digital solutions.

Digitalization and sustainability influence business models in a way that digitalization reshapes the fit among activities while sustainability targets should become the integral part of value creation in the business model. Additionally, the research has shown that data skills become extremely important for the business. The way to obtain these resources and develop new capabilities is to hire employees with digital competences for building an in-house team and to engage into alliances with technological companies.

Sustainable digitalization projects can affect the market image of the firm. Sustainability initiatives are increasing in importance because sustainability is becoming required by legislation. As it is claimed that 2020-2030 will be the “Decade of Action”, we expect to see the new era of shipping with different

technology. A lot of changes are also to come in other industries (e.g. fast moving consumer goods), and, thus, we consider this direction of research fruitful.

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