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Master's Thesis

Navigating the Seas of Change:

A Grounded Theory Analysis of the First Adopters of Wind Propulsion Technology in the Shipping Industry

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By:

Sofia Heleena Laaksonen

Shazbah Shafi

Department of Service Studies

Campus Helsingborg

Supervisor:

Yulia Vakulenko, Lund University

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Shazbah Shafi

ABSTRACT

Study purpose: The maritime shipping industry, particularly the commercial sector, is a significant contributor to carbon emissions and environmental pollution. Various solutions are being proposed to enhance the sector's sustainability, including the adoption of wind propulsion technologies. However, the economic feasibility of these technologies on a large scale remains uncertain. Despite this, early adopters are forging ahead. Thus, this paper aims to investigate the underlying factors influencing shipping companies' decisions to choose wind propulsion technology, whether driven by operational, legislative, technological or other factors.

Methodology: In order to identify the driving factors behind the adoption of wind propulsion technology, a grounded theory methodology was employed. The constructivist grounded theory approach was adopted for data collection, while Strauss and Corbin's paradigm model and conditional/consequences matrix were used to analyse the results. The research methods included document analysis and intensive interviews, while existing literature on wind propulsion shipping provided the foundation for the research problem.

Findings: The results of this study highlight several crucial factors that can be categorised based on the paradigm model. It is important to address the interconnectedness between these factors from three levels, including the individual, organisational, and international levels. The proposed theoretical framework suggests that the first adopters of wind propulsion technology are driven by emotions at the individual level, business concerns at the organisational level, and regulations at the international level. However, sustainability drivers are present at all levels.

Research implications: This thesis contributes to theoretical, managerial, and social areas. The proposed theoretical framework complements existing theories such as the resource-based view and first-mover advantage, as well as broad concepts such as emotional engagement. Moreover, it provides a foundation for future multidimensional research on driving factors. From a managerial perspective, the thesis creates a conversation on developing business models, providing knowledge on technologies for decarbonisation and creating new market opportunities for the shipping companies. Finally, the findings of this study address industry inequalities and can help to promote better work-life conditions for workers in the maritime shipping industry.

Keywords: grounded theory, wind propulsion technology, shipping industry, sustainability, paradigm model, conditional/consequential matrix

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1. INTRODUCTION

The introduction chapter begins with presenting the study background to accentuate the researched topic. To give the reader a clear understanding of the subject and its importance, the chapter first displays the comprehensive information and then narrows it down to the focus of the thesis. Like a roadmap, the problem of this paper and its aim with the associated research question is featured next. Lastly, the structure of the thesis is presented to offer guidance for the following chapters.

1.1 Research background

Each year around 80% of the global freight, amounting to 11 billion tons of physical goods, are transported across the world's oceans and waterways on ships (ITF, 2020). The maritime industry has a crucial role in developing world economies through highly sophisticated supply chains making it possible for many countries to gain access to foreign markets and engage in international trade. Shipping continues to be the most energy-efficient transportation mode since large cargo volumes can be transferred inexpensively in relatively fast delivery schedules. Regardless of the effectiveness of sea transport, the operations of the business sector emitted more than 1070 million tonnes of Greenhouse Gas (GHG) emissions, which is approximately almost 3% of the entire world's CO_2 emissions in the year 2018 (IMO, 2020). To place it into perspective, if the shipping sector was considered as a country, it would be the 6^{th} largest CO_2 producer (Schlanger, 2018).

The environmental impact from shipping is causing concerns as the GHG numbers are estimated to further increase by 130% by the year 2050 (IEA, 2020). The present energy structure runs through fossil-based fuels, namely heavy fuel oil (HFO) and marine diesel, which make up more than 98% of the total current fuel demand (International Chamber of Shipping, 2021). There are three main adverse effects of burning non-renewable fuels in shipping: firstly, accelerating climate change, secondly, acidifying oceans, and lastly, increasing air pollutants that can cause damaging health consequences (OCEANA, 2022).

In pursuance of diminishing the environmental and societal burdens caused by the shipping activities, the industry has looked for solutions in setting international policies, as well as researching the potential benefits from alternative propulsive systems. A specialised agency under the United Nations, the International Maritime Organization (IMO), was established to govern over the maritime industry ensuring safe and responsible shipping worldwide (IMO, 2019). The

organisation set strategic targets to reduce GHG emissions by 50% before the year 2050 compared to the baseline year of 2008, and later on transition fully to emission-free shipping (IMO, 2018). To ensure compliance towards the goals, the IMO has issued operational and market-based measures that would be applied to all of the over 60,000 existing vessels and future ones (ITF, 2020).

The current mandatory policies, including the application of the Energy Efficiency Design Index (EEDI), the Energy Efficiency eXisting ship Index (EEXI), and most recently, the Carbon Intensity Indicator (CII), aim to reduce GHG emissions and promote sustainability in shipping. CII is to be employed for vessels with internal volumes larger than 5000 gross tonnage (Chica et al., 2023). The inability to meet the targeted policy measures at ship level does not yield to sanctions but places vessels into rating categories which showcases the energy efficiency over time. Nevertheless, the existing regulations from the IMO are not deemed strict enough to find the reduction targets feasible to achieve (De Beukelaer, 2021). Therefore, the shipping industry is compelled to come up with its own sustainable solutions with innovative new technologies to offer zero-emissions propulsion systems which obligates in meeting the climate goals.

Recent developments in the field of shipping have led to a renewed interest among shipping companies on solving the environmental issue based on their own research & development results leading to a wide range of options from renewable fuels, such as ammonia, hydrogen and biofuels. One potential zero-emission solution is harnessing wind power through various wind propulsion systems and technologies which theoretically can reduce up to 90% of produced emissions (Falck, 2021). The pivotal changes within the shipping industry relating to the adoption of wind propulsion has gained novel interest from academia and the public domain, especially after the release of the targeted decarbonisation efforts to fight climate change set by the IMO (Psaraftis, 2019). Big industry players have started to invest in building new ships or retrofitting existing ones to utilise the free energy source to reach climate targets; they are taking on a chance of potentially reviving an old technology, as former ships ran on sails, to deliver a more cost-efficient substitute to shipping decarbonisation (Van Pallandt, 2022). However, far too little attention has been paid to understand the uptake of wind propulsion in the industry.

1.2 Research problem

The most obvious and vocalised reason for considering wind propulsion technology (WPT) is for the high potential of bringing the shipping emissions down. However, it should be emphasised that fully wind-propelled ships are still in the early developmental stage with very minimal representation of wind-assistance or retrofits in the water (Van Pallandt, 2022). From a commercial perspective, the idea of wind propulsion has not yet been proven to be viable. In one instance, well-known shipping company Maersk pursued WPT, performed tests on it and later on rejected it from further developments (Mandra, 2021). Despite the outcome of Maersk's evaluations, there is still high interest in wind propulsion and it is not fully understood why certain shipping companies decide to still explore wind possibilities. This has created a certain degree of disconnectedness between stakeholders', for example between the shipping companies and scholars whose perception on WPT differ on matters concerning the practical implications of its adoption and the possibilities of actual decarbonisation of the industry (De Beukelaer, 2021).

Nonetheless, the interest around wind has steadily grown which has also caught the attention of academia. Yet there is a substantial research gap in learning why WPT adoption is rising despite the decisive barriers which current research has tended to focus more on. Addressing this research problem would bring a great contribution to the research field by answering the identified research gap with new knowledge on the matter. Also, from a managerial perspective, placing effort into understanding the driving forces to emission-reducing solutions, like wind, can assist first adopters in making more reformed decisions with increased information on decarbonisation efforts. The first adopters can be individuals, corporations, in this matter shipping companies, or even people as part of organisations who are connected to the shipping industry (Allwright, 2018). In terms of commercial viability of WPT, some studies do show the minimal economic and sustainability savings with WPT on a smaller scale. However, for a larger market there are distinctive logistical and technical challenges (Julià et al., 2020).

1.3 Research aim and question

The objective of this paper is to explore the underlying elements influencing shipping companies in their decisions of choosing WPT. In other words, the paper tries to understand the motives towards the adoption of wind propulsion in the maritime industry from all sides, whether it is operational-, legislative-, technology-driven or something else. The focus will be on the first adopters of the movement who are highly persistent in using wind propulsion. The research primarily focused on WPT related to full wind-powered vessels aiming for zero emission shipping. However, throughout the data collection, the authors came across relevant information on wind propulsion technologies in the context of wind assistance solutions.

Since there is little existing knowledge or theory on wind adopters' motives, therefore, the present study carried out research through Grounded Theory (GT) methodological approach as it tries to reach the aim of developing a suggestive theory, where there is no strong theoretical basis from which a well-focused research question can be developed (Clancy & Vince, 2019). GT has evolved in the past five decades and has several branches. For data collection, this thesis will follow Charmaz's (2014) constructivist way towards GT. However, as the research progresses, the authors adopted Strauss and Corbin's (1990, 1998) analytical frameworks to start the data analysis in an inductive manner. Thus, GT will help to understand the more implicit and hidden factors that are not explicitly stated or expressed through the analysed results. The following research question was explored to achieve the research aim:

RQ: What are the factors that drive first adopters to pursue wind propulsion technology in the maritime industry?

1.4 Thesis structure

The upcoming chapters of the thesis are presented as follows. The second section covers previously published works in which relevant literature and theories in the domain are evaluated against the research aim. Since the thesis is conducted through GT, the role of literature has been also analysed. The third chapter presents the methodology with the justification of the considered methods. In the fourth chapter, empirical results and findings are presented. The emerging categories from the theoretical coding process are conceptualised through the paradigm model adapted from Strauss and Corbin (1990). The fifth part of the research consists of the analysis and discussion followed by a proposed theoretical framework to address the identified research gap and answer the research question in the study's aim. The sixth and final chapter consists of covering research implications from theoretical, social and managerial aspects, as well as, future research directions followed by concluding remarks of the thesis.

2. LITERATURE REVIEW

This chapter in the paper covers previous literature surrounded by the research aim in the domain of WPT. Firstly, a brief discussion is presented of the paper's approach of using literature in GT. Furthermore, an evaluation of the suitability of previously used theories in similar studies has been made.

2.1 Approaching literature in GT

All the dominating perspectives of GT, namely Glaserian GT and constructivist GT, have come to a consensus that a developed theory is grounded in the data and not through the existing literature (Ramalho et al., 2015). The literature overall should be used as a supportive knowledge for the analytical research strategy rather than as a theoretical framework; in the majority of research studies a literature review is written prior to data collection and analysis to review research against published works (Creswell, 2012). In terms of when a literature review should be conducted in GT, there are varying arguments based on the epistemological stances.

When Glaserian GT was first formed, a literature review was advised to be avoided before collecting data or at least postponing the writing of the section until the very late stages of research to ensure unbiased opinions and not having *"categories contaminated"* (Glaser & Strauss, 1967, p. 45). An adjourned review is seen as a way to support grouping of ideas without previous knowledge on the subject. Within the GT sphere, numerous scholars oppose Glaser and Strauss' statement of naïve empiricism when entering research objectively, and therefore reject the pure induction approach in the Glaserian GT (Charmaz, 2014). Thornberg (2012) proposes an informed GT path where the authors can see the pre-existing literature, findings and theories as benefits rather than barriers in the research process. From this perspective, undiscovered knowledge gaps become more apparent and definable. Concurrent, GT researchers can take a more critical and reflective stance towards the research problem by remaining sensitive to differences in the existing data (Thornberg & Keane, 2022).

Informed GT is based on the rational ideology of abduction which being most suitable with constructivist GT (Charmaz, 2014). As this paper is formed and performed through Charmaz's GT, the literature review likewise follows the constructivist approach. The literature review process

started with an initial review of published research papers to become familiar with the research domain within the shipping industry and define the existing knowledge gap, in this case regarding significant works in WPT for ships. Charmaz (2014) acknowledges that in constructivist GT, previous literature is used as a comparative method along all stages of research showing how the developed theory provides extensions and challenges to predominant ideas in the field. Furthermore, prior theories and concepts are to be treated as partial and temporary perspectives and not as factual truths (Thornberg & Keane, 2022). Accordingly, this thesis has created the literature review dynamically along the research process and moulded against published written matter.

2.2 Shipping industry with wind propulsion

The maritime industry has experienced three important paradigm shifts, starting with the transition from sailing ships to steam and coal vessels, followed by diesel engines taking over with fossil fuels to the current situation of considering sustainable renewable propulsion options (International Chamber of Shipping, 2021). In hindsight, all cargo merchant vessels were once propelled by wind power before the arrival of steam and diesel engines (Mander, 2017). Historically, the first signs of shipping activities can be traced all the way back to the third century (Di Fonzo & Llamas Costas Paris, 2018). Changes started to occur at the beginning of the 1800s when the first shipping revolution began gradually transitioning the industry away from wind as a main propulsion system (Geels, 2002). Now, the environmental policy pressures and increased fuel prices have made some scholars to wonder if harnessing wind could be a solution for the 4th propulsive revolution to the industry, and be a competitive option to other alternative energy systems (Julià et al., 2020; Smith et al., 2013).

The multi-level perspective (MLP) refined by Geels (2002) has gained significant research interest for understanding the changes in the shipping industry. The longitudinal case-study on technological transitions (TT) by Geels (2002) sees technological niches, formerly diesel engines and now WPT having to penetrate sociotechnological regimes, such as infrastructure, markets and financial networks, in order to create changes in the landscape. Therefore, in order for a technology to be accepted by society, dynamic changes must happen on micro (novel configurations), meso

(regimes) and macro (landscape) levels hence the MLP (Stalmokaite et al., 2022). Following this study, scholars argue that decarbonising the industry with wind power is predicted to offer a similar type of industry reconfiguration when a new paradigm shift happens again (Karlsen et al., 2019).

TT developments in other sectors, like the automobile industry, have similar developmental characteristics of altering the surrounding environment (Geels, 2005). However, there are several barriers in the MLP framework which are unique to the shipping industry, such as variety in vessel operations, relationships of transnational partnerships and naturally the decarbonisation efforts (Ghaforian Masodzadeh et al., 2022). The hurdles relating to WPT inspired other authors to research more on the landscape impacts the technology could have. For example, Chica et al. (2023), Karlsen et al. (2019) and Köhler (2020) papers use agent-based modelling for qualitative assessment on barriers in the shipping sector for the expansion of wind propulsion.

Karlsen et al. (2019) findings found that WPT could be encouraged with setting carbon pricing policies for existing vessels and also introducing global speed limits to diminish excess pollution. The above finding is consistent with the study by Psaraftis (2019) on creating a carbon policy, like a market-based emission tax, but in contrast, the energy efficiency of ships would hardly be improved with speed limits as it could potentially distort competition by creating an unfair advantage between ship types. In addition, other papers detected that applying a carbon levy would increase fuel prices and thus make WPT a more favourable option. Nevertheless, for other ships to compete in the industry, slow steaming would be applied meaning ships would slow down the speed to cut down fuel consumption (Mander, 2017; Tillig et al., 2020). Therefore, first adopters will have to accept slower speeds to tackle the limitation of power and develop new operational arrangements without a wind-supported structure (Köhler, 2020). Furthermore, there are more analytically oriented papers which conclude that using optimising tools and mathematical simulation models on ships can improve energy efficiency with WPT (Chou et al., 2021; Thies & Ringsberg, 2022).

Still wind propulsion research is expressing, that as a solution to decarbonising the industry, the technology while appreciated is not enough by itself to create massive changes in the landscape (Chou et al., 2021). This finding follows the MLP framework stating there is no one cause for a shift but rather several reinforced processes happening across many dimensions at the same time which is known as circular causality (Geels, 2005). Correspondingly, researchers see that changes

in the maritime industry can be approached through two types of environmental thinking: ecomodernism (reducing emissions through innovation) and degrowth (lowering levels of consumption as a society) (De Beukelaer, 2021). In addition, it was deemed that WPT can be the solution to both perspectives, and thus a way to achieve the emission targets set by the IMO (De Beukelaer, 2021).

2.3 Operational considerations with WPT

Existing literature has identified extensively both operational barriers (Mander, 2017; Rehmatulla et al., 2017; Rojon & Diepernik, 2014) and opportunities (Ghaforian Masodzadeh et al., 2022; Perez et al., 2021; Stalmokaite et al., 2022) when it comes to adopting WPT. Based on existing research, like other alternative fuel options, there are a substantial number of uncertainties with wind propulsion relating to the regulatory framework, the commercial feasibility and the variability of technologies which first adopters need to consider. Firstly, due to wind-powered sea trials being in the early testing stages and with a limited number of existing demonstrators in the water, there is a high degree of uncertainty on what the future infrastructure related to wind will look like (Chica et al., 2023). And according to scholars, the lack of infrastructure around wind represents challenges for future regulations, since the IMO, institutions and sovereign states face pressure to set stricter decarbonising targets (Köhler, 2020). These regulatory-level actors are expected to play a decisive role for the future WPT uptake (Chou et al., 2020).

Researchers have found that certain nautical regions, for example the North Atlantic trade routes, have more favourable wind conditions than any other area suggesting the industry might face substantial challenges of adopting WPT on a global level (Seddiek & Ammar, 2021). Paakkari et al. (2022) share similar results with their weather routing simulations. On the contrary, the findings also suggest that harnessing predictable winds is possible with adequate voyage optimisation, thus limiting the ambiguity of fuel savings and emissions reduction (Paakkari et al., 2022). This links closely with fuel usage as it is harder to predict and generalise to a wider market the exact savings incurred with a diverse portfolio offer of ships (Rehmatulla et al., 2017; Zhang et al., 2021). The shipping industry's incompetency to lower the uncertainty of how much fuel can be saved with wind accelerates further the ambiguous planning for fuel consumption as Andersson et al. (2015)

study points out that the cost of sailing or fuelling depends strongly on the chosen speed of the vessel. In contrast, there are a range of results from research of simulations studies which have established if taking speed, vessel design, season and route, all into account, fuel savings can be achieved by between 10-60% (Talluri et al., 2018; Seddiek & Ammar, 2021).

Further, other scholars have concluded that wind propulsion as a sole energy system on a vessel cannot endure routes with tight schedules since it requires flexibility with arrival and journey times (Thies & Ringsberg, 2022). Furthermore, a study on assessing the commercial feasibility of wind technologies found that the shipping industry will not successfully achieve the emission targets set for the year 2050 with WPT alone; even with alternative fuels on board, they may not generate the most optimal results with the current energy efficiency measures in place (Chou et al., 2021).

Ship owners often choose the technologies or propulsive systems closest to their practices (Köhler, 2020). Furthermore, the heterogeneity of the shipping industry and its broad selection of ship types are established impediments making it adversely more challenging to adopt wind processes (Karlsen et al., 2019; Pantuso et al., 2016). Another dimension of complexity comes from the many different forms of WPT, as today there are 30 different wind-oriented technologies spread out to eight different categories: Flettner rotors, traditional soft sails, DynaRig systems, hard sails, kites, suction wings, turbines and hull-form wings (Allwright, 2018). As of today, prototype vessels which are pursuing full wind-powered propulsion systems are mostly considering soft and hard sails (Pantuso et al., 2016). Among the categories, first adopters have an additional set of practical and economic considerations, such as manoeuvrability, height restrictions and installation costs, which need to be evaluated against their needs (Thies & Fakiolas, 2022).

2.4 Undiscovered territory as a first adopter

It has been suggested that merchant ships can operationally last around 25 years, meaning the turnover of shipping fleet is slow, and the speed of replacing vessels depends on the current market demands (Pantuso et al., 2016). Existing research estimates that approximately 80% of the cargo carrying vessels in service today are still likely to be in service in the next decade (Pålsson, 2020). Therefore, according to Stalmokaite et al. (2022) the decisions made by shipping companies now

can have a lasting impact on the industry's direction, especially when it comes to choosing a fitting decarbonisation pathway, and whether to invest in WPT or not. Studies suggest installing WPT on board has substantially higher payback-time costs compared to other renewable energy sources, which can be a decisive factor when considering vessels' lifespans to the return on investment (Thies & Fakiolas, 2022). Scholars have based the economic barrier on the current shipping attitudes as liquidity is higher valued than profitability creating a shortage of financial means for WPT (Rojon & Dieperink, 2014).

In an attempt to create more trust around wind propulsion, an organisation was created in 2014 called the International Wind Ship Association (IWSA) which scholars believe can push for global WPT adoption (Allwright, 2018). Furthermore, complexities relating to supply chain (SC) disruptions, rising economic costs, geographic conditions among other business-impacting challenges can impact decisions of adopting WPT (Almasi et al., 2022). Scholars found that when first adopters share insights with different technology requirements, there is a higher chance of convincing more actors to join wind propulsion and provide shared learnings of the barriers they have faced while entering the new market (Karlsen et al., 2019).

In accordance, some previous literature identified two dominating strategies for shipping companies to address the uneasiness of not knowing the future of shipping (Almasi et al., 2022; Stalmokaite et al., 2021). The first strategy is called *fit and conform*, in which having *strategic patience* and choosing a wait-and-see approach is more appropriate than taking any active action which could potentially lead to severe consequences considering all the uncertainties (Stalmokaite et al., 2022). The second strategy is aiming for green premium with a substantial competitive advantage when estimating if green fuels will be in short supply in the future (Almasi et al., 2022). Based on the literature, the first approach has been more in favour due to shipping companies not wanting to take unnecessary risks which could lead to market failure (Talluri et al., 2018). On the contrary, the second strategy can be deemed to be beneficial if categorising wind as a free energy source with an unlimited supply of it against current fuel volatilities (Perez et al., 2021). However, choosing either of the strategies will not place first adopters of WPT in a superior situation as the uncertainties still overpower the practicality and feasibility of the technology that the state-of-the-art research shows (Ghaforian Masodzadeh et al., 2022).

2.5 SC theories in WPT

Since the current study scope covers a substantial part of the shipping industry which in turn maintains an integral part of global supply chain management, it is natural to evaluate the fit of existing theoretical approaches with the research's aim. In SC studies, there are four dominating organisational theories which have proven useful in explaining structural and management problems of SC: principal-agent theory (PAT), transaction cost analysis (TCA), network theory (NT) and resource-based view (RBV) Halldórsson et al., 2007). These middle-range theories touch upon areas of conflictual interests among different entities (PAT), outsourcing prospects within corporate boundaries (TCA), cooperative partnership possibilities between firms (NT), and competitive advantage through resources, as well as capabilities (RBV) (Halldórsson et al., 2007). However, when looking into literature covering WPT or other renewable energy solutions in the maritime industry, there is a lack of representation of the established theoretical approaches that prevail in SC. The reasoning behind this lies within the fact that SC, as a research discipline, is evolving and has not fixated on a scientific position, and thus invites the incorporation of other evolutionary theories from other domains to enrich contemporary studies (Halldórsson et al., 2015).

Currently, published papers in SC and logistics are gradually transforming the traditional theoretical frameworks. Nevertheless, the domain is still inherently influenced by the positivist paradigm (Golicic et al., 2005). Generally, research done on the transformation of the shipping industry with newly emerging phenomena, especially with studies on decarbonisation, are struggling to adopt the quantitative theories which frame around analytical and mathematical structures. Simultaneously, the rise of complexity in the operational logistical environment, makes it less agreeable to select quantitative methods (Golicic et al., 2005). Therefore, qualitative methods and case study approaches should be embraced to achieve a deeper level of analysis into contextual information in SC and logistical processes together with respective structures (Selviaridis & Spring, 2007). In terms of building theory in SC, it is on the more limited side. Nonetheless, scholars argue that the creation of more exploratory studies which can generate new SC theories can beneficially broaden the understanding of the real-world sphere of logistical settings (Halldórsson et al., 2015). Furthermore, in order to construct theories in SC, researchers should consider looking into research designs which include action research and GT (Sweeney et al., 2015).

Considering the research problem attempts to understand the factors leading to wind propulsion adoption, RBV (Barney, 1991), and a close complimentary marketing theory, first-mover advantage (FMA) (Lieberman & Montgomery, 1988) could be deemed fitting for establishing the theoretical framework. Both approaches would see WPT as a way to gain an advantage over competitors or existing market share, yet the focus in both theories touch upon companies' internal and external competences, and not so much on the interrelationships of the adopters across and within company borders, and what is the correlation of all the adopting aspects to one another. Furthermore, the concept of emotional engagement to phenomena, such as special events, has been researched before through GT. However, it has been narrowed down to an individual's personal experience (Sorbello & Karsaklian, 2016). Hence, these theories and others alike from SC or logistics would only scratch the surface or address the research problem from one perspective of the underlying phenomenon. Moreover, conducting research with GT would only benefit researchers to fully explore undiscovered research areas without limits (Sweeney et al., 2015).

3. METHODOLOGY

This chapter describes the roadmap of the entire thesis project from a systematic and scientific methodological standpoint. To address the inadequate understanding of the overall phenomenon, this chapter outlines the steps to evaluate, justify and establish an appropriate research philosophy, and methodological approaches for the progress of the research.

3.1 Research design

The selection of research design indicates the significance of different dimensions of the research process and one of those are a deep understanding of *"behaviour and the meaning of that behaviour in its specific social context*" (Bryman, 2016). Since this study is focused on finding driving factors (deep rooted causes) for first adopters, and there is not much research done in this field, therefore, logically the nature of this research is exploratory and qualitative.

This study is based on a GT approach specifically Kathy Charmaz's constructivist GT (Charmaz, 2014). The research design in a GT study compared to other generic models of qualitative research is different from many angles and one of the main differences is that in GT, the theory emerges from the iterative data analysis process (Bryant & Charmaz, 2008).

Since the inception by Glaser and Strauss (Glaser & Strauss, 1967), GT has evolved a lot and throughout the decades of research and academic debates at present GT has four most used versions which are Glaserian GT, Straussian GT, constructivist GT, and situational analysis (SA) (Thornberg & Keane, 2022). This distinction is important to understand and discuss since all these different versions of GT, although coming from the same root, can be distinguished by a divergent philosophical framework and contradictory methodological decree (Kenny & Fourie, 2015). After careful evaluation of all the options and aligning them with the research aim and objective, Charmaz's constructivist GT approach was found the most appropriate among the other options. Justification for this methodological stance will be covered later in this chapter.

A qualitative research design must address some important components of the research such as the theoretical framework, the selection of empirical materials, the concrete questions, the methodological procedures etc. (Flick, 2014). However, research philosophy, methodology and methods are the three most crucial elements that shape a GT research design (Birks & Mills, 2022).

Therefore, the chapter is divided into three main sections; the first one being the methodological stance of the research followed by the research philosophy and finally the methods that helped shape the research.

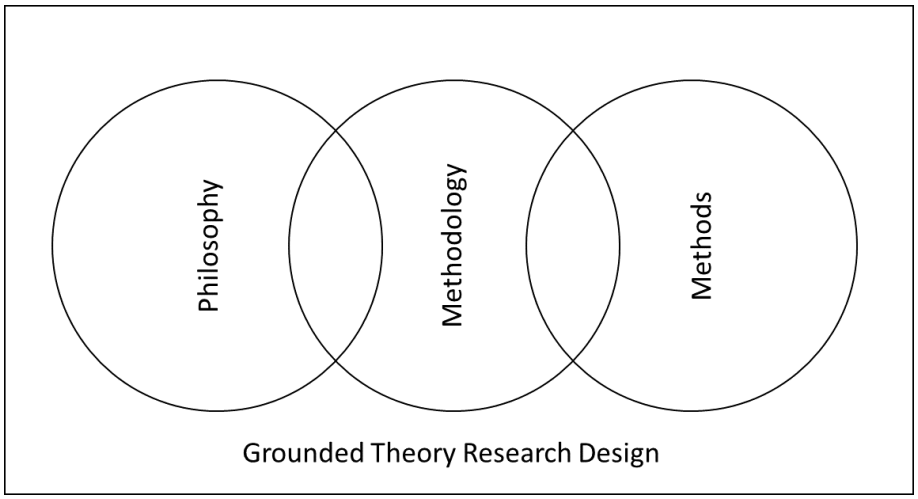

Figure 3.1: GT research design (adapted) (Birks & Mills, 2015)

3.2 Research philosophy

GT is a technique for creating theories to comprehend the worlds that are being studied, as well as a way to learn about them (Charmaz, 2014). From the inception, much debate has been going on regarding the philosophical stances on different versions of GT, especially when it comes to classic GT (Kenny & Fourie, 2015). Glaser considered classic GT to be as a *general method*, and thus detached it from philosophical considerations (Urquhart, 2002). Although Strauss and Corbin associated a GT philosophical view with symbolic interactionism and pragmatism (Strauss & Corbin, 1994), Charmaz argued both Glaserian GT and Straussian GT corresponded to a realist ontology and positivist epistemology (Charmaz, 2000). This differentiation on a GT philosophical standpoint is important for this research on many levels. The research problem of figuring out the factors that are driving the first adopters of WPT might sound like they stem from a realist philosophical point of view, or they are socially constructed. However the goal was to dive deep and understand what is not explicitly said and written by the participants, therefore the notion of an interpretative philosophical ground was more appreciated. Hence, Charmaz's constructivist GT is a more relevant choice for this research in comparison to Glaserian GT and Straussian GT.

3.2.1 Ontology

Based on the argument presented above, the fact is that Charmaz's ontological stance is based on relativism (Charmaz, 2000; Kenny & Fourie, 2015). According to a relativist ontology, the aim of science is to comprehend the subjective experience of reality and different truths (Levers, 2013). Adding to this, the author stretched his views on Charmaz's ontological stance as critical realism (Levers, 2013). Nevertheless, one thing is very clear that ontologically Charmaz constructivist GT is very much in contrast to realism (Charmaz, 2000).

3.2.2 Epistemology

Charmaz introduced relativity and subjectivity into debates of GT's epistemology (Charmaz, 2014). In order to create an interpretative representation of participants' experiences, Charmaz underlined that her epistemological viewpoint clearly supports the researcher and participant's co-construction of knowledge and mutual interpretation of meaning (Charmaz, 2000). Therefore, constructivist GT epistemologically follows subjectivism (Mills et al., 2006). Furthermore, as Charmaz emphasized on the mutual interpretation of meaning and creation of knowledge, Charmaz's GT also indicates towards a relativist epistemological stance (Kenny & Fourie, 2015; Levers, 2013).

3.2.3 The authors' philosophical view

According to Denzin & Lincoln (2005, p.22), *"All research is interpretive; it is guided by the researcher's set of beliefs and feelings about the world and how it should be understood and studied. Some beliefs may be taken for granted, invisible, only assumed, whereas others are highly problematic and controversial"*. As discussed above, Charmaz's "constructivist" point of view allows the researcher to become more involved in construction and interpretation of the data (Charmaz, 2014). That being stated, since there is a lack of existing data and theory available on the subject matter, it was important for the authors in this research to move away from the objective posture and be more participative in generating the data and theory. Especially in the later part of this research, interpretation of the focused coding was very crucial. Therefore, after careful consideration from the ontological and epistemological context, the authors decided to base their philosophical stances on

relativism, and they also believe that studying the first adopters' subjectivist point of view can explain the driving factors in a better way.

3.3 Methodological consideration

When it comes to a formal definition of methodology and method, it is important to understand and to be able to distinguish them (Birks & Mills, 2015). Methods, are techniques or instruments that researchers use for data collection and methodology is concerned with the study of those methods that are used in research (Bryman, 2008). Deriving from the subjectivist epistemological standpoint, this research, which is inductive in nature, and where theory generation is in focus, is naturally inclined towards a qualitative research strategy and fundamentally is different from the quantitative, deductive, and positivistic research strategy. Thus, to create theories from the data itself, GT methodology approaches use systematic yet flexible rules for gathering and interpreting qualitative data (Charmaz, 2014). All these criteria played a logical role for considering GT methodology for this study.

Since there is no predefined theoretical framework in GT research, the authors faced a methodological dilemma while choosing GT. Based on the initial research problem concerning driving factors, first adopters' adoption of wind propulsion, concepts and theories mentioned before were very relevant. However, having those frameworks had the possibilities to limit the extraction of unknown facts from the interviews while pursuing a more realist methodology. Although in the following chapters, some portions of the results might show similarities with the theories mentioned above but the research was completely unbiased methodologically towards any theoretical framework prior to data collection.

3.4 Research methods

Charmaz described GT as a *constellation of methods* (Charmaz, 2014). According to Birks and Mills (2015), important elements (figure 3.2) of GT methods are initial coding and categorization of data, simultaneous data generation and analysis, memo writing, theoretical sampling, comparative analysis based on inductive and abductive reasoning, intermediate coding, identifying

core categories, advance coding and finally integration of theory. The whole process is iterative until the theoretical saturation is met and no new category emerges from the data (Charmaz, 2014).

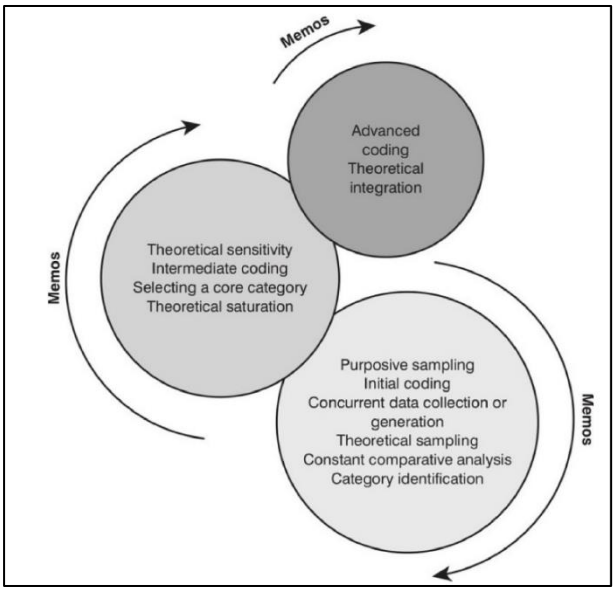

Figure 3.2: GT methods (Birks & Mills, 2015, p. 13)

3.4.1 Sensitising concepts

Starting a GT research with sensitising concepts is a beginning step. And sensitising concepts are the concepts that help the authors with initial ideas about the topic, and allow use of them as tentative tools to move forward in the process to define the data (Charmaz, 2014). Thus, before moving into data collection, sampling, and coding, it was beneficial for the research to establish a general understanding of the maritime shipping industry and wind propulsion technology as sensitising concepts. And as Charmaz mentioned *"if particular sensitizing concepts prove to be irrelevant, then we dispense with them"* (Charmaz, 2014, p. 85). Some concepts were not taken in consideration later since they were out of the scope of the research (adoption of other alternative propulsion systems). Thus, these concepts guided the research further.

3.4.2 Sampling methods

Despite many differences, all grounded theorists confirm that data collection and analysis happen concurrently, and cannot be separated (Morse, 2007). In simpler terms, sampling denotes the technique of selecting the cases from a wider population to make statements of generalisation (Flick, 2014). In GT research Charmaz (2014) mentioned about sensitising concepts as initial ideas to start with. However, for data collection and initial coding until reaching a theoretical saturation point with more conceptualised categories, some sampling techniques are required. This research has been inspired by Morse's (2007) GT sampling method, thus started with convenience sampling followed by purposive sampling and finally theoretical sampling.

- ***Convenience sampling:*** Accessibility is taken into consideration while choosing participants. This sample technique is employed at the start of a project to determine the scope, key elements, and course of the entire process (Morse, 2007). In this research, the access to data was a critical issue due to WPT in the shipping industry being a novelty. Hence, three podcast interviews solely focused on WPT were chosen as the primary data set to begin with. The podcast channel is called "Hoisting the Sail, a supply chain podcast." The interviewees were all first adopters and promoters of WPT, and the interviews were publicly available.

- ***Purposive sampling:*** The departing point from convenience sampling to purposive sampling is that, *"a convenience sample is simply available by chance to the researcher, whereas in purposive sampling the researcher samples with his or her research goals in mind"* (Bryman, 2016, p. 408). Thus, in the first round of sampling, the coding process went on with any kind of wind-related technology and one of the podcast interviews was on Flettner rotor technology (see figure 3.4). However, in the second phase where the sampling was based according to the emerging data and analysis (which was more inclined towards pure wind propulsion), interviews related to other technologies were not included in the sampling process. In this phase the research has 11 more podcast interviews to analyse. Among those, the first five interviews were from the same channel "Hoisting the Sail, a supply chain podcast". Then, the next four were from another

channel called “Listening to the wind”. These were very specially focused on wind propulsion shipping, and the companies that are highly invested in these projects. Finally, the last two interviews were chosen from two different shows, one called, “Shipping Podcast”, and the other one is “The Evolution Show”. Both are highly relevant since the interviewees were from one of the most prominent WPT promoters currently in the world (see table 3.1).

- ***Theoretical sampling:*** In the progression of the data collection, more and more categories were emerging. Although there is a common misconception of reaching numerical significance with sampling, in GT, theoretical sampling is concerned with conceptual categories that emerge in relation to the research interest (Conlon et al., 2020). The following definition can clarify the whole process: *“Theoretical sampling is the process of data collection for generating theory whereby the analyst jointly collects, codes, and analyses his data and decides what data to collect next and where to find them, in order to develop his theory as it emerges. This process of data collection is controlled by the emerging theory”* (Glaser & Strauss, 1967, p. 45).

  Therefore, after analysing 11 podcast interviews in the purposive sampling phase, the theoretical sampling strategy was used to concentrate on emerging categories, and as a method for developing and refining them (Charmaz, 2014).

  And, to do so, six interviewees were chosen strategically to fill out those categories (Conlon et al., 2020). Demographic and other details of these interviews are described in the following section (see table 3.2) of data collection and the analysis and the gradual development of more conceptual codes from theoretical sampling will be discussed in the later chapters.

Podcast interviews [Document analysis]						
Podcast name	**Episode name**	**Interviewee**	**Company**	**Role**	**Interview date**	**Length**
Hoisting the Sail, a supply chain podcast	Orcelle Wind	Roger Stevens	Wallenius Wilhelmsen	Vice President Global Sustainability	31/01/2021	36:02:00
Hoisting the Sail, a supply chain podcast	Grain de Sail	Stefan Gallard	Grain de Sail	Marketing director	14/04/2021	27:00:00
Hoisting the Sail, a supply chain podcast	Fair Winds!	Gavin Allwright	International Wind Ship Association (IWSA)	Secretary General	21/04/2021	37:08:00
Hoisting the Sail, a supply chain podcast	SailCargo Inc	Danielle Doggett	SailCargo Inc	CEO & Co-founder	11/09/2021	25:57:00
Hoisting the Sail, a supply chain podcast	A slam dunk for the sailing ships	Dr Sergio Perez	US Merchant Marine Academy	Professor of marine engineering	18/10/2021	21:47:00
Hoisting the Sail, a supply chain podcast	Blue Observer	Amadeus Beaujolin	Blue Observer	Director of development	09/02/2022	31:52:00
Hoisting the Sail, a supply chain podcast	Discover Aloft	Miles Keeney-Ritchie Satchel Douglas	ALOFT	Founders	02/07/2022	36:06:00
Listening to the Wind	Interview with Wallenius Marine	Per Tunell	Wallenius Marine	COO & future CEO of Alfalaval Oceanbird	06/10/2021	45:17:00
Listening to the Wind	Interview with SAILCARGO Inc	Danielle Doggett	SailCargo Inc & Veer	CEO & Co-founder	30/03/2022	45:11:00
Listening to the Wind	Interview with AYRO	Marc Van Peteghem	AYRO	Yacht Designer, Owner of VPLP & Chairman	07/04/2022	52:42:00
Listening to the Wind	Interview with Zéphyr & Borée	Amaury Bolvin	Zéphyr & Borée	COO & Co-founder	01/06/2022	44:47:00
Shipping Podcast	202: Wallenius Archives	Niclas Dahl	Oceanbird	Managing director	01/12/2022	30:13:00
The Evolution Show	World's largest sailing ship, future of shipping with Wallenius Marine	Per Tunell	Wallenius Marine	COO	26/05/2020	37:23:00

Table 3.1: Content analysis data on podcast interviews

3.4.3 Data collection

GT employs the data collection techniques that best suit the real research problem and the current data analysis rather than being constrained to any one method (Thornberg & Charmaz, 2014). Some scholars might consider interviewing as the only data collection method for GT research. However, methodological eclecticism in GT is very much evident and it supports the argument of using documents for collecting data (Charmaz, 2014). Ethnography, a very prominent method of data collection in GT, was near to impossible to

implement in this research because there is lack of full-scale demonstrators of WPT and difficulties to get access to first adopters to observe them (Stalmokaite et al., 2022). Therefore, document analysis and interviewing were the best suited data collection methods for this research.

In this research, the data collection process is based on two sources; one is a direct source where the authors actively participated with the interviewee in knowledge construction which is termed here as elicited data, and the other source is analysis of podcast interviews which are termed here as extant data where the research has no hand in shaping the data. These terminologies are based on Charmaz's (2014) emphasis on document analysis in GT research.

- ***Document analysis:*** The first two phases of data collection, which were done through convenience and purposive sampling, were primarily based on podcast interviews (see table 3.1). Confusion may arise on categorising podcast interviews; therefore, this study has considered them as document analysis. By documents, a broad array of contents can be used such as personal documents, official written texts, and visual objects, media outputs, virtual documents etc. (Bryman, 2016). In GT, interviews are not the only way of conducting research and documents in conjunction with interviews might bring better results (Charmaz, 2014). Based on the nature of these podcast interviews these were recorded visual media. However, for coding purposes, the authors transcribed those and considered them as extant documents (Charmaz, 2014; Ralph et al., 2014). However, these interview transcriptions were not just used as a means for data collection, rather carefully evaluated by contextual positioning by having the targeted questions of who, what, when, where, why, and how (Ralph et al., 2014).

- ***Interviews:*** In contrast to document analysis, interviews are on the other side of the spectrum being the elicited form of data. In this research, there are a total of six interviews which were all conducted through theoretical sampling. As Charmaz (2014) mentioned to look for participants who have first-hand knowledge and experience that are the most suitable for the research, all the interviewees are well-

established professionals in the maritime industry (see table 3.2). The interview process chosen for this research was intensive interviewing (Charmaz, 2014). One important point of choosing an intensive interviewing process was to capture the interviewees' (maritime professionals/first-adopters) personal experiences with WPT as *"intensive interviews focus on the research participant's statements about their experience, how they portray this experience, and what it means to them"* (Charmaz, 2014, p. 138). The targeted questions used in the interview guide were broad and open-ended to fill the emerging categories in the process of theoretical sampling. This action of using confrontational questions is based on the fact that investigative interviewing to uncover hidden actions, policies and practices can be done with an intensive interview too (Charmaz, 2014). The interview followed the style of having broader, open-ended questions in the beginning and also some probing questions after to clarify the information further (Collignon & Sternberg, 2020). An interview with open-ended questions can branch out easily and thus, to keep the flow on track within the topic of wind propulsion, an interview guide was maintained throughout the interview process (see appendix 1). The already emerging categories from the document analysis helped in formulating the interview guide.

Intensive open-ended interview				
Name	**Designation in the company**	**Interview date**	**Length**	**Format**
Interviewee 1	Naval architect, project leader	22/08/2022	01:02:50	Online (Zoom)
Interviewee 2	Director	23/01/2023	00:58:28	Online (Zoom)
Interviewee 3	Engineer	13/03/2023	00:33:19	Online (Zoom)
Interviewee 4	Engineer	15/03/2023	00:38:46	Online (Zoom)
Interviewee 5	Sales Director	17/03/2023	00:58:53	Online (Zoom)
Interviewee 6	Founder	20/03/2023	01:10:00	Online (Zoom)

Table 3.2: Interviewee details

3.4.4 Data analysis and coding

Data analysis in GT is an iterative process and going back and forth to the transcripts and the coding is a natural process (Bryman, 2016; Charmaz, 2014). In this study, extracting the raw data from the interview to make transcripts out of them and further coding the data has been a simultaneous process.

- ***Instrument of data analysis:*** The podcast interviews were recorded via an audio recorder and then initially transcribed by an artificial intelligence transcription software Otter.ai. However, the transcriptions were imperfect, so the authors manually corrected the errors by repeatedly listening to the audio files. Once the transcriptions were ready, they were uploaded to qualitative data analysis software NVivo 12 Pro for initial coding. No automatic coding functions were used rather the authors used line-by-line coding techniques (Charmaz, 2014) in the beginning. When the broader codes were emerging from the initial codes, then Microsoft Excel was used to organize all the initial codes in a manageable format to proceed with focused codes.

- ***Coding:*** By definition, *"Coding means naming segments of data with a label that simultaneously categorizes, summarizes, and accounts for each piece of data"* (Charmaz, 2014, p. 235). This research followed Charmaz's (2014) approach of GT coding where there are two phases, the first one being initial coding and the second is focused coding.

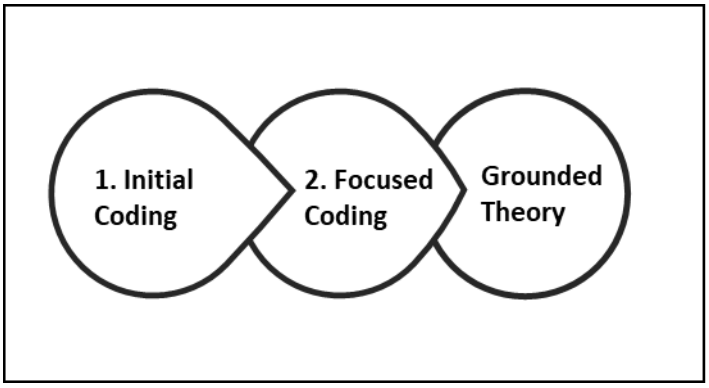

Figure 3.3: Coding procedure of Constructivist GT (Kenny & Fourie, 2015, p. 12)

- ***Initial coding*:** In this first phase of initial coding, the authors coded and recoded the first three interviews three times to align the coding process with Charmaz's (2014) line-by-line coding technique. Since the thesis research is done in a paired group, coding similar interviews and comparing them initially was an essential step for maintaining consistency. Initial codes must stick close to the original data from the transcript and line-by-line coding is a form of that where it is suggested to name each line of the transcribed data (Charmaz, 2014). Coding with gerunds was specifically an important factor since coding with gerunds compared to nouns is a heuristic device used to immerse the researcher in the data, allow interaction with them, and examine each fragment (Charmaz, 2014). Therefore, all the initial codes in this study started with gerunds, portraying an action in a contextual frame, or studied phenomenon. Coding GT is comparative and interactive. Coding each line individually requires the researcher to interact with the data (Charmaz, 2014). And that helped the authors in this study to build a more in-depth contextual knowledge since a big part of the extant data came from transcribed podcast interviews. Numerically for 19 cases, this research had 2182 initial codes.

- ***Focused coding:*** After analysing and comparing 19 total cases including both podcast interviews and intensive interviews, more categories started to emerge from the data. Therefore, to conceptualise them and to analyse them in depth, focused coding was needed. As mentioned before in the first phase of coding there were 2182 initial codes and not all of them were directly relevant for the research. Hence, those initial codes were needed to be examined, sorted, and synthesized and analysed into broader categories to establish strong analytical guidance (Charmaz, 2014). Also, while categorising the focused codes, there were a lot of codes that the authors did not find directly relevant with the research problem, and they were labelled as *spare codes*. However, they were not disregarded immediately, but rather kept in the Excel file for further comparison.

- ***Conceptualisation of the codes:*** In the later phase, theoretical coding was done to further analyse the focused codes coherently and comprehensibly (see appendix 5) (Charmaz, 2014). Furthermore, these theoretical codes helped to theorise the data and the focused codes (Charmaz, 2014). To visualise the interconnection of the theoretical codes and the emerging concepts in a structured manner, the paradigm model (Strauss & Corbin, 1990) was used in the result part. Further, in the process of explaining and analysing the driving factors from a multi-dimensional perspective, the Consequential/Conditional Matrix (Strauss & Corbin, 1998) was applied. Although the coding process followed Charmaz's (2014) techniques, to visually represent the results and to analyse them, the authors adopted the above-mentioned models from Strauss & Corbin (1990, 1998) in their own way.

- ***Memo writing:*** Memo writing is a crucial part in GT research. There are differentiating principles of GT among the classic GT, Straussian GT and Constructivist GT but memo writing and using the memos to analyse the data is one of the unifying factors that all the scholars agreed upon (Kenny & Fourie, 2015). Charmaz (2014) emphasised reflexivity in data and memo writing while maintaining a methodological journal. Memos in relation with diagrams and early phase of representations of frameworks (see appendix 6) were used in this research to guide the analytical and theoretical coding progress since these techniques are also a part of the analysis (Corbin & Strauss, 2015). Memo writing for this research was mainly done in the Nvivo 12 Pro software (see appendix 3). Since the software has a dedicated section where codes and particular sections of the transcripts can be linked as memos the process was easier. Nonetheless, for the interviews, handwritten memos were also used (see appendix 4).

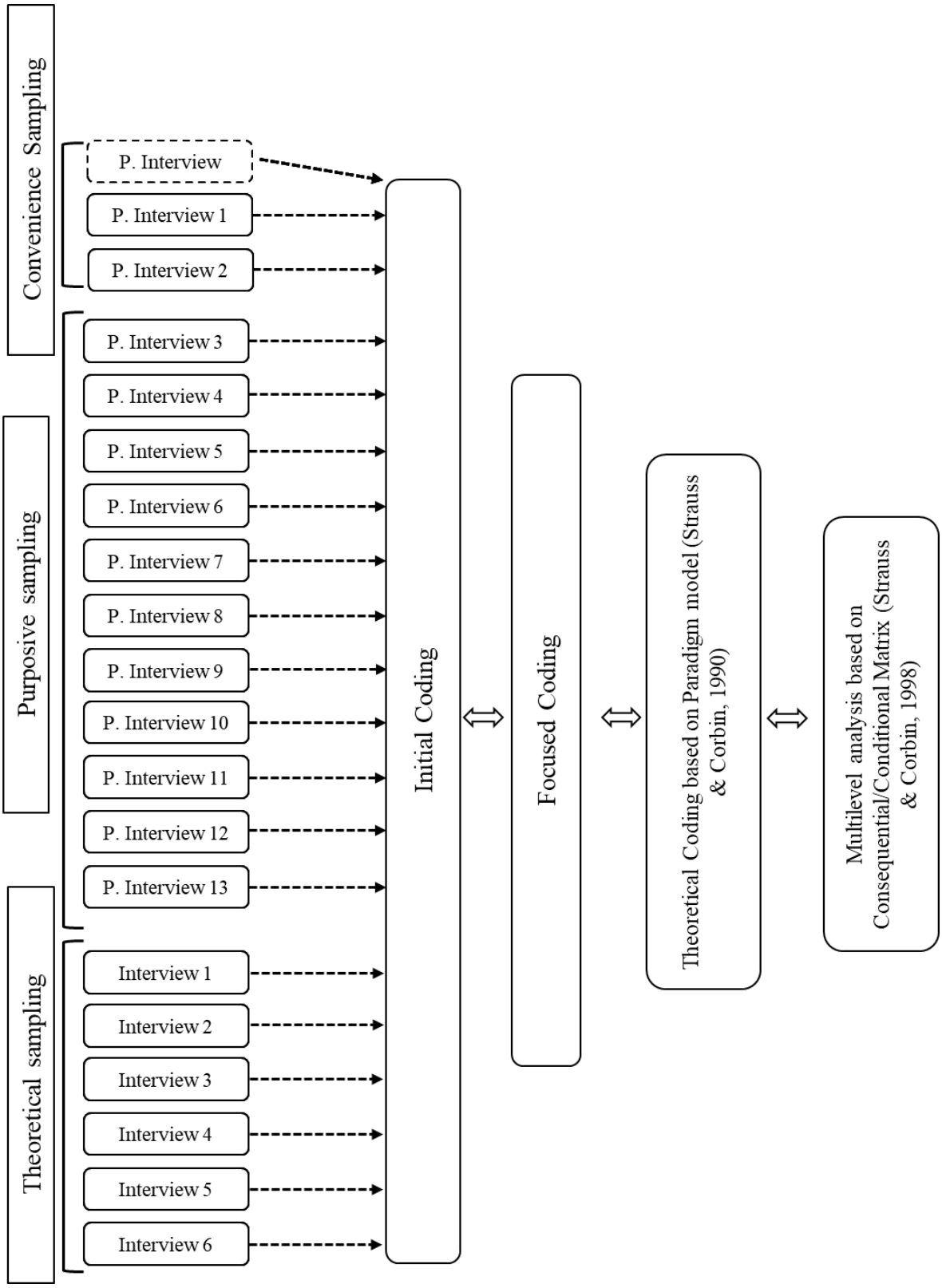

Figure 3.4: Visualisation of the research design; P. Interview denotes podcast interviews

3.5 Data saturation

In any research it is important to understand when to stop collecting new information or data. And, for GT research, the answer lies in theoretical saturation (Thornberg & Charmaz, 2014). "*Theoretical saturation means the saturation of the properties of a theoretical category*" (Charmaz, 2008, p. 13). Intensive theoretical sampling is necessary to reach a theoretical saturation in GT research (Charmaz, 2008). Thus, during the focused coding phase, much care was put into theoretical sensitivity to understand the emerging patterns and to define their distinctive properties in order to create broader conceptual categories (Charmaz, 2014). These broader conceptual categories started showing saturated information and nothing new was emerging from any of the interviews. Therefore, after the 19th case, the authors stopped collecting new data as the theoretical categories were already quite evident from the existing focused codes. As the interviews were based on theoretical sampling, the authors had the focus to cover the industry in a way so that the research problem is addressed fully. Thus, there was very little scope left for new information to appear in a short time.

3.6 Ethical consideration

Based on the four ethical principles of Bryman (2016), this research carefully considered all the ethical aspects; no harm to participants, no lack of informed consent, no invasion of privacy and no deception is involved. Firstly, the participants for the intensive interviews were contacted via LinkedIn or Email and no stress or pressure was imposed upon the agreement of the interviews. Secondly, consent was taken in both a formal and an informal manner from the interviewees. A consent form was sent to the interviewees beforehand (see appendix 2) and, upon the agreement with them, the authors took the Institutional Review Board (IRB) into consideration and European Union GDPR law to maintain anonymity of the participants and not to explicitly mention their workplace and any kind of designation that reveals their identity in the study. Moreover, what can be published and what cannot be published in the paper was discussed during the interview. Finally, the data and the information are presented in the results section as they were extracted from the interviews. The authors have taken careful measures such as being transparent with data sources, quoting with proper references etc., to remain free from any kind of exploitation and deception with the information from the interviewees.

4. RESULTS AND FINDINGS

This chapter illustrates the results and findings from the document analysis and the interviews in an analytical manner. In the process, first the paradigm model has been adopted to explain the interconnectedness of the emerging categories. The extracted data has been carefully evaluated against the elements of the paradigm model and finally, the authors presented a framework based on the results.

4.1 Paradigm model

Based on the theoretical categories in the coding process and few forms of visualised representation of emerging categories (diagramming), the paradigm model framework from Strauss & Corbin (1990) was selected to explain the results section. Since the clarity of interconnection was a bit blurry in the initial diagrams, the paradigm model adopted by authors was deemed a better fit to demonstrate the interrelation among the emerged categories and integrate the data into the theorization process (see figure 4.1). The analysis of the linkage between the categories through the paradigm model takes place based on four distinctive steps that occur simultaneously (Strauss & Corbin, 1990). In this result section, firstly, the authors hypothetically related the subcategories to a broader category to explain the causal conditions, context, intervening conditions, action/interaction strategies, and consequences; secondly, the authors verified the hypothetical relationships with actual extracted data; thirdly, the authors further analysed the properties of the categories; and finally, the authors analysed the dimensional location of the data (Strauss & Corbin, 1990).

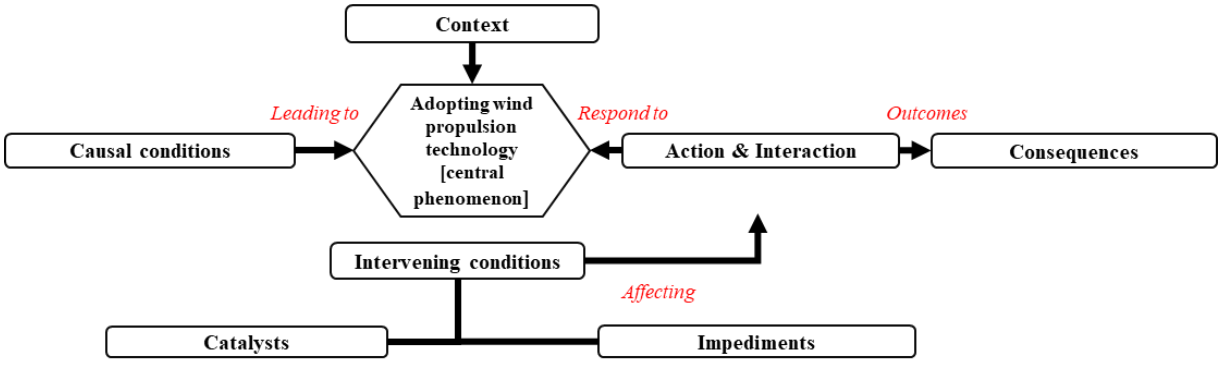

Figure 4.1: Paradigm model adapted from Strauss & Corbin (1990)

4.2 Causal conditions

The starting point for building a theoretical framework can be deemed the causal conditions which are a set of events or circumstances leading to the development of the central phenomenon (Strauss & Corbin, 1990). Causal conditions can be located within the data through asking the questions why, and how in regard to the phenomenon, and the incidents that precede it (Corbin & Strauss, 2015). Through data collection, nine theoretical categories are seen as causing factors for the central phenomenon: (1) establishing regulations, (2) acquiring financial support, (3) conducting research and development (R&D), (4) adapting operational processes, (5) setting ambitious targets, (6) individual background, (7) beaming passion, (8) heritage, and (9) having environmental concerns. Strauss & Corbin (1990) state that phenomena seldom stem from a single causal condition but rather a cluster of conditions, as mirrored in this research, that have varying properties and dimensions of the causes.

Establishing regulations: First adopters recognise that if there are no regulations in place for cutting emissions in shipping, the rate of adopting wind propulsion will be considerably low. The 2018 emission targets of the IMO have made it more compelling for shipping companies to consider wind energy systems. For example, interviewee 5 (table 3.2) discusses that a big motivational factor for their customers is having a regulatory structure (sensitive company information is omitted here for ethical reasons as well in following sections):

> *"I think for our first movers that are **** and ****, they of course have some other motives, but behind that is that they need to find out how they can become compliant."*

Other adopters are persistently demanding stricter regulations be put into place. A very prominent figure from the wind ship world, Gavin Allwright (table 3.1) sees that governing bodies like the IMO should set stricter emission rules, not only for encouraging the uptake of wind solutions but also to place the industry on a clearer decarbonisation path:

> *"Well, firstly, I mean a carbon tax. So, a price on carbon, a price on pollution. I cannot imagine a single argument that says we shouldn't have that. It absolutely has to be priced into everything that we do. Period. Now when it comes to shipping."*

However, the data shows that the regulatory bodies are deemed conservative while making decisions related to decarbonisation which seems from the first adopters' perspective that they are failing to take adequate actions. Interviewee 6 (table 3.2) relates with this when discussing that the current regulations are not supportive enough for wind solutions:

> *"Now one of the problems was that there was no regulatory driver at this point. EEDI had a weak effect here. So, there was no regulatory driver."*

Amadeus Beaujolin from Blue Observer (table 3.1) conquers with the previous statement from his views when talking about international meetings:

> *"The One Ocean summit major event of this year, we know a lot of those big international meetings have failed to produce concrete results in the past years or even decades."*

Thus, from the results it is evident that, although regulations play a vital role in driving the swift adoption of WPT, there is a need to set stricter regulations.

Acquiring financial support: Data shows that WPT, bears a significant amount of initial research and installations costs, therefore, getting financial support is a necessity. Roger Stevens at Wallenius Wilhemsen (table 3.1) emphasises that being in the maritime industry is already expensive with his question:

> *"What's the fastest way to become a millionaire in shipping...Start out as a billionaire."*

Hence, to be a successful wind-powered ship owner, companies need funds to back operations, and ultimately remain commercially viable. In the Listening to the Wind podcast, Per Tunell (table 3.1) affirms why and how they managed to get financial security of their wind ship project:

> *"It should be commercially feasible, this vessel and the reason for having that as one of the primary objectives is that unless it's commercially feasible, it will never happen...And we went to Trafikverket which is the Swedish Transport Agency authority and asked for some funding... They were happily doing that."*

In line with the research, getting monetary support will cause shipping companies to pursue wind in a greater manner.

Conducting R&D and adapting operations processes: Whether it is building new vessels or modifying existing ones, running R&D processes has contributed largely to wind adoption according to interviewees. Testing design models, incorporating new technologies on board and optimising existing voyage routes are some of the many identified attributes (see appendix 5) of R&D that have improved WPT to a more modern approach than with the traditional sailing ship structures from the past. Niclas Dahl of Oceanbird (table 3.1) recounts how R&D is in a pivotal role in their operations yet is work in progress:

> *"We also done a lot of this testing of both wind tunnel test, have a seven meter long prototype where we've been out sailing with it to understand how the wind behaves and also in between different wings...I think we have come quite far but I'm sure I mean all these technologies since it's quite new we will develop over time, we will learn more and better always."*

Among the ones embracing wind, R&D processes vary depending if the focus is on new builds or improving existing fleet. Adapting infrastructure, speed targets and making sailing efficient are goals of shipping companies who want to alter their existing vessels. Marc Van Peteghem (table 3.1) explains how technology that is ready to be assembled on board adds great benefits:

> *"We have worked on a system that could be adapt on a container vessel which is of course it's not the ideal setup but we managed to find solutions to retrieve the wing sail in pockets and allow all the commercial service to operate without any major change in operation which is very important."*

Confirming to data, without R&D and changes to current operations, the drive for wind propulsion would be almost non-existent. The shipping community sees harvesting wind like any innovative technology needing a robust amount of testing and developing for it to cause mass usage in the future.

Setting ambitious targets: To have wind stand out from other options, setting bold objectives can be a leading cause as seen with Per Tunell's (table 3.1) statement in the Listening to the Wind podcast:

> *"And so we started with formulating the project with the objective of becoming 90% less emission than the best of class vessels of today."*

Shipping companies engaging with wind are enforcing their beliefs and values through their targets, as they want to see change, and become successful with what they are doing; communicating this with ambitious targets might convince others to join the movement. In the data, a common detected feature with these goals are the wind adopters having faith in the future of wind being accepted as a mainstream energy system. For outsiders, these targets can be deemed unattainable, but for first adopters, which were interviewed, they set a clear intent of following through with their actions.

Individual background: Interviewed working professionals end up in the shipping industry often through their training and educational background luring them to wind solutions. The majority of the individuals studied naval architecture or shipping engineering meaning they had sufficient training in vessel operations and marine-related business activities. And, among them, most had done sailing prior to studying the maritime industry as interviewee 4 (table 3.2) reveals how their training led them to their career path:

> *"Since I was a kid I've been out with my parents, they've always had a motorboat but I've always been a bit interested in sailing, been fascinated by it. So when you ask the questions now and I start to ask myself the same I realised as well that it's been a bit present for quite some time in my life in one way or another in the background."*

Others were introduced to wind technologies when studying sustainability or renewable energy domains. These interviewees had concerns for the environment and decided to pursue wind as a way to solve the faced issues. For example, the founders of Grain de Sail (table 3.1) described how their background guided them to wind:

> *"They had worked in a few different industries, the original founders, and especially in off-shore wind farms. So they had already maritime experience working with large scale industrial projects and harnessing the power of the wind as a way to generate carbon friendly power. So this was sort of a next evolution for them in the process of what else can we do with the wind."*

Some came purely from academia, such as Sergio Perez (table 3.1) who is a professor at the US Merchant Marine Academy. A couple of participants were trained in technology and robotics who did not have any significant background in shipping or sailing but gained an interest in wind as they had seen the potential of developing the technology through automated processes.

Beaming passion: One of the strongest causal conditions emerging from data collection is a passion for wind propulsion and its related activities. Being passionate is expressed both up front and indirectly in the interviews and document analysis. In this case, passion takes several forms: taking pride in their actions, thinking idealistically of wind opportunities, driving sustainability as a core fundamental of the companies, and, most importantly, having passion ingrained in who they are as a person (see appendix 5). For instance, Amaury Bolvin from Zéphyr & Borée (table 3.1) briefly mentions the strong enthusiasm steaming from his early life:

> *"I always since my childhood being passionate about sea, and about sail."*

Similarly, in Listening to the Wind podcast, Per Tunell (table 3.1) interprets how he was fixated to wind:

> *"Into wind power, I was born into wind power. I've been sailing there my entire life, windsurfing and kitesurfing. So that's, one of my great hobbies. And that's, you know, I just love to wind."*

Inside companies that are using wind technology, passion can be deemed as a universal shared quality as seen with Blue Observer (table 3.1):

> *"We are saying that sail is a solution. It answers a lot of needs. We are happy to be part of it. And Blue Observer, this is how it started. It's a group of friends that had the passion that had concerns that had the dream also."*

Interviewees further display a strong interest in leadership within the industry since they believe of serving a greater purpose with their impact. Using passion as a captivating attribute can cause outsiders to explore wind propulsion as a potential option in the future.

Heritage: Shipping as an industry has deep societal roots since the first trading routes were founded through merchant sailing ships (Perez et al., 2021). Therefore, many times during interviews, recollections of historical sailing vessels were contrasted to modern wind-powered vessels, from when it was abandoned with its inability to compete with diesel engines, and wishing sailing was brought back to shipping. Interviewees are not saying that society should return entirely to sailing but rather using the old technology with new updates to make it more efficient. Stefan Gallard (table 3.1) discusses how in Grain de Sail they incorporate old proven methods to fit modern sailing requirements:

> *"The sails are using modern, right, they're not old cloth sails, they're using modern composite. So wind turbines, on board hydro generators, three packs of solar panels to generate electricity on board, of course, all of the modern technology on board terms of computers and safety, technology, et cetera. So we call it retro innovation, where we're definitely looking back at some of the tried and proven techniques and harnessing the wind to go over the seas. We've got to do it in a modern way."*

Appealing to shipping heritage and its historical past into the consciousness of the general population is a causal condition for the phenomenon, and first adopters are not even attempting to hide it, as seen with Niclas Dahl's interview (table 3.1):

> *"I think [heritage] goes very much into the heart of people in the shipping industry with really going back to the tradition and so on."*

Having environmental concerns: WPT, the fact that it is seen as a far greener alternative to existing fossil fuels, causes many environmentally conscious people to embrace it for the emission-free benefits. Interview data shows that there is a concern for the future of the planet, both from a

social and environmental perspective, if no changes are made, and interviewees are advocating strongly for removing dependency on fossil fuels. The managing director of Oceanbird (table 3.1) shares his thoughts that being environmentally aware can have an extensive impact on the entire industry:

> *"It's savings on the climate and I truly believe that if you are going to make a shipping revolution...We are driven very much about the sustainability part and that I really like."*

4.3 Context

A context in the paradigm model is the location where the actions-interactions appear, and they are explained through certain conditions, causal and intervening, leading to expected consequences (Strauss & Corbin, 1990). Context is in most cases hard to define as it includes various aspects, situations and meanings that are unique to the central phenomenon and like in this paper four distinctive theoretical categories emerged within context: (1) market differences (Europe vs. World), (2) external decisions, (3) characterising the maritime industry, and (4) wind being free energy. Another level of complexity of context is the exchange of micro and macro conditions that overlap with each other, and it is especially visible within the shipping industry.

Market differences (Europe vs. World): When it comes to pursuing WPT, many adopters acknowledge the discrepancies with the level of adoption, especially between Europe and the rest of the World. The data collection suggests that predominantly strong sailing nations like Sweden, Norway, and France, have most innovation and adoption around wind propulsion. The European wind market gets lot of its support from the European Union offering more visible opportunities for smaller players in the market. An interviewee in the podcast episode *Discover Aloft* (see table 3.1) highlights the European technological adoption compared to the US:

> *"Europe is really different. Europe has a ton of small companies and small ship owners trying out all kinds of different technologies."*

Though other parts of the world, such as the US and Asia are slower with building an infrastructure around wind, the financial support, however, is a greater driving force in the areas. Many interviewees agree that the US is not a big player in the industry, yet US-based banks provide substantially more investment opportunities for shipping companies. This section relates more to the micro dimension of the context as it consists of the many differently operating and competing markets having to synchronise together to make up the industry.

***External decisions**:* An important section emerging through context is the external decisions made in the industry by independent stakeholders. The category is divided based on the interviewees' sentiments towards the decisions, either supporting, or in this case, mainly criticising them. Decisions on regulations has stirred most objection amongst interview participants, like Per Tunell (table 3.1) in the Listening to the Wind, who spoke about his disappointment of set regulations at the time:

> *"I am supportive of strong regulations. And these kinds of revelations will help to push in these directions but I really think that IMO took a bad decision in 2011 or so when around there the EEDI was formed...And I think that was a really bad decision because it's not a very good instrument."*

The IMO's decisions to regulate the emissions in shipping with EEDI, EEXI and CII has been an intense discussion topic with the participants with varying opinions.

Characterising the maritime industry: From a macro perspective, there are three characterisations of the maritime industry (see appendix 5). Firstly, data deduces that the shipping industry is a highly polluting and dirty sector. Danielle Doggett, the co-founder, and CEO of SailCargo Inc. (table 3.1) views the transportation sector in a negative light:

> *"So while I don't need to preach to the choir as many of us know, there are many problems with the shipping industry, from air pollution to sewage discharge oil spills and accidents at sea."*

Being aware of the existing issues in shipping has been a main argument and convincing point for the first adopters of WPT, as they see changes need to happen sooner rather than later. The ever-

growing shipping industry is not foreseen to slow down any time soon, which makes wind supporters, such as Gavin Allwright (table 3.1), more concerned about the current situation:

> *"And if [industry] will grow, then emissions, total emissions will grow in shipping. Pretty much whatever we do operation at the moment."*

The second character, the growing demand for the wind shipping industry, is a direct result of the first one. From data, cargo owners are said to give demand signals for wind options to fight the growth of pollution, thus a big driving factor for wind adopters. And lastly, the third character really displays why substantial changes have not happened in the industry as it is pictured to be quite the conservative market. Interviewee 3 (table 3.2) expresses the conservatism in their own words:

> *"My feeling is that the entire marine industry is very traditional. So every new thing coming into places [faces] a lot of scepticism so we need to get everyone on board to fix it."*

The shipping industry seems to have remained static with changes, which makes the newly introduced wind technologies harder to enter the market. Interviewee 6 (table 3.2) agrees with the previous statement, and suggests the reason for slow adoption of newer technologies is within the regulatory framework:

> *"IMO fundamentally is a safety technical focused organisation. And that means, in its very essence, it is prudent, it's conservative, and it looks if you can't measure it, they won't regulate for it."*

Wind being free energy: A major issue which emerged in the context of WPT, is that first adopters consider wind as a free, accessible, and available energy source. For some wind enthusiasts, it seems non-sensical to not utilise wind as a propulsion system for ships. The benefits of harvesting wind compared to its disadvantages is often backed up with its abundance, as the secretary general of the IWSA points out (table 3.1):

"You know, we really can't be ignoring such an incredibly important energy source, which is uniquely available for shipping, you won't have to compete to get your fair share of wind out at sea."

Thus, in the context, forever supply of wind makes the conditions more favourable for accepting WPT.

4.4 Intervening conditions

Intervening conditions affect the actions or interactions that are taken in response to the central phenomenon. In this thesis, the coding results has demonstrated two types of intervening conditions; catalysts that affect the actions in a positive manner and impediments that hinder the strategies or the process of WPT adoption.

4.4.1 Catalysts

Based on analysed interviews, certain situations facilitate a faster and easier acceptance of WPT, while also reducing the uncertainties that potential wind adopters may encounter. These catalysts affect the taken strategies in adopting WPT (Strauss & Corbin, 1990). The authors identified six major catalysts: (1) gaining public trust, (2) defending with factual data, (3) being opportunistic, (4) planning strategically, (5) avoiding risks and (6) saving fuel.

Gaining public trust: Wind getting positive exposure has aided in building trust around it not only in the public eye but among other fellow adopters. To demonstrate the value in building credibility around wind, interviewee 6 (table 3.2) elaborates its possibilities with a wind-supporting organisation:

*"But **** itself adopted a transparent approach as possible because we understand if the industry doesn't trust us, we've got to build trust. And if they don't trust us, if they think we're trying to hide failures, or dead ends that were developed, that's a, that's a very corrosive, erosional approach."*

Therefore, with gaining trust from others, wind seems more approachable leading to even more positive reaction from the shipping companies.

Defending with factual data: In line with data collection, in order to convince others that wind propulsion is a working technology, it needs to be factually proven. Rational statements serve as a boost towards acting with wind as seen in Marc Van Peteghem's statement (table 3.1):

> *"But one thing is we proved that the system was really performant. We have real data that comes from experience for real science. And we thought that if we could adapt these systems to the maritime industry sector, it could be very interesting."*

The scientific work on examining and combining other technological physical models with wind has been prominently in the background of wind adopters based on interviewee responses. Using that as a justification can accelerate the adoption for wind among other catalysts.

Being opportunistic: When in pursuance of a new innovation such as WPT, seeing opportunities is important to consider according to interviewees. A great deal of opportunities could potentially solve current shipping-related issues, ranging from environmental savings, paying a premium for services to guaranteed delivery times and so on. Interviewee 4 (table 3.2) explains why wind is seen now as a favourable circumstance:

> *"But [wind] is picking up momentum, and we're seeing quite a lot of interests."*

In other words, the shipping community is witnessing change in the industry in terms of visibility, recognition and attitudes towards wind alternatives.

Planning strategically: Creating a roadmap or performing comprehensive strategic planning can speed up processes within the business activities. Per Tunell (table 3.1), in Listening to the Wind, reveals how their planning is essential to get ahead of the competition in the field:

"We of course started working in a structured way to realise that vision, how to get there…That's one and it wasn't actually only one roadmap, but several roadmaps, so a roadmap for operation energy carriers, technology emissions et cetera, et cetera. But also for our competence."

By mapping out the developmental steps, like in the case of Wallenius Marine, there are chances of becoming more aware of the critical points that needed to be addressed. And identifying these crucial points have wind-adopting companies acting at a faster pace than businesses that do not plan strategically in advance.

Avoiding risks: Making rash decisions can result in quickly going out of business as clarified by Roger Stevens (table 3.1):

"We are really doing these evaluations carefully. Because otherwise, you know, you can very quickly, you know, have one glorious half year and then go out of business."

Hence, being aware of potential endangering actions in WPT, can assist many in moving forward in a safer and improved way as data suggests.

Saving fuel: A major identified benefit of wind propulsion is the possibility to save fuel in financial and environmental ways. Sergio Perez (table 3.1) explains how much fuel in fact can be saved with using sails during strong winds in a discussed study:

"Using [strong wind] strategy, they were able to save 85% of the fuel. So burning 50% less fuel this way."

Nowadays, fuel savings are achieved through slow steaming, and wind adopters believe there is a potential double win with using sails with the slowing-down tactic as it could cut the entire fossil fuel dependency with vessels. This trade-off is seen to have placed wind options in a more favourable light and acts as one of the main catalysts to take them up as an energy system.

4.4.2 Impediments

In this thesis, the impediments define the challenges to adopting WPT. Although the research problem is about the driving factors, nonetheless, to have a heuristic view, these challenges are also taken into consideration from the perspective of the first adopters as they mentioned them quite often in the interviews. The authors have categorised the impediments in four major categories: (1) operational and technical challenges, (2) perception challenges, and (3) facing inequalities, and (4) decision-making challenges.

Operational and technical challenges: Technological innovations have been positive resources for the first adopters in most cases. However, since wind propulsion is a new technology, the results show that many companies face some operational and technical challenges while working with it. Per Tunell, (table 3.1) in Listening to the Wind, admitted these technical issues as:

> "*Well, of course there are a lot of difficult technical issues".*

The shipping companies are also concerned with WPT, and how to integrate it in the conventional system. This can play a hindering factor to adopt wind propulsion as Satchel Douglas (see table 3.1) from Discover Aloft expressed:

> *"There's a lot of ship owners who are really concerned about how the technology is going to integrate with the vessel and how that's going to affect their cargo operations, that they've been doing the same thing with very similar looking vessels for a lot of years."*

Furthermore, to address this new technology, finding adequate talent is also a different kind of challenge that has been brought up by many interviewees. One such example given by interviewee 3 (table 3.2):

> *"I also heard it is just hard to find people who are qualified in the right area who have done anything similar and who are keen to work with something new at this moment."*

Perception challenges: The interviewees advocating for WPT have highlighted a specific challenge that primarily concerns end-customers. Such challenges are: lack of end-customer awareness, customers having minimal interest in the product and an in-general perception challenge (see appendix 5), which are not limited to the perception of the technology but also to the current state of shipping. Amadeus Beaujolin showed his concern as follows (table 3.1):

> *"I think no matter how bad the situation is, let's not be too candid. And the situation is dramatic. The urgency is only increasing, people are looking the other way."*

When it comes to WPT, the industry faces perception challenges in the form of scepticism. In one of the interviews, interviewee 3 discussed about industry scepticism (table 3.2):

> *"But then, of course also there is a lot of, I guess, scepticism in the entire industry, because it's not seen as so reliable. As yeah, classic ship is classic vessel in terms of time, and they are withdrawals can be taken and so on."*

Furthermore, perception issues on the environmental pollution was brought up by Marc Van Peteghem (table 3.1):

> *"Well in the context where it's less expensive to pollute than to make any effort there is no solution, because everybody will go for the cheaper solution is so important for them."*

Facing inequalities: From the interviews and the document analysis, the discussion on fairness was addressed in different scenarios and contexts. Especially the conflict of fairness between developed and underdeveloped countries is quite prominent in the data. In giving an example of cruising around in yachts versus poor fishing boats, Gavin Allwright expressed his feelings (table 3.1) as follows:

> *"So, you've got the rich using a free source of energy, and you've got the poor, having to pay, you know, hand over fist for expensive diesel. Not just that, but the contradictions there."*

Apart from this kind of unfairness, there is also inequality while evaluating all types of fuel options together. Gavin once again raised his voice against it (table 3.1):

> *"So, what we're asking for in this open letter is firstly a level playing field, you know, something where all of the fuels all of the sensitive fuels, all of the alternative propulsion systems are analysed and evaluated together without prejudice."*

Decision-making challenges: In the data, the interviewees have always mentioned that the shipping industry is a big and broad industry where there are many stakeholders, therefore making big changes is not always easy. Thus, the industry faces peer pressure, social pressure, payback/commercial issues, and stakeholder issues all the time (see appendix 5). While shipowners are some of the biggest stakeholders in this business, still they are difficult to approach as Miles from Discover Aloft has put it (table 3.1):

> *"The more tricky potential customers to speak to are the shipowners. That's been, frankly, a difficult journey….That kind of uncertainty isn't the way shipowners like to invest."*

From the data, payback issue is substantial in WPT adoption projects as these are usually long-term investments. Danielle Doggett from SailCargo Inc also discussed these challenges in her interview (table 3.1):

> *"…the thing that comes a little bit less naturally or is more of a challenge is making sure that investors are happy, and that everything is paid for and that the clients are paying a price that they can actually pay which is affordable to them and not prohibitive."*

To have discussion more on a broader scope, interviewee 6 shed some light on how a French company faced challenges getting subsidies:

> *"The problem for Neoline was they wanted to keep it in in France, then they couldn't keep it in France, because the high prices and the French government wouldn't subsidise the cost there. So, then they look wider in Europe, and still the EU wouldn't subsidise the costs."*

Thus, the challenges related to stakeholders, pressure from peers are always there which have a negative effect on the adoption process. However, companies have taken different measures to tackle the situations which are discussed in the following sections.

4.5 Actions and interactions

The intervening conditions provoke the actors in the environments to act or respond in developing strategies (Morrow & Smith, 1995). From the document analysis and the interviews, six major theoretical categories of actions appeared from the coding process: (1) engagement, (2) industry partnership, (3) competitive interaction, (4) creating strategies, (5) pushing sustainability agenda, and (6) commitments. These actions towards adopting WPT happen in different levels as Strauss and Corbin (1990) would explain them in terms of macro and micro levels.

Engagement: Engagement is a big category that has emerged from the data. It is a broad term, therefore it needs further explanation. Based on this research, engagement entails new students taking an interest in WPT, growing institutional interest, engaging and attracting potential customers, crew or personnel engagement of the ships, team management, engaging the shipping companies, and attracting new ideas from people related to WPT (see appendix 5). By taking these actions, first adopters are interacting and engaging with more people. People not only from the outside but also from the inside of the industry are getting engaged which may lead to more adoption. And the more engaged the people are the better it is for the industry to grow. Interviewee 3 (table 3.2), shared their vision of how they were engaged with wind propulsion:

> *"Yeah, almost. So, for me personally, I've definitely wanted to work with wind propulsion, after I've been working with that in my whole entire master."*

In addition to that, a first-adopter company in driving WPT has also taken an awarding approach to attract new ideas. Interviewee 1 (table 3.2) shared some insights in this regard:

> *"In addition, we understood that if we should maintain the interest of *** overtime, we said launch something they called the **** award. So, we established a yearly price and a competition among inventors so they could apply for or compete in in the*

competition. And that also brought a lot of ideas and people to the table to help us out on this."

Engaging the shipping companies is also important for the whole maritime industry to adopt a new technology like wind propulsion. To emphasize on that Amaury Bolvin (table 3.1) mentioned:

"So, for that you need long-term contracts and for that you need to build the shippers. The shippers are the key to the development of the industry."

Industry partnership: The theoretical coding suggests that cooperation and making partnerships, having wind-supporting organisations and industry interconnectedness are crucial for adoption of WPT (see appendix 5). Firstly, the focused coding results show that all the first adopters of the WPT are collaborating with different universities or organisations in terms of technological development, branding purposes, sharing resource purposes. Per Tunell, on the podcast episode of World's largest sailing ship, future of shipping with Wallenius Marine (table 3.1), shared his thoughts as follows:

"The research and innovation project that we are running right now, and that's together with SSPA and KTH. It's I mean, we managed to gather the really strong competence around sailing in Sweden."

The results not only show shipping companies collaborating with universities but also collaboration between other industries too. In the interview with Zéphyr & Borée, (table 3.1) Amaury Bolvin emphasized working with industry experts to get the best technology to understand how the technology works as he puts it:

"We went to meet people in the Ocean Race that were doing routing, because we were thinking that if we can route sail ship I mean racing sail ship we can route hybrid sail merchant ship and so we then meet with the DICE engineering and with their software we were able to polar of the ship the statistics of the history, history just when statistics we were able to read the ship on different line and to assess what could be the performance of a wind corporate ship in an industry and size."

Thus, the results indicate that collaborating with expert partners drive the industry of WPT at a faster pace.

Competitive interaction: In the maritime industry, shipping companies were joining more projects, keener to take part in climate conferences, also loving the competition in a positive sense to grow the industry, and in general focusing on the market research for understanding the competitive environment. Interviewee 6 (table 3.2) shared their thoughts on taking part in climate conferences such as COP23:

> *"I think, for also 2017, there was a big conference, we had a COP23, which we actually organised which brought together about 140 key industry people. And it wasn't just focused on wind propulsion, it was focused on decarbonisation, it was the first time that a collection of serious industry players have turned around and said, you know what, we can decarbonize shipping, we've got the tools to do it."*

The fact that interacting with competitors being beneficial which ultimately leads towards adoption of WPT has also emerged from the codes. Interviewee 3 (table 3.2) talked about competitions and how that's beneficial for the industry:

> *"We do interact. I mean, as this wind propulsion industry is very small. I think everyone who is in there is very aware of what is happening around and we follow at least closely everything we can hear from other competitors. And then at such locations, like conferences or so there's interaction going on same as SSPA. You had the wind propulsion day or so last autumn. That's super nice opportunity, I think for everyone. And that brings a benefit to small competitors in the end."*

Creating strategies: In this thesis, the authors have shown some specific strategies which are very much geared towards building and adopting a wind-propulsion-centric system in the shipping industry. Some interesting facts emerged from the results, which illustrate shipping companies adopting a wind-assist system first then moving towards full wind propulsion strategy. Some of

these strategies that appeared from the theoretical coding are hybridisation (retrofitting combined with wind-assistance), starting with wind assistance first, comparing other sustainable industries, evaluating wind options, evaluating energy systems, and coming up with alternative solutions (see appendix 5). In one of the podcast interview episodes "A slam dunk for the sailing ships", Sergio Perez (table 3.1) expressed his thoughts as:

> *"So maybe it's going to have to start with sail-assisted propulsion, where primary method of proportion is an engine, but assisted by sails. So, I think this is probably the best way for things to start."*

Apart from academicians, many professionals also shed some light on this preliminary strategy to adopt WPT on board in a quicker manner. Interviewee 5 (table 3.2) did consider retrofitting wind-assistance technology as a quicker solution to wind propulsion:

> *"Maybe to learn, but if you look at the business case, it's probably better to go for a new build, because there you can do the reinforcements or the hull ship modifications, right from beginning cheaper. So, from that perspective, it's better with the new building. But of course, if you want to learn and get something on board today, it's retrofit."*

Hybridisation has emerged as a big conceptual category in the coding process, which might be a scope for the future research. However, since this research primarily focused on the full wind propulsion adoption, the authors considered "hybridisation" as a strategy to address the central phenomenon and will discuss more about it in the future research direction section.

Pushing Sustainability Agendas: The first adopters of WPT are also found to be pushing their sustainability agendas with their actions and interactions. Some strategies related to this issue emerged as: going emission free and focusing on previous sustainable actions (see appendix 5). Per Tunell of Wallenius Marine (table 3.1), in the Evolution show podcast, supported these results:

> *"We were determined to be able to push the limits and push the sustainability agenda for shipping."*

He further explained their previous sustainable actions as a driving motive for the present-day wind propulsion projects.

> *"We started working in a structured way with sustainability and environmental issues and trying to reduce the environmental impact from our operation already in mid 90s and looked at reducing sulphur emissions reducing NOx emissions. Looking at how can we deal with the ballast water challenge anti-fouling etc."*

In support of the document analysis results, interviewee 1 also advocated for their company (table 3.2):

> *"I must admit that **** were pushing the environmental issues in that respect."*

When it comes to going emission free, the strategies are more towards achieving a full wind propulsion system which is the opposite of what was presented in the previous section as "hybridisation" and some companies are very much aligned towards that action. From the SailCargo Inc podcast interview, Danielle Doggett (table 3.1) focused mostly on their wooden ship and its emission-free nature:

> *"The primary engine of this vessel is her sails and she's a true sailing vessel."*

With Gavin Allwright, in Hoisting the Sail (table 3.1), highly promoted zero emission fuels:

> *"Of course, we need alternative fuels, we need zero emission fuels. Absolutely….So, if we don't make any drastic changes, now, we've got until about 2028. And then we go off a cliff, and we have to go to zero emissions immediately."*

Thus, the results show that, although there are shipping companies and actors who are more vocal about using wind assistance as a starting point, achieving zero emission is still the focal point and should be brought as the main matter of concern.

Commitments: While conceptualising the theoretical codes, it was quite conspicuous from the results that the shipping companies or the first adopters of WPT are asking for long-term commitments from the stakeholders. They are building their companies around smaller missions which lead to bigger visions re-evaluating ideas, and working to turn the ideas into realities (see

appendix 5). Thus, showing commitment was a very crucial finding from the data that may influence the adoption of WPT for many companies in near the future. From the podcast interview with Zéphyr & Borée (table 3.1), Amaury Bolvin highly focused on long-term investments from the investors:

> *"So, like integrated sails in like a competitive scheme we needed to have a long-term transport contract to be able to have this long return on investment…. So, for that you need long-term contracts and for that you need to build the shippers."*

The results show long-term commitments in adopting WPT can have companies re-evaluate their initial ideas. Interviewee 1 (table 3.2) expressed their company's vision of planning and working long-term:

> *"So that and then we came up with the idea that we should have a vision, so we just, we say, we put on the wall, our vision is totally zero emission in 2025. That would be 20 years ahead."*

Therefore, responding to the adoption of WPT the first adopters are driven by long-term commitment.

4.6 Consequences

Actions and interactions taken in response to the central phenomenon will lead to certain consequences (Strauss & Corbin, 1990). The consequences for the actions or strategies taken in response to the adoption of wind propulsion from the data may seem like they are also the causal conditions of WPT which is not denied by the authors as this situation in a paradigm model can occur; *"consequences of action-interaction at one point in time may become part of the conditions in another"* (Strauss & Corbin, 1990, p. 106).

Pioneers in the shipping industry who are pushing the WPT as the consequences of their actions are realising the wind viability through R&D. Per Tunell, in the Evolution show podcast interview (table 3.1) talked about it:

> *"When we looked at the free energy that is around us, we realized quite soon that wind was the most viable option."*

Furthermore, Amaury Bolvin (table 3.1) although admired other options, still found wind being the most viable option:

> *"Nobody's nobody knows what is the best solution. But we can say that wind propulsion is like a solution that is quite a no brainer for us".*

Even though the industry as mentioned before is quite rigid and many stakeholders simply do not want to take risks there, the first adopters are breaking free from these old constrains. In this regard, vice president of global sustainability, Roger Stevens from Wallenius Wilhelmsen (table 3.1), mentioned:

> "*Now, of course, it does require overcoming some well-established conventions and, and joined up thinking".*

These notions from the interviews and from the podcast transcriptions are showing results that pioneers in this industry, although are unsure about the best solution, yet are still motivated to explore the unknown and they are being bold in this regard. Interviewee 6 (table 3.2) explained the opportunities for exploring the new areas of unknowns for the young professionals:

> *"I mean, it's just everything's on the table. Nothing is nothing is sure, you know, what the fuel is going to be in the future, what the designs are going to look like, the hydrodynamics, the aerodynamics, you know, just everything's up for grabs at the moment."*

From the business perspective, taking the initiative before anyone else to expand a company portfolio, and ultimately being a market leader in the segment is the main goal of many companies. Roger Stevens (table 3.1) explained this opportunity as follows:

> *"This is an opportunity to grow market share, if we can find a zero emission solution as competitive in the marketplace, sooner than any of our competitors, those opportunities like that. Now, that's a once in a generation thing. It very much makes sense to us to take the initiative."*

Thus, from understanding the viability of wind propulsion to taking the initiative to adopt it, the consequences of adopting WPT ultimately may lead a first adopter to gain a competitive advantage over another and be a market leader in the industry.

Through the rigorous coding process, theoretical sampling, and from the lens of GT principles, the authors are able to illustrate the findings based on the paradigm model as seen in figure 4.2. The relationships among the components of the paradigm model demonstrates the complexity of understanding WPT adoption as a whole, which includes the driving factors. Therefore, to theorise the findings, the next chapter will analyse the results in-depth and will propose a theoretical framework.

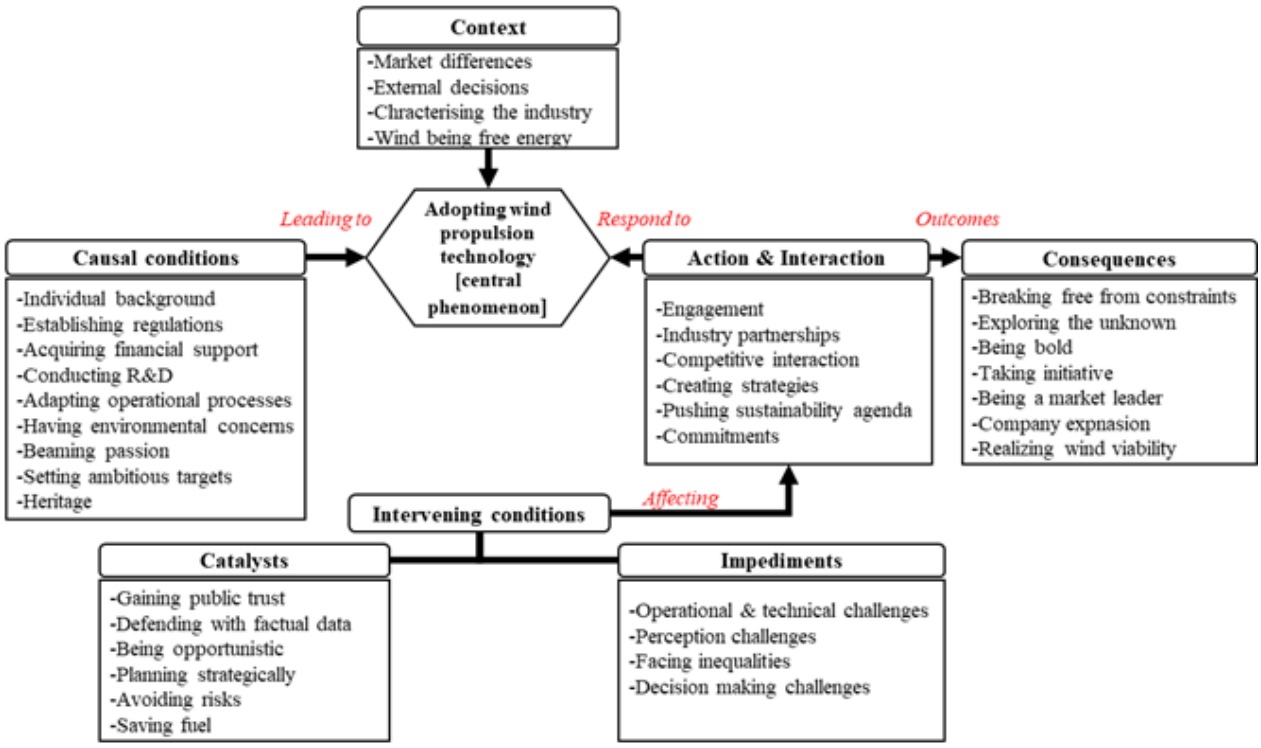

Figure 4.2: Illustration of the paradigm model based on the theoretical coding results

5. ANALYSIS AND DISCUSSION

In the previous chapter, the paradigm model helped to explain the relations among the categories of results. However, since there are different actors involved in the system, it is difficult to discuss and analyse the causal conditions and consequences mentioned in the previous chapter from a single perspective. Hence, to analyse and discuss the factors in this chapter, the authors have used the conditional/consequential (CC) matrix from Strauss and Corbin (1998). Furthermore, a theoretical framework based on the matrix is proposed to demonstrate the driving factors of wind propulsion on three different levels.

5.1 Levels of analysis through the CC Matrix

To make sense of the abstract categories presented in the results through the chosen paradigm, a model framework, the CC matrix is presented to distinguish the different levels of analysis. The causal conditions and consequences described in the findings are the leading factors towards WPT whereas the actions, interactions and intervening conditions are necessary responses to reach there. Therefore, the authors are considering the causal conditions and the consequences from the paradigm model as the main driving factors for the adoption of WPT since they can be interchanged in many situations (Strauss & Corbin, 1990). The actions and intervening conditions are still very much important and part of the process to adopt wind propulsion but do not directly act as driving factors, which the research question is aiming to answer. GT research at its core is a process of analysis, where the phenomenon is evaluated and understood through the matrix with regards to the complex relationships of the conditions, actions and interactions, as well as, consequences in the corresponding interactive nature (Strauss & Corbin, 1990). The matrix can be illustrated in a diagram to assist in seeing the connectivity of theoretical concepts among structural notions and fluid processes (Strauss & Corbin, 1998). Hence, the authors are proposing a theoretical framework based on the CC matrix in order to theorise the studied research phenomenon (see figure 5.1).

The theoretical framework is characterised through a set of parallel and interconnected circles corresponding to different levels of the contextual world, one inside the other (Strauss & Corbin, 1990). The framework in the case of WPT identifies three layers that are a subject of analysis with the actions and interactions connected to the phenomenon located at the most inner part of the

framework. Within each level there are arrows, moving both away and toward the centre of the diagram, depicting the intersection of intervening conditions flowing in a non-linear manner. Each circle has a set of causal conditions interacting to consequences depending on the nature of the level.

The outermost circle is classified as the international level which includes notions of governmental policies, economical structures, environmental issues and globally set regulations, for example the IMO. The middle layer consists of the organisational or institutional level having the structures, rules and barriers of corporations adopting WPT. Lastly, before the central phenomenon, the individual level is attained describing the knowledge, philosophies, experiences and passions of the people pursuing wind. The individual layer in the circle has the most micro perspective on the phenomenon compared to when branching out to the international level covering the macro angles. The following sections will go through each level and discuss how the results are explained through the framework.

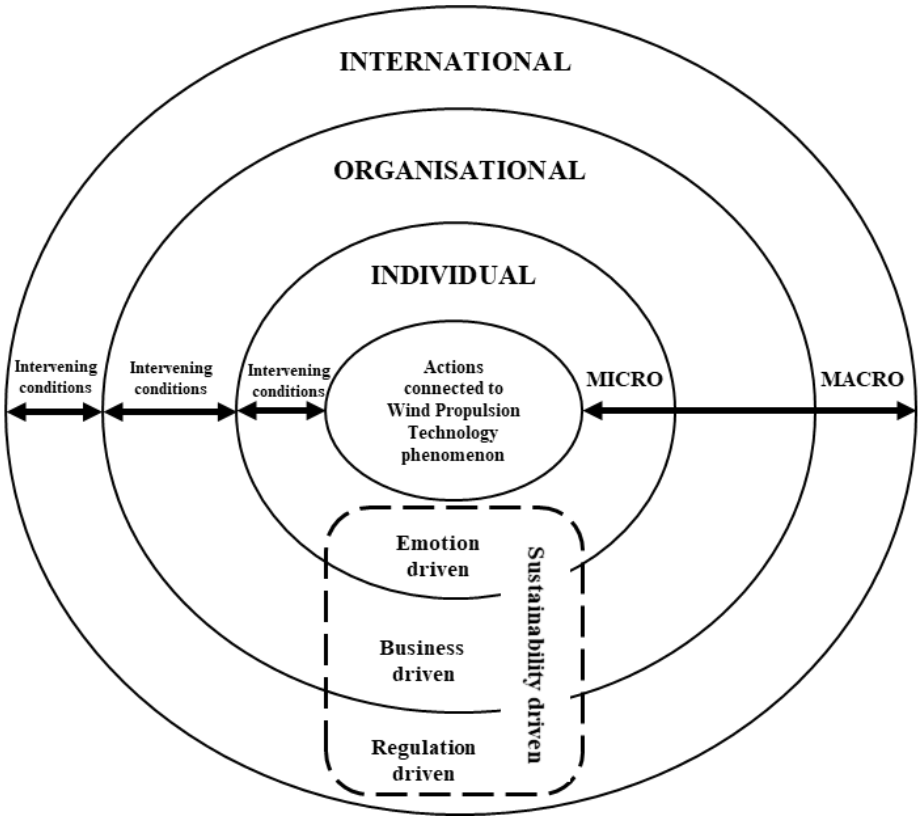

Figure 5.1: Proposed theoretical framework of WPT adoption

5.2 International level

The outer level covers structures and systems that universally impact the operations of the organisations and individuals engaging in the maritime industry. According to results, one of the biggest international-level driving factors for wind is an inclusive regulatory framework. This includes the IMO as the main governing body, and other side-line associations like the IWSA that works to support regulations around wind. Data shows that the uptake for wind would be higher if rules for new incoming innovations like WPT would be eased for it to have a competing chance against not only other green propulsive systems but existing fuel solutions. When specific emission regulations, such as EEDI and CII, were brought up during interviews, the response was largely unified in seeing them having weak influence on their supposed agenda. Existing literature also agrees with issuing stronger and more encouraging regulations for wind to lower the barrier of adoption, since the current policies in place are not strict enough (Rojon & Diepernik, 2014). Simultaneously, these rules have the potential to overcome misinformation on wind and some financial disparities, like split incentives which is a major issue already in shipping, which both scholars (Karlsen et al., 2019) and interview participants can agree on.

However, what seems to be hindering the desired improvements in regulations, is the industry itself which is notoriously known for being conservative as research respondents impose it. There are three identified reasons behind the bold statement: firstly, the set operational characteristics, secondly, global structures in place, and thirdly, lack of alternative demonstrators in the water. The first part addresses the heterogeneity of shipping since depending on which geographic location or market one operates in, there is barely any overlapping, and thus, it is hard to decide on universal regulations when each part of the shipping world is performing differently (Ghaforian Msaodzadeh et al., 2022). Bringing wind into the combination, is just adding another level of complexity for the policymakers in their decision making for the most optimal solutions for the industry. These decisions will ultimately impact the entire maritime fleet, which even now faces difficult choices with renewal paths of the ships to fit current market demands without proper future value estimations (Pantuso et al., 2016).

The second part with analysing the conservatism of the maritime business, is regarding the structural formation of the shipping landscape. Wind can be seen as a technological niche that is trying to penetrate socio-technical regimes, for example the sectoral policies of the IMO, in order

to make permanent change in the landscape developments, and this analogy is in close comparison with Geels' (2002) MLP framework. Thus, the very core issue with the limited push for wind propulsion let alone the ability to make ground-breaking changes in the regulatory dimension is because the niche needs to be accepted by societal networks, and impacting those takes time. This second point leads to the third one which is about the absence of existing wind-powered vessel demonstrators. Since it is established that the shipping industry is built of diverse territories that are all trying to change the infrastructure in their own ways, including WPT supporters, and the guidance of the IMO's global policies, according to results has created an obscure traditional environment with several uncertainties. This, consequently, has led to shipping companies not wanting to take action or unnecessary risks to pursue wind technologies. Previous research finds this situation as a "chicken-and-egg-issue", because actors cannot prove the concept of wind without regulations, and, vice versa, rules will not be changed if there are no existing demonstrators (Rehmatulla et al., 2017, p.223). Hence, stakeholders are waiting and seeing what will happen with the ambiguous future of wind (Almasi et al., 2022), which is the opposite stance to what wind supporters are fighting for with trying to gain more trust around it.

Looking from the international-level lens, another prominent driving factor which is closely tied with the regulatory one, is the environmental concerns. With deep heritage to global trade, shipping has gone through many significant changes and industry-wide transitions across hundreds of years with first carbonating sailing vessels to steam ships to now attempting to decarbonise, for instance with wind propulsion. Although the maritime regulatory foundation, the IMO, is recognised to implement change at a slow pace, it still has placed very ambitious targets to tackle the growing CO_2 emissions. Results see these environmental goals as growing the awareness of the harmful impact shipping has on the planet and as guidance to become compliant to adapt infrastructure. Published papers support this argument since they found the IMO regulations to have sparked interest in new propulsion technologies like wind which can both decrease fuel usage and environmental emissions (Talluri et al., 2016; Talluri et al., 2018).

Shipping companies have been presented with a wide variety of options to choose their future sustainable course, and, as intervening condition results show for WPT, it is vital to create roadmaps that prompt strategic well-thought plans. In the wind community, the choices are between either retrofitting with wind-assisted entities or new builds with pure or hybrid wind

propulsion approaches for sustainable shipping. Therefore, deciding between these strategies comes down to international-level selection criteria, not of course excluding the specific organisational-level ones which are more secluded to each shipping company. But within the global context, results and published papers (Munim et al., 2023) believe that overall infrastructure readiness, possible GHG emission reductions, public acceptance and available funding of a particular wind solution are the worldwide elements that will come into question when selecting the appropriate wind propulsion solution.

5.3 Organisational level

In the theoretical framework, first adopters of wind propulsion have actions and interactions on different levels, however, the organisational level is specifically important because wind propulsion promoters although being individuals, are representatives of shipping companies or some kind of organisations in most cases. Thus, these shipping companies are also considered as first adopters of wind propulsion in this research. Even if each wind propulsion adopting company has their own internal capabilities and procedures in the ways they operate, there is still some level of influence from the external environment.

Starting with the present financial models in shipping, as results demonstrate, having financial support and using commercially proven concepts for wind innovation are not done in isolation outside of the environment, which previous literature agrees on (Mander, 2017). The same is cited by scholars who describe the dynamic capabilities of wind organisations being adapted according to the operational structures (Stalmokaite et al., 2022). These findings also align with the other identified causal conditions, such as having strong R&D and adapting operational processes. Furthermore, being a market leader in the specific segment is also the goal of many organisations. Driven by that motivation, many of them want to take the initiative before anyone else does. They also consider exploring the unknown as part of risk taking and expanding their company portfolio to serve a wider market.

These strategic business choices or, in other ways defined as, organisational driving factors enable companies to pursue WPT, and to analyse these aspects of an organisation, particular theories are

used to explain the phenomenon. Looking through the lenses of the FMA (Lieberman & Montgomery, 1988) and RBV (Barney, 1991) provides a broader insight into why organisations are adopting wind.

When it comes to being the market leader or forerunner in the business, the commercial side is usually in focus. In that context, the FMA is defined *"in terms of the ability of pioneering firms to earn positive economic profits"*. (Lieberman & Montgomery, 1988, p. 41). Therefore, although there are some specific factors found in the results, in a broader sense, the key driving factor in this case is to earn positive economic profits. The three primary sources for first-mover advantages are, technological leadership, pre-emption of scarce assets and buyer switching cost (Lieberman & Montgomery, 1988). In this research, from focused coding and later from the core categories of coding, it is found that all the shipping companies (both in podcast and intensive interviews) explained how they are using technology in their ships. Furthermore, the representatives of those companies (interviewees) have also explained in detail how their R&D on different wind propulsion systems can and will keep them in the frontline compared to their competitors. Previous papers on wind solutions back these claims since the advantage of having a unique technological niche aids in creating a profitable and resilient business model (Allwright, 2018; Thies & Fakiolas, 2022). These notions support the first source of FMA which is technological leadership.

Moving on to the next source which is pre-emption of scarce resources, and this point discusses gaining superior information compared to others and controlling assets that already exists (Lieberman & Montgomery, 1988). Although every wind adopter in the interviews promoted wind as a free and open energy source for everyone, there are many things to consider related to harnessing the power of the wind. In this regard, if the actions of these organisations are analysed, it is also found from the results that they have partnered up with different technology companies for better software design, better routing systems, and for many other technological aspects in order to make their system as effective and efficient as possible. Thus, they are trying to control the already existing asset (wind) in a better way to get superior, accurate and predictive information about the routing which plays a crucial role with optimal wind conditions. These notions of using resources also align with the theory of RBV where the firm's competitive advantage depends on its valuable, rare, inimitable, and non-substitutable resources (Barney, 1991). Although wind is a free energy source, there are many solutions to use it. And the results show no-one really knows

which solution is the best one. Every company has their own R&D team and, according to their research, they have come up with a solution which, in their perspective, is the best one. Thus, from RBV every company in an organisational level is driven by their technological advancement to gain sustained competitive advantage to be the market leader.

Finally, the last source of FMA is buyers switching cost, and first adopters of WPT in the interviews mentioned about working with long-term commitments, gaining trust from the potential customers and people in general, and getting positive exposure through media and word of mouth. Therefore, once the customers are signed up to a long-term contract with the first adopters, then it will be more costly for the late entrants to switch the already committed customers towards their companies. Proceeding in this way, might also mitigate some of the previously confirmed economic barriers in wind shipping regarding split incentives and initial cost of capital (Rehmatulla et al., 2017).

Thus, analysing the data from the results with the previous studies, and supported theories of FMA and RBV, on the organisational level the driving factors are mostly impacted by business gains and commercial viability of the system where the companies aspire to be the market leader. However, apart from the business models, the sustainability agenda of the companies and overall regulatory push from the international level also play crucial roles in the faster adoption process of WPT in the organisational level. As seen in the international context, environmental considerations are shaping the shipping infrastructure which in return has a chain reaction to the organisational level as individual companies are understanding the need to transition to zero carbon solutions.

Relating to the FMA, it is visible that corporations adopting wind solutions, have the possibilities to gain green premiums with undiscovered market opportunities (Almasi et al., 2022). From a business perspective, data and literature shows that wind has possibilities to enhance the energy efficiency intake of existing ships and reduce a significant amount of emissions as well as costs, since dependency on fuel declines (Chou et al., 2021). However, what can be deducted from interviewees' views, is that there are fixed requirements that need to be in place in order to make wind a successful solution from a sustainable view. In other words, it is not enough to build a wind supporting structure to vessels but also consider factors of route optimisation, speed targets and sailing efficiency which are also discovered by scholars in the past (Andersson et al., 2015; Julia et al., 2020; Thies & Ringsberg, 2022).

5.4 Individual level

The innermost circle of the framework is analysed from the most micro level narrowing the possible scope to the phenomenon (Strauss & Corbin, 1998). The results show in an individual level, the driving factors for adopting WPT are more inclined towards some of the causal conditions and consequences such as individual background, beaming passion, environmental concern, heritage and being bold. Although as mentioned previously some of these factors can also be analysed in the other two levels, for example environmental concern, the possible impact of them in the individual level is much narrower.

It has been discussed in the previous chapter that professional and educational background drive people to join a certain industry, and in this case shipping which is geared towards WPT. And, apart from that, a passion for sailing and kayaking also played a big role in the background for them to find the industry more relatable. The result also shows some individuals are highly driven by the heritage of sailing and want to bring it back in a modern way to the shipping industry. These deeply rooted passion and interest for sailing and shipping, work as strong driving factors for adopting WPT in the individual level and are quite abstract to explain through a rigid framework. Hence, in this research, the driving factors in the individual level are analysed through the lens of emotional engagement (Sorbello & Karsaklian, 2016).

The concept of emotional engagement is usually used in the field of marketing and branding studies along with the established theories such as consumer brand engagement (CBE) as there are multi-dimensional decision-making aspects involved in the process (Gambetti et al., 2012). However, since a branding decision-making process is different than adopting a new technology, this research is only focused on the emotional engagement part. When Sorbello and Karsaklian (2016) conducted a GT research on an Italian festival week, emotional engagement and the key findings or proposed framework suggested that, identity, hedonic fulfilment and typicality lead to emotional engagement which have effects on changes in behaviour and some residual effects. The result shows, sailing creates a sense of identity among the people where the interviewees often introduced themselves as “sailors”. Many of them studied naval architecture, marine engineering or sustainable shipping which created a form of identification. On this note, identity is a fluid, contingent concept that is literally achieved through constant interactions and negotiations with other individuals. Thus, in this sense, discussing identification rather than identity could be more appropriate (Buckingham,

2008). This research shows that first adopters of wind propulsion tend to find like-minded people in different situations related to sailing both on a professional level and recreational level. Thus, the dimensions of identity that Sorbello and Karsaklian (2016) has shown which are self, cultural, and social identification aligns with the results of this research. Furthermore, some interviewees took pride in their country of origin and their long relation and heritage to sailing, and these diving factors align with Sorbello and Karsaklian's (2016) typicality dimension. Finally, being bold about any particular passion or sector which, in this case, is pursuing WPT and exploring the unknown in that journey shows the hedonistic side of the first adopters. Stretching this a bit further, being concerned about the environment on an individual level is also a positive side of the hedonic fulfilment.

Although Sorbello and Karsaklian's research (2016) was conducted on the premise of an Italian festival, the involvement of the participants and the result (e.g., leaning towards a specific culture) has similarities with the focus of this study. Emotional engagement is a broad concept and can be used in many disciplines. However, the proposed conceptual framework from Sorbello and Karsaklian (2016) that this research followed had similarities with involving emotional engagement with a specific phenomenon. The results and applicability of this paper's framework convinced the authors that emotional engagement drives people towards wind propulsion in the microenvironment which then goes broader to other levels.

Apart from emotional engagement within the industry, previous literature and the research result also show that some individuals, along with their company philosophy, thrive to pursue WPT with the concept of degrowth while there are contrasting views on that regarding ecomodernism (De Beukelaer, 2021). Specially, in De Beukelaer's (2021) research and in the result of this study, one individual related to sailing company SailCargo proposed the decreased demand of shipping which definitely drove the idea of reducing the ship size for them to make a wooden cargo vessel using WPT. Furthermore, the findings of Köhler (2020) put ship owners in the micro level of the graph and defines that they change their preferences according to the general influence from the landscape, which, in this case, would be the international organisations. This situation explains that international level has an impact on the individual level which transmits to the organisational level. Thus, through the lens of the above-mentioned findings, regulations can drive the adoption of wind propulsion from a micro level, which this study also justifies.

5.5 Discussion on key findings of the analysis

The analysis shows that the driving factors can be fluid in three different levels: individual, organisational and international. The authors compared these three levels from micro to macro conditions. Although the factors can be dynamic in those three levels, the authors identify some factors which have a stronger connection to a specific level.

Looking back at the research aim of understanding what is driving first adopters to WPT, the analysis reveals the critical factors of the phenomenon through a theoretical framework based on the CC matrix. Following the results that are situated in the theoretical framework, four prominent driving factors towards WPT were established: emotional, business, regulatory and sustainability drivers. The identified driving factors showcase the answer to the research question in the study aim. This study contributes to existing literature in the uptake of WPT that have mostly been centred on economic, technological, and structural barriers (Mander, 2017; Rehmatulla et al., 2017).

Firstly, based on the analysis, the theoretical framework proposes that, in the individual level, the first adopters of wind propulsion are mostly driven by their emotional engagement towards the industry. The motivation behind going for WPT is at the most abstract level because of the emotional engagement part. To elaborate on this, factors found in the results, such as individual background, beaming passion, environmental concern, heritage and being bold, are most prominent in the individual level.

Secondly, the analysis also explains that the organisational level plays the biggest role in adopting WPT because the shipping companies, shipyards and many other different stakeholders who have more decision-making capabilities fall under this category. Since big investments are considered, the first adopters in this level are particularly business driven. Commercial viability of the projects and leading the market to gain competitive advantage are main motivations for the actors in this level. Nevertheless, environmental concerns and the push from the international level with the regulations also play important roles here. Thus, the shipping companies who are the first adopters are driven by the factors that ensure economic profitability and market-leading consequences.

Thirdly, the international level, according to the analysis of the results, is predominantly driven by the regulatory factors. International actors, such as the IMO, have crucial roles to play in terms of shipping regulations. Another international organisation, the IWSA has been vocal about using wind propulsion in the shipping industry on a commercial level, and thus trying to promote the regulations that are important for zero emissions. And, for that reason, partnerships and collaborations are being formed on an international level. Therefore, it is quite evident that the international-level actors are mainly driven by regulatory decisions and overall maritime sustainability agendas.

Finally, when comparing the different analytical levels, individual actors' contributions to the new energy system become crucial once they join an organisation that shares the same ambition. However, the regulatory framework in the international level still holds the upmost influence and governance over the activities and individuals under the sphere. And, lastly, apart from those specific driving factors, concern for the environment and sustainability are present in all those three levels, therefore complementing the results of existing literature which have also discussed the importance of sustainable activities to push wind propulsion (De Beukelear, 2021).

6. CONCLUSION

The final chapter of this research demonstrates the conclusion based on the literature review, empirical findings, and the analysis of those findings. The chapter starts with the possible implications of the research findings from a theoretical, managerial, and social perspective followed by quality considerations, critiques and limitations of the methodology. A summary of the research is presented as final remarks. Finally, the chapter describes and gives directions for the future research.

6.1 Research implications

6.1.1 Theoretical implication

As previously mentioned, the lack of an overall theoretical foundation on the subject matter led this research towards a GT approach. However, to justify and analyse the results, several established theories and literature have been used. The use of an emotional engagement concept in describing some parts of the individual-level driving factors can add a new dimension to the much more established marketing theories such as consumer brand engagement (Gambetti et al., 2012). Emotional engagement is a broad concept but the use of this concept in this research opens opportunities to evaluate the concept in more wide scale research for any business model adoption cases. Furthermore, some crucial aspects of the organisational-level driving factors were discussed in relevance to the FMA theory (Lieberman & Montgomery, 1988) and RBV (Barney, 1991) which are usually used in supply chain and logistics research arenas (Selviaridis & Spring, 2007). However, the RBV and FMA theories often focus on the buyer side only, but this research showed examples of partnerships and inter-firm connections to develop the innovation and performance regarding wind propulsion technology (Selviaridis & Spring, 2007). Similarly, the presented theoretical model, CC matrix, offers an alternative approach to viewing technology adoption in an industry to Geels' (2002, 2005) MLP framework. The CC matrix achieved to show that changes, such as in the case of adopting WPT, are more fluid and dynamic between the levels, and can appear from inner to upper levels and vice versa, as opposed to an MLP framework seeing niches moving in a more linear direction. Overall,

the proposed theoretical framework offers to complement existing literature by bridging the identified research gap.

6.1.2 Managerial implication

The managerial implications of this research have the potential to turn this conceptual idea into a big industry soon. Since business and commercial viability are key driving factors for the organisations, the managers should evaluate whether the practical relevance of a proposed business model is important, implementable, non-obvious, novel, and not too costly (Svanberg, 2020). The findings of this thesis may guide the managers in general decision making and in creating strategic business models from a more practical sense. Already, there are approximately 50 commercial vessels (operational and under construction) (RINA, 2023) that have some degree of WPT on board. However, understanding the motives of the first adopters on different levels, is very important to create a new market. The results described that there is a shortage of experienced professionals in this field and, at the same time, a lot of young graduates are showing an interest in joining this industry. Managers need to take these factors into consideration to communicate the right things to the right people and bring the new talents to the industry. Furthermore, to promote and capture engagement around this new technology, it is crucial to understand the customers and also it is important to understand why people are emotionally engaging with this movement (Gambetti et al., 2012; Sorbello & Karsaklian, 2016). Managers should apply the customer brand engagement techniques and strategies based on the results for market creation or brand building around WPT.

6.1.3 Social implication

This research has discussed many social aspects. Firstly, multiple interviewees highlighted the inequality side of the maritime industry. This is often overlooked when it comes to sustainability issues because it is easier for the developed nations to implement newer rules and regulations. However, underdeveloped and developing nations struggle with sustainable fuel options and it is cheaper for them to pollute than to be sustainable. Thus, this research can draw some attention in this regard and help the unprivileged nations with

shipping to some extent. Furthermore, multiple interviewees discussed about creating job opportunities with their projects and providing a better life for the sailors through automation systems in the ships, which help to improve social conditions. Apart from these, growing concerns in the shipping industry for the environment and its sustainability needs have been highlighted in this research. It has ignited the need for more conversation on this topic and possibly can leave an influencing impact on overall maritime policy making.

6.2 Quality consideration

In qualitative research, the quality criteria are not yet settled (Charmaz & Thornberg, 2021), although some criteria from quantitative studies such as validity, reliability, replicability and generalisability are often applied in a qualitative arena (Barbour, 2014). However, given its special characteristics, GT requires a unique set of criteria for assessing the quality of the research (Charmaz & Thornberg, 2021). GT scholars have shared their views on quality criteria differently although they share some common ground; Glaser (1998) suggested four criteria: workability, relevance, fit and relevance. Charmaz (2014) proposed another four criteria which are credibility, originality, resonance and usefulness.

In this research, the documents and the interviews that were analysed and coded following the GT methods led to theorising the data and explain the driving factors of first adopters of WPT. The results of the study clearly fitted with the data (Glaser, 1998) and demonstrated credibility (Charmaz, 2014) and trustworthiness. Furthermore, the empirical findings and conceptualisation of the theoretical categories propose a framework that defines workability (Glaser, 1998) since the theory helps to explain the interconnection between the causal conditions, consequences, and intervening conditions with the adoption of WPT through the lens of existing literature. The exploratory nature of the study and the newfound driving factors on different levels express originality (Charmaz, 2014) of the work. The findings propose further research on each level of the consequential/conditional matrix (Figure 5.1) along with creating business models based on the individual-level driving factors of WPT. This creates a huge opportunity of future research which demonstrates the usefulness (Charmaz, 2014) of the study. In addition to that, the consequential/conditional matrix leaves room for new driving factors to be included which supports

modifiability criteria of Glaser (1998). Finally, the study also shows resonance (Charmaz, 2014) and relevance (Glaser, 1998) by creating the space for the participants to share deeper insight of the subject matter and relate with the phenomenon.

6.3 Critical discussion on methodology and research limitations

Throughout the study and especially in the methodology chapter the authors have justified their stances on GT and its methodological approaches. One of the critical points of this study where the authors adopted Charmaz's (2014) constructivist GT in the data collection and Strauss & Corbin's (1990,1998) frameworks to analyse the data may create some confusion. However, it is not always necessary to adopt the pure form of a GT approach and there is potential for creativity, adaptability, and flexibility while using the chosen GT approach (Kenny & Fourie, 2015). That being stated, the philosophical view of this research is based on subjectivism. Hence, there is always room for the extracted data to be interpreted differently.

Furthermore, the sampling techniques of this study, although they had justification, may not represent the whole wind propulsion shipping community. The authors had to narrow down to specific types of WPT, and there are ample opportunities to study more about the other wind power systems in the future. In addition to that, some podcast interviews are three-four years' old and much development in this field is ongoing. Thus, the dynamic nature of the industry may reflect some different results after the thesis is published.

Finally, due to accessibility limitations in the shipping companies and to their founders, the authors could not opt for any ethnography and had to rely on interviews and document analysis for data collection. The main challenge with the document analysis was certainly the lack of authors' participation in the process but nevertheless the recorded podcast interviews in conjunction with the in-person interviews yielded sufficient information to analyse the phenomenon in depth.

6.4 Final remarks

This thesis intended to understand and interpret the underlying motives of first adopters in pursuing WPT in the maritime industry. Since the industry is actively looking for solutions in becoming more sustainable and transitioning to emission-free fuel options, there are some who are choosing WPT despite identified barriers, and the absence of commercially operating demonstrators in the water. The research problem had limited coverage on published literature. Along with studying the driving factors of wind propulsion adoption, one of the main outcomes of this research is to provide some visibility of wind propulsion systems in the academic world as well as in the industry.

From the methodological point of view, the study adopted a GT approach due to lack of theoretical foundation in the existing literature specially that attempted to explain the research problem of this research. However, the existing literature on the maritime industry and sustainable shipping along with some wind propulsion system analyses were crucial to build up the arguments throughout the research process. In addition to that, a GT approach to understand the driving factors of the first adopters, helped the authors to stay unbiased to the interviewees' opinions and to raise critical questions on the subject matter.

The result of this research shows several factors that are directly driving the first adopters of wind propulsion technology and identifies several intervening factors (catalysts and impediments) that have important roles to play in the process of the adoption. To illustrate the interconnection among those factors, the paradigm model (Strauss & Corbin, 1990) has been used. And, to further analyse those aspects, the CC matrix (Strauss & Corbin, 1998) was implemented.

In the CC matrix, the adoption of WPT was analysed through three different levels of analysis, which are driven by four main driving factors. The study proposed individual level to be emotion driven, organisational level to be business driven, and international level to be regulation driven. However, sustainability driving factors are present on each sphere.

This research conceptualised the whole phenomenon of wind propulsion adoption from a holistic perspective which involves the motives of the first adopters from an individual level to the international level. Thus, this study helps to frame the entire wind propulsion adoption process in

a structured way. A lot of the previous literature talks more about barriers, whereas this study also highlights how WPT can create a new market and business in the upcoming future.

This thesis represents a substantial development in the discipline and a unique examination of WPT. This work closes a significant gap in the literature by using an innovative GT approach and offers previously unobtainable insights into first adopters of wind propulsion. Its pioneering findings contribute to strengthening the existing body of knowledge in this field while establishing the foundation for the future research.

6.5 Future research directions

This thesis proposed a theoretical framework to explain the driving factors for the first adopters of WPT. Although the factors are relevant with previous studies, the framework opened many more doors of opportunity for further research. The maritime industry is a broad field of study and there are endless research areas. This study remained in its scope of research within the adoption of WPT, but the authors considered the future scopes of the findings in the following manner.

Full wind propulsion is still undergoing a lot of testing, and some shipping companies focused on hybrid solutions as a starting point to reach there. Thus, further research on hybrid technologies for ships need to be done which was out of the scope of this thesis.

The authors have witnessed that previous studies in this field are mostly descriptive and not normative in nature. WPT is a fairly new concept and thus many areas are still unexplored. The theoretical framework (figure 5.1) suggests three different levels of first adopters of WPT. For the future studies, each level needs to be analysed in-depth. There are many different types of actors in each level and thus their adoption process of a new technology is also different. This study presented an overall concept of WPT adoption and recommends studying the levels further.

Furthermore, in the organisational level, there is a need for evaluating the profitable business models as well as feasibility analysis of creation-potential markets since economic profitability is a driving factor for the shipping companies. In addition to that, this research analysed data mostly

from European and US companies. But there is a rise in the Asian market with WPT (Allwright, 2018), which needs to be assessed for future market expansion.

Finally, this research has shown that many shipping companies are gradually considering WPT. Therefore, for feasibility and economic viability analysis, there is a need for quantitative research with statistical evidence to approach the investors in a convincing manner on a larger scale.

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APPENDICES

APPENDIX 1. Interview Guide

Opening question

- Do you have any questions before we start this interview and the recording?

Background questions

- Could you introduce yourself and where you are working?
- What kind of background do you have?
- How did you hear about wind propulsion on ships?
- How did you get to work with the company? Tell us about your steps to get where you are today.

Discussing wind propulsion technology

- What are key developments over the last decade(s) for wind propulsion technology?
- What factors determined your company to go for wind propulsion?
- Which aspects have been central for the progress of wind propulsion technology (e.g. individuals, technology, legislation etc.)?
- Do you see or believe companies share something in common with adopting wind propulsion technology?
- What are the current issues you are facing with adopting wind?
- There is a lingering discussion in shipping about approaching a tipping point regarding the emission targets yet legislation and policymakers, for example the IMO have been slow to create changes. Why do you think this is the case?

Evaluating alternative propulsion systems

- If wind power was not deemed viable based on your research or the results you have required, what was the next alternative fuel or energy system you would look into?
- How will your existing fleet deployment change to adopt wind propulsion or accommodate a new network?
- When looking at the industry, there are obviously many changes happening with wind propulsion, some have pursued it and then abandoned it; why do you think they abandoned wind propulsion?
- Has your company considered first adopting wind-assisted solutions? And why?

Closing question

- Where do you see your company in the near future?
- Do you have any questions for us?

APPENDIX 2. Consent Form

Dear interviewee,

We would like to first thank you in advance for participating in this interview and contributing to our master's study. We will give you brief background information on what the thesis research is about. We are trying to understand the reasons behind adopting wind propulsion in the maritime industry. Also, capture why some companies are investing in new vessels with wind-power, and at the same time compare it with other shipping companies who are not investing in wind. This is a short summary of the research.

Shazbah Shafi [Researcher A] &, Sofia Laaksonen [Researcher B] Lund University

I, _____ agree to participate in a thesis study conducted for the Service Management program in the Service Studies department.

The purpose and scientific nature of the study have been explained to me orally and in writing.

I participate voluntarily and I am free to withdraw, without giving any reason and without being penalized or disadvantaged in any way.

I understand that participation includes complete anonymity and my identity will be referred to by code names in the study.

I allow my interview with Researcher A and Researcher B to be recorded.

I understand that excerpts from my interview may be quoted in the study if permission is granted. (Please choose a box)

I allow excerpts from my interview to be quoted [ ]

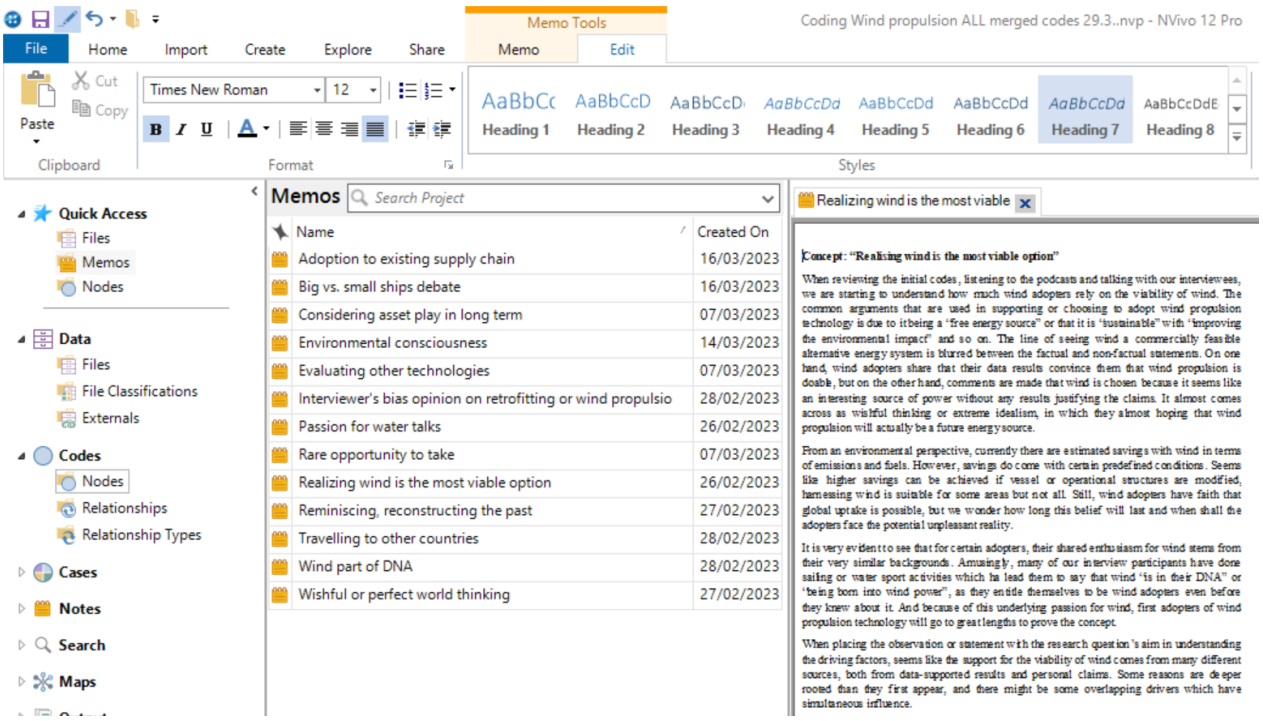
I do NOT allow excerpts from my interview to be quoted [ ]

Signature [interviewee]……. Date:……

Signature [Researcher #A]…..…… Date:……

Signature [Researcher #B]…..…… Date:……

APPENDIX 3. Screenshot of Nvivo Pro Software's Memos



APPENDIX 4. Memo example

February 26th, 2023

Concept: "Realising wind is the most viable option"

When reviewing the initial codes, listening to the podcasts and talking with our interviewees, we are starting to understand how much wind adopters rely on the viability of wind. The common arguments that are used in supporting or choosing to adopt wind propulsion technology is due to it being a "free energy source" or that it is "sustainable" with "improving the environmental impact" and so on. The line of seeing wind as a commercially feasible alternative energy system is blurred between the factual and non-factual statements. On the one hand, wind adopters share that their data results convince them that wind propulsion is doable, but on the other hand, comments are made that wind is chosen because it seems like an interesting source of power without any results justifying the claims. It almost comes across as wishful thinking or extreme idealism, in which they are almost hoping that wind propulsion will actually be a future energy source.

From an environmental perspective, currently there are estimated savings with wind in terms of emissions and fuels. However, savings do come with certain predefined conditions. It seems like higher savings can be achieved if vessel or operational structures are modified; harnessing wind is suitable for some areas but not all. Still, wind adopters have faith that global uptake is possible, but we wonder how long this belief will last and when shall the adopters face the potential unpleasant reality.

It is very evident to see that for certain adopters, their shared enthusiasm for wind stems from their very similar backgrounds. Amusingly, many of our interview participants have done sailing or water sport activities which has led them to say that wind "is in their DNA" or "being born into wind power", as they entitle themselves to be wind adopters even before they knew about it. And because of this underlying passion for wind, first adopters of wind propulsion technology will go to great lengths to prove the concept.

When placing the observation or statement with the research question's aim in understanding the driving factors, it seems like the support for the viability of wind comes from many different sources, both from data-supported results and personal claims. Some reasons are deeper rooted than they first appear, and there might be some overlapping drivers which have simultaneous influence.

APPENDIX 5. Theoretical coding for paradigm model

Causal conditions	leading to	Central phenomenon within	Context		Intervening conditions	affecting	Strategies (action/interactions)		Consequences	outcomes
Regulations (STARTING POINT)	Establishing regulations		*Having operational differences*	Market/Location differences (Europe vs. World) [MACRO]	CATALYSTS/INTERVENING CONDITIONS		*Students engaging in wind*	Engagement	Breaking free from old constrains	Breaking free from old constrains
			Adopting overall differently		*Gaining trust*	Gaining public trust	*Growing institutional interest*			
Getting financial support	Acquiring financial support		*Funding and its processes*		Getting Positive Exposure		*Engaging & Attracting potential customers/people*			
Understanding and establishing financial structures							*Crew/personnel engagement*		Exploring the unknown	Exploring the unknown
Commercial viability being a must					Combining (not) physical models and technology		*Team management*			
			Supporting decisions	External decisions	Justifying with data		*Engaging with shippers*		Being bold	Being bold
Having R&D ready	Conducting R&D		Criticising decisions/perception		Growing shipping industry		Attracting ideas			
Optimizing route conditions					Automating the processes	Defending with factual data			Taking initiative	Taking initiative
New technology/technical knowledge			*Maritime shipping being dirty*	Characterising the maritime industry	Thinking rationally		Cooperation/partnerships			
Testing concept/models			Growing demand in wind shipping		*Academia inputs*		Having wind-supporting organizations	Industry partnerships	Being a forerunner/first adopter	Being a market leader
Expanding knowledge/new learnings			*Industry (BEING CONSERVATIVE)*				Industry interconnectedness		Market-leader	
					Witnessing change	Being opportunistic				
					Seeing opportunities		Joining projects	Interaction from competition	Expanding company portfolio	Company expansion
Adjusting (vessel) structures for wind	Adapting operational processes		Wind being free energy	Wind being free energy			Taking part in climate conferences		*Serving/Contributing to a bigger market*	
Speed targets					*Creating roadmaps*	Planning strategically	Loving competition			
Making sailing efficient					*Creating a lifecycle analysis (SETTING TARGETS)*		*Doing market research*		Realizing wind is more viable [memo]	Realizing wind viability
Adapting infrastructure										
					Avoiding risks	Avoiding risks	*Building all by hand*	Creating strategies		
Environmental consciousness [memo]	Having environmental concerns				*Saving fuel (SETTING TARGETS)*	Saving fuel	*Hybridisation (retrofitting + wind-assistance)*			
Concerns for the future					HINDERING FACTORS/INTERVENING CONDITIONS		*Starting with wind assistance first then wind propulsion*			
Desire to see change in fossil fuel dependency					*Regulations*		Comparing other sustainable industries			
					Failing with actions	Regulatory challenges	Evaluating wind options			
Studying naval architecture/engineering	Individual background				*Regulations (BEING CONSERVATIVE)*		Evaluating energy systems			
Coming from an academia							Coming up with alternative solutions			
Technology & Robotics					*Lack of end-customer awareness*					
Environmental/Sustainability/Renewable energy					*Perception*	Perception challenges	*Pushing the sustainability agenda*	Pushing the sustainability agenda		
Shipping					*Getting minimal interest*		*Going emission free*			
C-suite/Founder							*Previous sustainable actions*			
Sailing					*Operational*	Operational & Technical challenges				
Not having maritime experience/education					*Technical*		*Building a vision*			
Investors' portfolio					*Finding adequate talent*		*Missions*	Commitments		
							Re-evaluating ideas			
					Conflict with fairness	Facing inequalities	Turning ideas to reality			
Passion for wind	Beaming passion						Working long-term			
Passion for water talks [memo]					*Peer-pressure*	Decision making challenges				
Passion for leadership					*Social pressure*					
Passion for sustainability					*Cost/Payback/Commercial issues*					
Passion for wind					*Stakeholder Issues*					
Showing Excitement										
Taking pride										
Showing determination										
Appreciating the work/industry										
Thinking idealistically										
Serving greater purpose										
Having ambitious targets	Setting ambitious targets									
Investing in the values										
Enforcing the belief										
Having faith in the future										
Reminiscing the past [memo]	Heritage									
Heritage										
Pushing for a (wind) shipping revolution										
Historical developments of wind										

APPENDIX 6. Diagramming examples