Master's thesis

NTNU
Norwegian University of Science and Technology
Faculty of Engineering
Department of Mechanical and Industrial Engineering

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Mapping and Analyzing Products Strategies of European Shipbuilders Utilizing an Adaptation of Porters Generic Strategies Model

Master's thesis in Global Manufacturing Management
Supervisor: Marco Semini
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Submission date: 10.06.2023

Preface

This master's thesis is a part of the 2-year international master's degree program in Global Manufacturing Management, specializing in production management, at the Norwegian University of Science and Technology (NTNU) within the Department of Mechanical and Industrial Engineering (MTP).

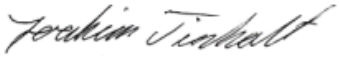
I am deeply grateful to my supervisor, Professor Marco Semini, for his invaluable assistance, feedback, and guidance throughout this process. His contagious passion for shipbuilding has been a constant source of inspiration and motivation.

I would like to extend my sincere appreciation to Per Olaf Brett from Ulstein International AS for his valuable advice.

I am also indebted to my fellow students in room 225, whose camaraderie, support, and sense of humour have made this journey more enjoyable. Their wise counsel, encouragement, and endless stream of bad jokes have helped me stay motivated throughout the process.

Trondheim

10.06.2023



Joakim Høydal Tinholt

Summary

With a rich history spanning centuries, shipbuilding has been a major industry in which Europe has played a pivotal role since its inception. However, the dynamics of the shipbuilding industry are evolving rapidly, highlighting the need for adaptation. Over the years, Europe's market share has experienced a significant decline, plummeting from approximately 50% in the 1950s to a mere 4% in 2023. This decline can be attributed to fierce competition, particularly from Japan, South Korea, and more recently, China. Considering these challenges, it becomes crucial to explore how European shipbuilders can leverage the unique qualities and strengths inherent to Europe to regain competitiveness and prevent further market share loss.

This thesis delves into the product strategies employed by European shipbuilders, aiming to acquire insights and understanding, that can be of importance for shipbuilders to create a competitive advantage. The main goals of the thesis include (1) establishing a suitable framework to map the product strategies of European shipbuilders using open-source data, and (2) to see if any patterns between financial performance and product strategy could be identified.

The literature study concluded that Porters Generic Strategy Model (PGSM) seemed to be a suitable model to map the shipbuilding product strategies, and the axes of the model were defined so that the KPIs could be collected from open-sources to remove the risk of a low response rate from companies to map product strategies of predefined regions.

Data was collected from 93 shipbuilding companies in Europe, and for objective 1, the adapted PGSM proved to be a suitable tool. This is due to the fit of the characteristics of the identified strategies, with established research and observations made during the data collection process. Regarding objective 2, it can be concluded that the product strategy associated with higher financial performance will vary depending on the geographical location, and that following a hybrid strategy generally doesn’t provide a shipbuilding company a competitive advantage. The companies following a hybrid strategy were consistently below the average financial performance independent of region, thus giving legitimacy to Porters “stuck-in the-middle” theory.

The contribution to research from this master thesis includes introduction of an adaptation of PGSM to map product strategies of shipbuilding companies with defined KPIs that can be extracted from open sources, and increased insight into the differences of European shipbuilder’s product strategies. Porters stuck-in-the-middle theory is also supported, which implicates that certain European shipbuilders should aim at creating a more distinct product strategy.

Further research based upon this thesis include more research on European product strategy where the focus should be on a single region/country to limit the implication of demographic differences like labour cost. The inclusion of additional variables is recommended to thoroughly assess the factors that contribute to a company's competitive advantage. Conduct a Systematic Literature Review (SLR) to map the knowledge gaps of European shipbuilder’s product strategies, and its consequent effect on the competitive advantage.

Sammendrag

Med en rik historie som strekker seg over flere århundrer, har skipsbygging vært en betydelig industri der Europa har spilt en sentral rolle siden starten. Imidlertid endres dynamikken i skipsverftsindustrien raskt, og behovet for tilpasning blir stadig tydeligere. I løpet av årene har Europas markedsandel opplevd en betydelig nedgang, fra omtrent 50% på 1950-tallet til kun 4% i 2023. Denne nedgangen kan tilskrives intens konkurranse, spesielt fra Japan, Sør-Korea og mer nylig Kina. I lys av disse utfordringene blir det avgjørende å utforske hvordan europeiske skipsverft kan utnytte de unike kvalitetene og styrkene som finnes i Europa for å gjenvinne konkurransekraft og forhindre ytterligere tap av markedsandel.

Denne avhandlingen dykker ned i produktstrategiene som europeiske skipsverft benytter, med mål om å skaffe innsikt og forståelse som kan være viktig for skipsverft for å skape en konkurransefordel. De viktigste målene for avhandlingen inkluderer å (1) etablere en egnet modell for å kartlegge produktstrategiene til europeiske skipsverft ved hjelp av åpne kilder, og (2) undersøke om det kan identifiseres noen sammenhenger mellom økonomisk ytelse og produktstrategi.

Litteraturstudien konkluderte med at Porters generiske konkurransestrategier virket egnet for å kartlegge produktstrategiene innen skipsbygging, og aksene i matrisen ble definert slik at nøkkelindikatorene kunne samles inn fra åpne kilder for å unngå lav responsrate fra selskaper.

Data ble samlet inn fra 93 skipsbyggingsbedrifter i Europa, og for mål 1 viste den tilpassede konkurransestrategimodellen til Porter seg å være et egnet verktøy, noe som skyldes at den er i tråd med kjennetegnene til identifiserte strategier, som er støttet av etablert forskning og observasjoner som ble gjort under datainnsamlingen. Når det gjelder mål 2, kan det konkluderes med at produktstrategien som er assosiert med høyere økonomisk ytelse, vil variere avhengig av geografisk beliggenhet. Det kan også konkluderes med at en hybrid strategi generelt sett ikke gir et skipsverft en konkurransefordel. Selskapene som følger en hybrid strategi, lå konsekvent under gjennomsnittlig økonomisk ytelse uavhengig av region, og gir dermed legitimitet til Porters "stuck-in-the-middle" teori.

Bidraget til forskningen fra denne masteroppgaven inkluderer introduksjon av en tilpasning av Porters generiske konkurransestrategier for å kartlegge produktstrategiene til skipsverft med definerte KPI-er som kan hentes fra åpne kilder, og økt innsikt i forskjellene i europeiske skipsverfts produktstrategier. Porters "stuck-in-the-middle" teori støttes også, noe som antyder at visse europeiske skipsverft bør sikte mot å skape en mer tydelig produktstrategi.

Videre forskning basert på denne avhandlingen omfatter ytterligere studier av europeisk produktstrategi med fokus på en enkelt region eller et enkelt land for å begrense implikasjonene av demografiske forskjeller som arbeidskostnad. Det anbefales å inkludere flere variabler for å grundig vurdere faktorene som bidrar til et selskaps konkurransefortrinn. Gjennomføring av en systematisk litteraturgjennomgang for å kartlegge kunnskapshullene i europeiske skipsverfts produktstrategier og den påfølgende effekten på konkurransefortrinnet.

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List of Abbreviations

AROA	Average Return on Assets
ROA	Return on Assets
ROE	Return on Equity
P/L	Profit/Loss
GT	Gross Tonnage
CGT	Compensated Gross Tonnage
PGSM	Porters Generic Strategies Model
SME	Small and medium-sized enterprises
CODP	Customer Order Decoupling Point
RQ	Research Question
ETO	Engineer-To-Order
EBITDA	Earnings Before Interest Taxes Depreciation and Amortisation
KPI	Key Performance Indicator
PSV	Platform Support Vessel
AHTS	Anchor Handling Tug Supply
OSV	Offshore Support Vessel
OCV	Offshore Construction Vessel
SOV	Service Operation Vessel
CLV	Cable Laying Vessel
SAR	Search And Rescue

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1. Introduction

The chapters 1.1 and 1.3 is mainly collected from the specialization project (Tinholt, 2022) conducted in the fall semester 2022. This is because the master thesis is a continuance of the findings from the specialization project, with similar background, motivation, and scope.

1.1 Background and Motivation

Shipbuilding is an industry with a rich history spanning centuries, and Europe has been a major player in this industry since its inception. However, the landscape is changing, and which quite evident than in the development of the shipbuilding industry. A good example of this can be found in the contrasting statistical portrayal of regions and building of new vessels (newbuilds) in the "Review of Maritime Transport 1971" (UNCTAD, 1971) compared to the "Review of Maritime Transport 2021" (UNCTAD, 2021) by the United Nations Conference on Trade and Development. In the 1971 statistics, Southern Europe and Eastern Europe were considered separate regions, accounting for 11% of the world's newbuild ships, not including Western and Northern Europe. However, in the 2020 statistics (see table 1), Europe is not even mentioned as a distinct shipbuilding region but rather categorized under "rest of the world." This category represents a mere 5% of the total, with European shipbuilders comprising approximately 4% of this figure. In other words, a significant development has occurred within the European shipbuilding industry. Europe has not been able to stay competitive, especially against Japan, South-Korea and more recently China.

Table 1: Deliveries of newbuildings in gross tons *(UNCTAD, 2021)*

Table 2.7 Deliveries of newbuildings by major vessel types and countries of construction, 2020
(thousand gross tons)

Vessel type	China	Republic of Korea	Japan	Philippines	Rest of the world	Total	Percentage
Bulk carriers	15 051	1 442	9 383	551	311	**26 738**	46
Oil tankers	2 702	7 071	1 901	1	478	**12 152**	21
Container ships	2 665	5 357	394	56	200	**8 671**	15
Gas carriers	869	4 046	353		7	**5 275**	9
Ferries and passenger ships	251	64	76		1 208	**1 600**	3
Chemical tankers	488	88	465		55	**1 095**	2
General cargo	390	1	142		360	**893**	2
Offshore	340	101	7		118	**566**	1
Other	501	4	107		162	**775**	1
Total	**23 257**	**18 174**	**12 827**	**608**	**2 898**	**57 765**	**100**
Percentage	*40*	*31*	*22*	*1*	*5*	***100***	

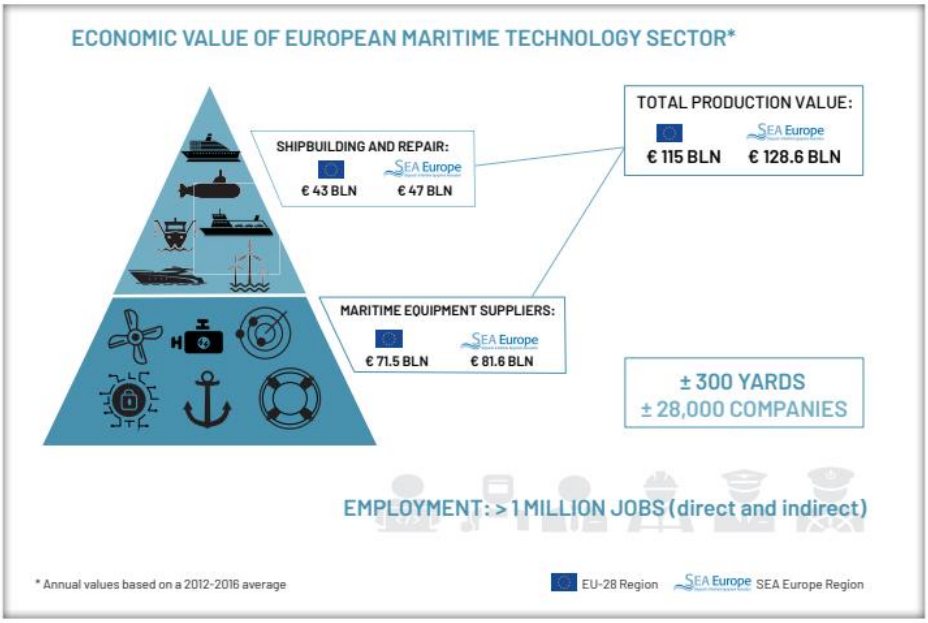
Table 2 provides an idea of how the constallation of major players in the global shipbuilding industry has changed over the years.

Table 2: world shipbuilding market share in terms of construction volume 1955-2010 *(Varela, et al., 2017)*

Ranking	1955	1965	1975	1985	1998	2000	2005	2010
1	Britain (18.3)	Japan (43.9)	Japan (50.1)	Japan (52.3)	Japan (42.0)	South Korea (40.7)	South Korea (35.2)	China (41.1)
2	Norway (14.5)	Sweden (9.6)	Germany (7.1)	South Korea (14.4)	South Korea (28.9)	Japan (39.0)	Japan (28.6)	South Korea (31.3)
3	Ger- many (9.9)	Britain (8.8)	Sweden (6.9)	Germany (3.1)	China (4.8)	Germany (3.3)	China (14.5)	Japan (21.8)
4	France (4.7)	Germany (8.4)	Spain (4.6)	Spain (3.0)	Germany (4.2)	China (3.2)	Germany (3.6)	Philip- pines (1.2)
5	Japan (4.6)	France (3.9)	Britain (3.6)	France (1.1)	Italy (3.2)	Taiwan (2.1)	Poland (2.3)	Romania (0.6)

According to the book “Shipbuilding and ship repair around the world”, todays constellation of major players in the shipbuilding industry with China as the dominant shipbuilding nation, followed by South-Korea and Japan, will stand fast for the foreseeable future (Varela, et al., 2017). Mainly due to the huge costs involved in establishing a modern shipbuilding industry, and it is also stated that especially China will most likely try to seize greater market shares within sophisticated tonnage, thereby potentially threatening the niche of which many European shipbuilding companies have chosen to specialize in. In short, it can be concluded that Europe probably has lost their role as a major player in shipbuilding for the foreseeable future. Still, that does not mean that there is no room for European shipbuilders, and the continent can showcase some unique qualities that can be seen as a competitive advantage. For instance:

- Strong social and economic security (Hoffmann, 2021)
- Minimal inequality (Roser, 2013)
- High degree of climate awareness (EuropeanCommission, 2020)
- Internal market integration (Ratcliff, et al., 2022)
- Major supplier of maritime equipment (see figure 1)



Source: SEA Europe

Figure 1: Economic value of European Maritime Technology sector *(SeaEurope, 2020)*

So how can European shipbuilders capitalize on the qualities and strengths found in Europe to regain some competitiveness, and possibly halt the loosing of market share? This pressing question serves as the primary motivation for conducting this thesis. To address it, a specialization project was first undertaken during the fall semester of 2022. The project aimed to explore potential patterns between strategic factors and profitability, seeking to uncover insights that could guide future research. Notably, the project's findings unveiled promising connections, particularly to product strategy. These findings lay the foundation for the background and focus of this thesis.

1.2 Objectives and Research Questions

The main objectives of this master thesis are twofold: (1) to establish an appropriate model for mapping the product strategies of European shipbuilders using open-source data, and (2) to investigate potential patterns between financial performance and product strategy. In this context, open-source data refers to information accessible through public sources such as financial and maritime databases, as well as company websites. By uncovering patterns between specific product strategies and financial performance, it can be argued whether they indicate a competitive advantage or disadvantage. This could potentially be a valuable addition to the research of European shipbuilders' product strategy and be useful for decision-making related to product strategy. To attain the main objectives, the following two research questions (RQ) were created:

RQ 1: *How can an established model of product strategy be adapted to map the strategies of European shipbuilders using open-source data, and do the characteristics of the mapped strategies fit with established understandings of European shipbuilder's product strategies?*

This will be done by first deciding on a suitable model, that is established in the field of product strategy. The model will then have to be adapted to allow for the collection of key performance indicators (KPIs) from open sources, which will be used to map the product strategies of European shipbuilders. The reason for focusing on open data sources, and not trying to retrieve data from companies, is due to the expected low response rate from the companies and the time constraint of the thesis. Furthermore, the mapped product strategies should align with established understandings of European shipbuilder's product strategies to ensure the model's suitability.

RQ2: *Are there any links between product strategies and financial performance amongst European shipbuilders, that consequently indicates a competitive advantage or disadvantage?*

By using the KPIs used to map European shipbuilder's product strategy as independent variables, and a financial performance metric as a dependent variable, a statistical analysis will be used to determine if there are any potential patterns. The analysis will also take shipbuilder perimeters like size and geographical location into account.

1.3 Scope

For this project, the focus will be exclusively on European shipbuilders involved in the construction of new vessels (newbuilds). Shipbuilders that solely specialize in services, repairs, modifications, or retrofitting will be excluded from this thesis. The thesis will primarily delve into topics related to product strategy and shipbuilding. Given the relatively broad scope of the study, it is essential to structure the research in a manner that effectively addresses the research questions while considering constraints such as time limitations and data accessibility. In this subchapter, the definition of European regions and excluding factors will also be addressed.

1.3.1 European Regions

Due to internal differences in Europe, it is presumed beneficial to divide the continent into regions. There are however several definitions of European regions, but not an accepted definitions that defines European shipbuilding regions where all the countries are included. The established "United Nations geoscheme for Europe" (UNSTAT, 2022) is frequently used for statistical purposes within research applications and is deemed to be fit for the purpose of this thesis. This is based on the assumption that countries within the regions share cultural similarities, and a historic affiliation with the region of which they have been placed. Consequently, it can be assumed that countries within these regions have similar politics, laws, regulations, and industrial environments. However, using the UN geoscheme is associated with uncertainty because it clearly states that their division is not based upon politics (UNSTAT, 2022). This means that for instance countries with beneficial tax arrangements for shipbuilders will not be identified, possibly giving shipbuilders in these regions an unfair advantage.

The reason for not creating distinct shipbuilding regions for this study based upon the laws and regulations of each country that might benefit shipbuilders, and the strategy characteristics of the shipbuilders in these countries, is because of the time restraint related to this thesis. Such a categorization is assumed to be very time consuming to establish because of the amount of data related to laws and regulations needed, and the data needed to identify strategy characteristics of all the European countries. It is also assumed that such shipbuilding regions will be associated with considerable uncertainty, because laws and regulations are ever-changing.

Countries split between Asia and Europe will in its entirety be considered as European for the purpose of this thesis. In addition, it was decided to include Greenland and Cyprus due to their European connections. The division of regions can be seen in figure 2, which are made up of the following countries:

Northern Europe: Norway, Sweden, Denmark, Finland, United Kingdom, Ireland, Iceland, Faroe Islands, Greenland, Estonia, Latvia, and Lithuania.

Western Europe: Germany, Netherlands, Belgium, France, Monaco, Switzerland, Austria, and Liechtenstein.

Southern Europe: Portugal, Spain, Andorra, Italy, Malta, San Marino, Vatican City, Slovenia, Croatia, Bosnia-Herzegovina, Serbia, Kosovo, Montenegro, Albania, North-Macedonia, Greece, Cyprus, and Türkiye.

Eastern Europe: Russia, Poland, Slovakia, Czech Republic, Hungary, Belarus, Ukraine, Bulgaria, Romania, Moldova, Georgia, Azerbaijan, and Kazakhstan.

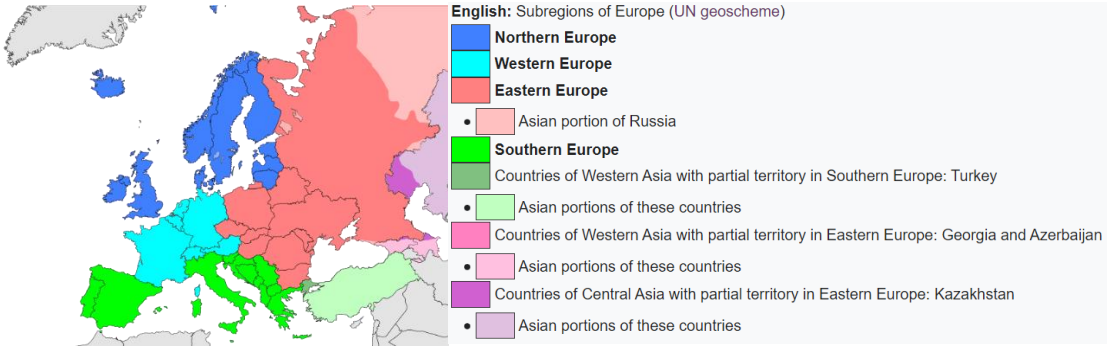


Figure 2: M49 geoscheme of Europe *(UnitedNations, 2022)*

1.3.2 Excluding Factors

The selection of excluding factors was agreed upon in a meeting together with supervisor Marco Semini, and advisor Per Olaf Brett from Ulstein yard during the specialization project. The purpose of selecting these exclusion criteria was to eliminate shipbuilders that were not considered suitable, resulting in a refined list of companies deemed appropriate for the specialization project. This list will be utilized again for this thesis.

Excluded yards with average turnover under € 10m

The classification of shipbuilders is based on the European Union's definition of small and medium-sized enterprises (SMEs), as depicted in figure 3. However, it is worth noting that the data collection was conducted in USD instead of EUR, as the financial database Orbis, which was utilized for gathering financial data, operates in USD as its standard currency. It was assumed that this currency conversion would have a minimal impact on the results.

A consensus was reached to exclude yards with an average turnover below $10 million, as including them would encompass several manufacturers focused on producing smaller recreational vessels and similar products, which are not the focus of this study. Instead, companies with a turnover ranging from $10 million to $50 million were categorized as medium-sized shipbuilders, and those with a turnover over $50 million to be large-sized.

Some modification had to be done for this master thesis, based upon the experiences from the specialization project, and include defining builders with average turnover between $10m - $50m as small-sized, $50m - $150m as medium-sized, and +$150m as large sized.

The main factors determining whether an enterprise is an SME are

1. **staff headcount**
2. either **turnover** or **balance sheet total**

Company category	Staff headcount	Turnover	or	Balance sheet total
Medium-sized	< 250	≤ € 50 m		≤ € 43 m
Small	< 50	≤ € 10 m		≤ € 10 m
Micro	< 10	≤ € 2 m		≤ € 2 m

Figure 3: EU definition SMEs *(EuropeanCommission, 2023)*

Excluded yards solely focused on service and modification

Since the specialization project and the master is focused on newbuilds, it is logical to exclude the companies that does not offer newbuilds as part of their services. This exclusion will remove a substantial part of the yard industry because many European shipyards are choosing not to offer newbuilds, assumed to be because of the due to low profitability.

Exclude yards with less than three years of available data

Shipbuilding is an industry characterized by considerable fluctuations in demand from year to year, which highlights the importance of having a minimum of three years of data to obtain a more precise assessment of financial performance. The reason why less than three years was chosen for exclusion and not more years, is because many potentially relevant shipbuilders would've been excluded if more years of available data was set as a minimum. The limited availability of data is attributed, in part, to the frequent reorganization of company structures within the European shipbuilding industry, involving processes such as mergers, acquisitions, and bankruptcies.

Excluded yards producing vessels under 24m

The exclusion of vessels under 24m was done to remove shipbuilders producing smaller vessels that are of lesser interest for this study. 24m was chosen because this is the maximum length of which people with an International Certificate of Competency (ICC) can operate, which is the only recreational sailing license approved by the UN (unece, 2022). The assumption is that it would exclude most of the companies producing recreational vessels, with the exemption of larger yachts, but include most of the companies building for instance fishing vessels, tugs, and smaller ferries.

1.4 Thesis Structure

Thesis Structure

Chapter 1 Introduction	The chapter will describe the motivation and background, the main objectives with the associated research questions, scope**,** and overall structure of the master thesis.
Chapter 2 Theoretical background	The chapter will present the findings of the product strategy literature study, and findings of the preliminary specialisation projects literature study about shipbuilding. The literature study conducted during this thesis will be the foundation of the proposed framework that will be utilized to map and compare European shipbuilder's product strategy.
Chapter 3 Methodology	The chapter will first present the research strategy of this thesis, methodology regarding the literature study, the data collection process and structure for analysing data.
Chapter 4 Data Analysis and findings	The chapter will present and analyse the gathered data, and discuss the findings by answering the RQs.
Chapter 5 Conclusion	The chapter will summarize the main findings of the master thesis and conclude whether the objectives has been reached. The thesis contribution to research, its limitations and suggestions for future research will also be addressed in this chapter.

2 Theoretical Background

This chapter will present the topics shipbuilding and product strategy, which are important to obtain sufficient insight. The topics related to shipbuilding was gathered from the findings of the literature study conducted for the preliminary specialisation project. The findings of the literature study that resulted in the adaptation of the chosen model to map product strategies of European shipbuilders will also be presented in this chapter. The methodology employed for the literature study can be found in chapter 3.2.

2.1 Shipbuilding

The process of shipbuilding can simply be defined as "the process and work of building ships" (OxfordDictionaries, 2022), but that is also where the simplicity ends. Ships are large buoyant marine vessels that often require thousands of components and manhours, and vary greatly regarding complexity, level of standardization, volume demand, size, and other characteristics. This chapter is aimed at introducing the main activities needed to build a ship, the main actors of the shipbuilding process and the main vessel segments.

2.1.1 Main Activities

Activities related to shipbuilding can generally be divided into two major categories. These are physical and non-physical activities, which can also be referred to as production processes and acquisition/information processes (Andritsos & Perez-Prat, 2000). The non-physical activities include the planning, design, and acquisition before production, and in this stage an enormous amount of information is created. The physical activities use the information from the previous stage to then transform the materials, components, and equipment to a functioning ship. Within the shipbuilding industry you will find companies that are specialized in one of the two major stages, but also complete service providers, all depending on the company strategy. The elaboration of the main activities in this subchapter is based upon the report (Semini, et al., 2013). These activities have been visualized in figure 4 for a customized design, and in figure 5 for a more standardized design, which is dependent on location of the Customer Order Decoupling Point (CODP). The CODP can be defined as the point in the value chain where the product is linked to a specific customer order (Semini, et al., 2013).

Design

The design-phase is a decision-making process that brings together the needs and ideas of the ship operator, shipowner, designer, planner, procurer, and producer. The design-phase can be divided into the subphases concept design, basic & functional design, and contract design.

- Concept design: aims at transforming the established requirements into specifications, and the main requirements involve parameters like size, weight, speed, stability, structure, coefficients, cargo capacities, etc. From this subphase, the output is most

often a limited number of concept alternatives with coherent text descriptions, sketches, and drawings.

- Basic & Functional design: continues to build on the selected concept to produce basic ship characteristics like specifications and diagram drawings, and is the foundation for the engineering phase. Basic design determines the system specifications like the type of ship, hull shape, main dimensions, etc. Functional design is more detailed specifications of the system specification so that the ship follows regulatory requirements.
- Contract design: is closely connected to the basic & functional design phase, and its main purpose is to create a solid foundation through documentation of which the buyer and the designer/builder can reach an agreement concerning the ship design and construction plan. If multiple yards are considered, then the yards would submit a bid proposal, where the total price usually is the factor of highest importance.

Engineering

Engineering is a phase that starts with the basic & detailed design, to develop detailed engineering drawings, sketches, and instructions needed to start producing the ship. The engineering phase is heavily reliant on close collaboration with the suppliers of main equipment and the departments in the shipyard and is to some extent carried out concurrently with production and procurement.

Planning & coordination

The planning & coordination phase starts at the same time as the design phase, and during the design phase some important aspects of the shipbuilding process are decided:

- Deciding on the building strategy
- Estimating time and resource requirements, mainly for tasks in design and production
- Developing a main schedule, including for instance possible delivery and milestones

The planning & coordination are constantly being updated as the project moves forward, and the level of detail increase in the engineering and production phase.

Procurement

The procurement phase mainly revolves around the selection, collaboration, and negotiation with suppliers of subsystems, components, and raw materials. The most critical aspect is the purchasing of the major equipment like engine and propulsion system. Procurers needs to collect offers from suppliers before contract signing because it has a massive impact on price, delivery date and functionality.

Production & assembly

The production & assembly phase is where the materials are being physically transformed, and where the major equipment and components are assembled, to create the ship. Most often it starts with the creation of the hull, which for smaller vessels and capital/equipment intensive ships is normal to construct as one piece. For steel intensive ships it is more normal to construct blocks, which usually are completely outfitted before being assembled to a complete hull. All work concerning the creation of the hull is done in the drydock, an after completion the hull is launched, and on-board outfitting is done at the quay. The reason for this is that all shipbuilding projects heavily rely on the dry dock to construct/complete the hull, so you want to launch the ship as fast as possible so that the dry dock is ready for new projects.

Commissioning & delivery

After a ship has been completed, it needs to be extensively tested to check if it delivers in accordance with the agreed upon specifications in the contract. If everything checks out, the ship is ready to be delivered to the buyer.

After-sale period

After the ship has been delivered, the warranty period starts. Deviations from agreed upon specifications are recorded and reported, and any problems must be fixed as soon as possible. When the warranty expires, replacement parts and repairs is the shipowner's responsibility.

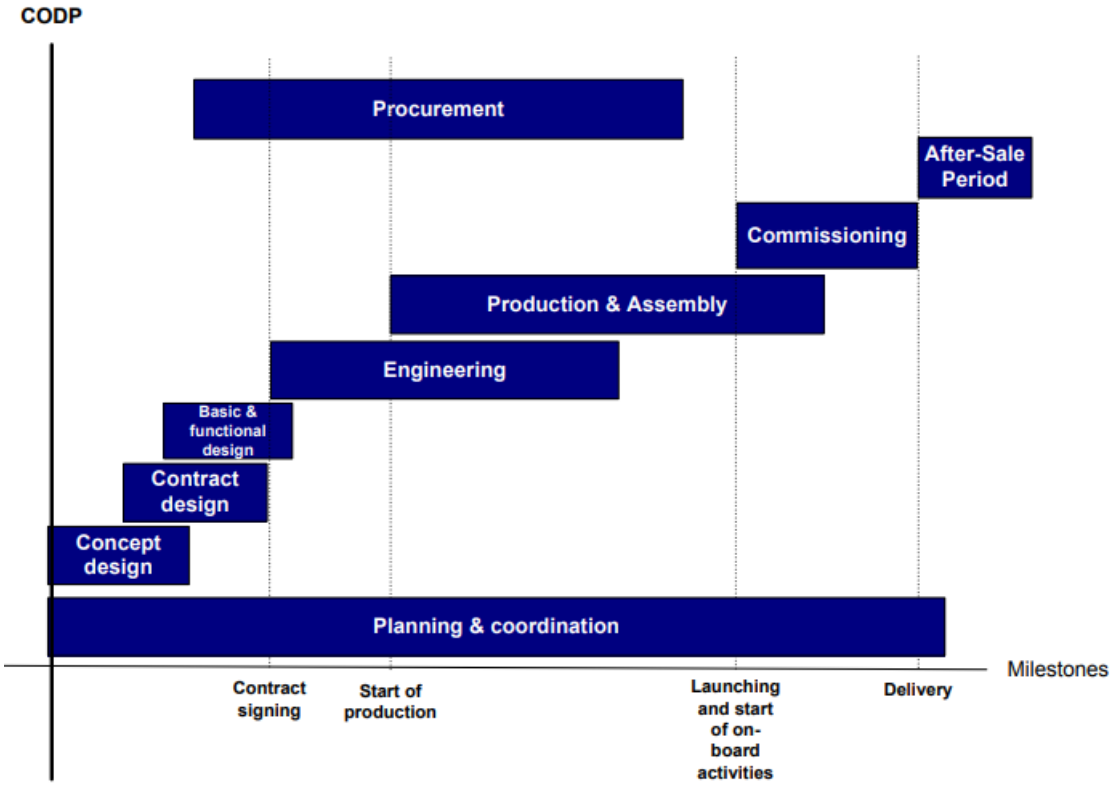


Figure 4: Activities and CODP in customized design *(Semini, et al., 2013)*

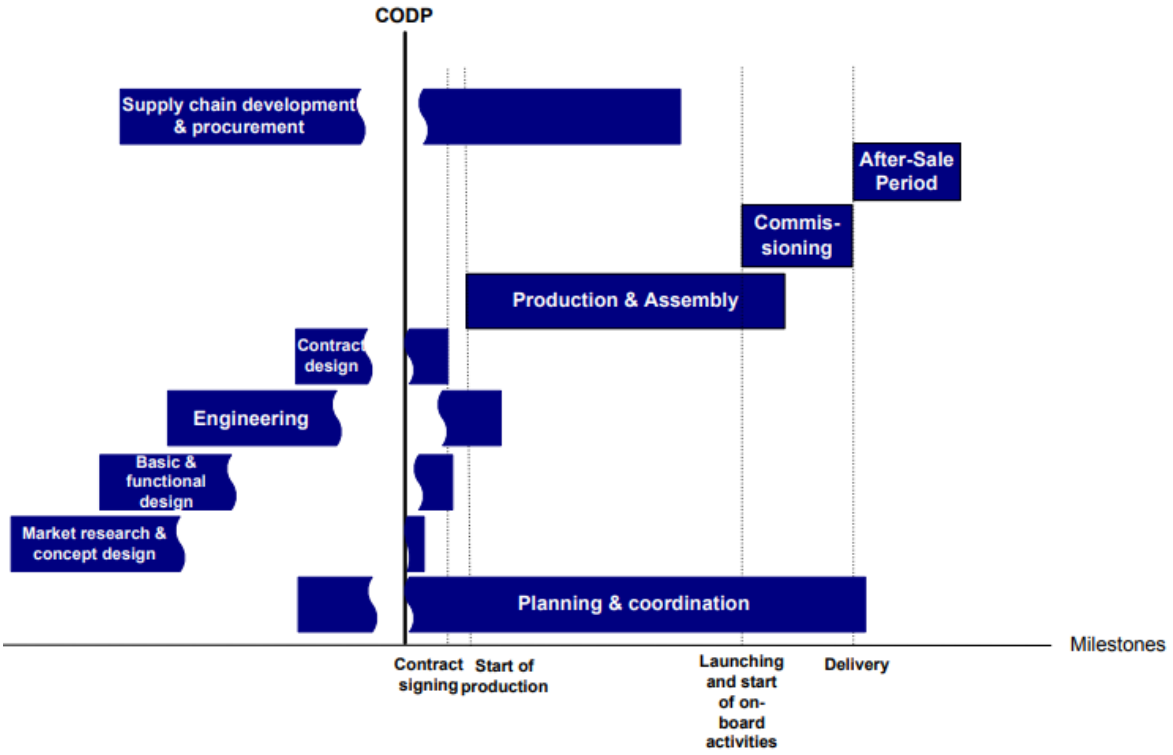


Figure 5: Activities and CODP in standardized design

2.1.2 Main Actors

The main actors in shipbuilding can either be individual companies or be part of a vertically integrated company. In figure 6, the information flow between the actors is illustrated as the dashed arrows, and the material flow as solid arrows. This subchapter is based upon the paper (Semini, et al., 2013), and the main actors are described as the following:

The ship designer is the actor mainly responsible for the concept design, and basic & functional design, which determines the shape, performance, and capabilities of the ship. The designer is usually to be regarded as a supplier to the shipyard, but in some cases, it is the shipyard who is the supplier if it's the designer's responsibility to choose a suitable shipyard for the shipowner. The responsibility of procurement and engineering is also often placed on the designer because these tasks are often based upon the agreed upon design.

The shipyard's main responsibility is most often the production and assembly, and commissioning and testing of the ship. Procurement of standard items like steel and piping, as well as certain engineering tasks, may also be within the yard's responsibility. The responsibilities regarding the procurement and engineering tasks can in general be said to be split between the designer and the shipyard, in different degrees. Repairs within the warranty is also usually the shipyards responsibility.

Main equipment suppliers are the ones that are responsible for delivering the major subsystems like engines, propulsion systems, on-deck machines other complex systems. The importance of the main equipment suppliers is mainly due to the significant effect their systems have on the ships design and performance, their significant cost, and their long lead time. As mentioned, the shipyard has the responsibility of repairs within the warranty of the ship, but there is most often also agreed upon warranty arrangements between the shipyard and the main equipment suppliers.

Shipowners are the essential customer of the ship and is involved in all aspects of design and construction. The owner can be thought of as the ultimate decision maker in most of the shipbuilding activities, but increasing levels of standardization and modularization moves the CODP further downstream in the process as seen in figure 6. COPD is explained in chapter 3.1.3. The reason for this is simply that most of the design aspects are completed before a customer is found.

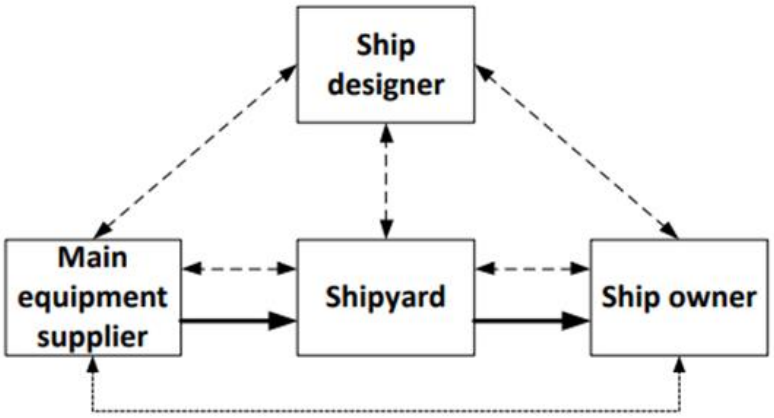


Figure 6: Main actors shipbuilding with material flows (solid arrows) and information flows (dashed arrows) (Semini, et al., 2013)

2.1.3 Vessel Segments

There is no unilaterally accepted definition of the various vessel segments, but for the needs of this study the categories defined in the book (Lamb, 2003) as seen in table 3, are deemed to be a fitting foundation. However, some modifications will be made to these categories to better align it with the European shipbuilding industry. For instance, vessels related to carrying passengers are especially important regarding the order book in GT as seen in figure 7, and the category should therefore be broken into sub-categories to better reflect this importance. Another important goal with adapting the categories from (Lamb, 2003), is to simplify the data collection process by using well-defined segments. The coding system "StatCode 5 Shiptype Coding System (IHSMarkit, 2023)" was also used as a source of inspiration, see appendix 1.

Table 3: Vessel definition *(Lamb, 2003)*

Cargo ships	Commercial, oceangoing ships that are primarily designed to carry the world's trade.
Passenger vessels	Commercial, vessels that are primarily designed to carry passengers and vehicles.
Naval vessels	Ships, boats, and crafts operated by navies, coast guards and other military or quasi military agencies.
Other ships/crafts	• Ships for catching, processing, and transporting fish and fish products. • Ships and crafts used for offshore exploration and production of oil and gas. • Tugs and towboats. • All other commercial vessels that do work rather than carry cargo or passengers.
Barges/inshore vessels	Inland barges, river-trading vessels, and a range of miscellaneous floating structures

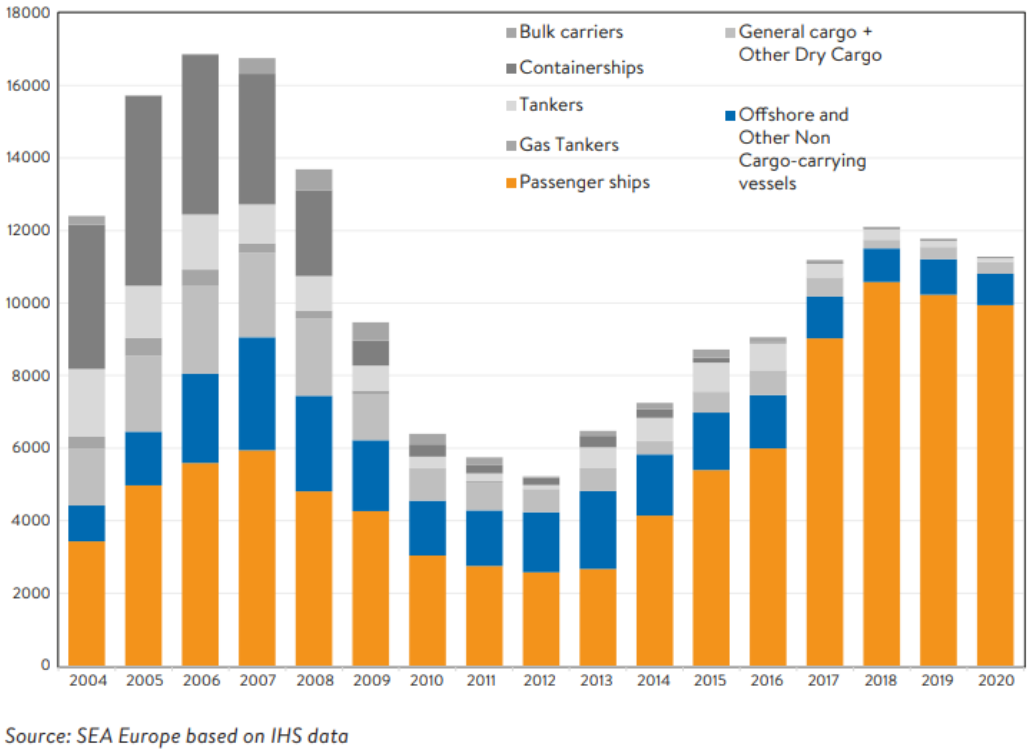


Figure 7: Evolution of the European Orderbook by Ship Types in Million GT *(SeaEurope, 2021)*

One important assumption made to define the segments, was that the vessels belonging to a certain segment generally cater to similar customers and industries (except the niche segment). The definitions from (Lamb, 2003) will be modified into the following segments:

- Other ships/crafts
    - **Fishing industry segment**
    - **Offshore industry segment**
    - **Port operations segment**
    - **Niche segment**
- Passenger vessels
    - **Public transportation segment**
    - **Tourism segment**
    - **Luxury segment**
- Cargo vessels
    - **Offshore cargo segment**
- Naval vessels
    - **Security segment**
- Barges/inshore vessels
    - **Inshore cargo segment**

Fishing industry segment

Defined in the book (Lamb, 2003) as “ships for catching, processing, and transporting fish and fish products”. Based upon this, the principle that will be used to decide whether a vessel belongs in this segment for the purpose of the thesis is whether they are in direct contact with the fish/seafood products. The main categories of vessels can be seen in table 4.

Table 4: Fishing industry segment

Vessel type	Description
Fish catcher  Picture 1: Trawler produced by Myklebust in Norway ***(Myklebust, 2023)***	Fish catchers does as the name impliy, catch fish, and are generally defined by the equipment that they use. Examples of this are trawlers, seiners, and liners.
Fish carrier  Picture 2: Fish carrier produced by Aass Mek. Verksted in Norway *(AasMek, 2023)*	Fish carriers are vessels that primarily carry live fish to and from fish aquaculture pens. If for instance a pen of salmon is ready to be slaughtered, the vessel will pump up the salmon and carry it to the factory.
Fish factory vessels  Picture 3: Fish factory vessel produced by Fitjar Mek. Verksted *(fmvas, 2023)*	Vessels that are purpose built for slaughtering and/or processing the fish are referred to as fish factory vessels.

Offshore industry segment

Offshore industry vessels are defined in the book (Lamb, 2003) as “ships and crafts used for the offshore exploration and production of oil and gas”. Offshore wind will also be included in the definition. In essence, the scope of this segment encompasses all vessels associated with the offshore industry, including those involved in exploration, cargo and crew transportation, anchor handling and offshore towing, construction of offshore installations, physical production of oil and gas, as well as safety and service/maintenance functions. Some of the most import vessel types can be seen in table 5 and table 6:

Table 5: Offshore industry segment #1

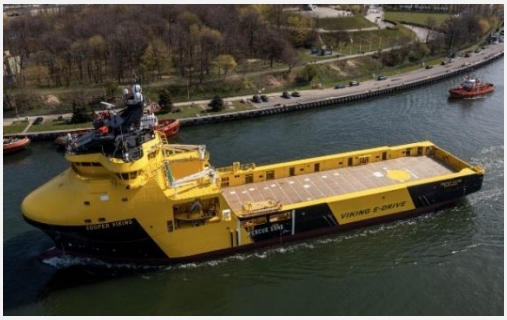
Vessel type	Description
Platform Supply Vessel (PSV)  Picture 4: PSV produced by Remontowa in Poland ***(remontowa, 2023)***	PSV is a specialized vessel, commonly used in the exploration, development, and production phase of offshore operations. It is designed to support offshore installations by transporting equipment, supplies and personnel, and is characterized by its versatile deck space and carrying capacity. It is also common to use the more general term Offshore Support Vessel (OSV) for these kinds of vessels.
Anchor Handling Tug Supply (AHTS)  Picture 5: AHTS produced by Vard in Norway ***(Anon., 2023)***	AHTS is a specialized vessel, that resembles a PSV, because they both have a flexible deck space. In addition to transport equipment and supplies, the AHTS is also designed to handle and position anchors for offshore structures, as well as having a significant towing capacity.
Offshore Construction Vessel (OCV)  Picture 6: OCV produced by Tersan shipyard in Türkei ***(tersanshipyard, 2023)***	OCVs are vessels specialized for offshore construction and installation. They are equipped with heavy duty cranes capable of handling large loads, such as subsea equipment, pipes, and offshore structures.

Table 6: Offshore industry #2

Vessel type	Description
Service Operation Vessel (SOV)  Picture 7: SOV produced by Astilleros Gondán in Spain ***(godán, 2023)***	SOV is a vessel specialized mainly to support operations and maintenance of offshore wind farms. SOVs' most prominent feature is their walk-to-walk gangway system, which lets the technicians safely transfer between the vessel and the windmill.
Crew/supply vessel  Picture 8: Crew/supply vessel produced by Alicat workboats in the United Kingdom ***(alicat, 2023)***	These are commonly fast vessels designed to transport crew and equipment to offshore installations such as windmills. Compared to other offshore industry vessels like PSVs and SOVs, the vessels are regarded to be relatively small.
Seismic  Picture 9: Seismic vessel produced by Ulstein in Norway ***(Ulstein, 2023)***	Seismic vessels are ships specialized to conduct seismic surveys and are mostly used for exploration of oil and gas resources.

Port operations segment

This segment is an adaptation to what is referred to as tugs/towboats in the book (Lamb, 2003). For this thesis, it was decided to name this segment port operations, and the vessels that falls under this category are mainly designed to support port operations. The main categories of vessels can be seen in table 7.

Table 7: Port operations segment

Vessel type	Description
Tug  Picture 10: Tug produced by Sanmar in Türkiye ***(Sanmar, 2023)***	As stated in the book (Lamb, 2003), tugs are the tractors of the sea, and the most common application is for port operations like mooring, escorting, and towing. Some tugs are also purpose built for firefighting.
Pilot vessel  Picture 11: Pilot vessel produced by SwedShip in Sweden *(SwedeShip, 2023)*	Another vessel included in the genre of port operations are pilot vessels, which are used to transport maritime pilots to/from ships. The pilot's main job is to aid in piloting a ship in harbours/dangerous waterways.

Niche segment

Defined in the book (Lamb, 2003) as vessels that "do work rather than carry cargo or passengers, usually specialized for a specific purpose". In this segment, we find vessels that don't fit into the other predefined segment of this paper. The most important vessels found in this segment can be seen in table 8 and table 9:

Table 8: Niche segment #1

Vessel type	Description
Work/repair (utility) vessel  Picture 12: Work/repair (utility) vessel produced by Sletta verft in Norway ***(Sletta, 2023)***	This category of vessels are highly flexible vessels intended to do various types of work and comes in a myriad of different shapes and sizes. Normal work tasks include assistance in aquaculture, construction, diving operations, trash collection in coastal areas etc. This category is also often referred to as utility vessel.
Dredgers  Picture 13: Split hopper dredger produced by Nodosa in Spain *(Nodosa, 2023)*	Dredger is a highly specialized category of vessels designed to do two main areas of work according to (Lamb, 2003). Dredging the bottom of for instance a harbour or river to make it deeper for ships, and transportation/dumping of dredging spoil (mud, sand etc.).

Table 9: Niche segment #2

Vessel type	Description
Cable Laying Vessel (CLV)  Picture 14: CLV produced by Ulstein in Norway **(Ulstein, 2023)**	These are highly specialized vessels used to lay, monitor and service underwater cables for telecommunication, electricity, and other purposes.
Research vessels  Picture 15: Research vessel produced by Cammell Laird in the United Kingdom **(Laird, 2023)**	This category of vessels is, as the name implies, occupied with research applications. According to (Lamb, 2003), "these vessels are a characteristic of virtually every country with a significant deep water economic zone, significant fishing industry, and/or an oil and gas industry". Vessels related to oil and gas, such as seismic vessels, will fall under the offshore industry segment for this paper. The remaining research/survey vessels, falls under the niche segment.
Icebreaker  Picture 16: Icebreaker produced by Helsinki Shipyard in Finland **(HelsinkiShipyard, 2023)**	An icebreaker can be defined as "a strong ship designed to break a way through ice, for example in the Arctic or Antarctic (oxford, 2023)", and is mainly used to clear shipping lanes and harbours of ice.

Public transportation segment

A ferry can be defined as “a boat or ship that carries people, vehicles and goods across a river or across a narrow part of the sea (oxford dictionary)”, and that they operate on regularly scheduled services as a means of transportation from A to B. Ferries also come in wide array of different shapes and sizes, but they can in general be divided into two main categories, which is passenger ferries and Roll-on/Roll-off passenger (RoPax) ferries. The main categories of vessels can be seen in table 10.

Table 10: Public transportation segment

Vessel type	Description
Passenger ferry  Picture 17: Passenger ferry produced by Cantiere Navale Vittoria in Italy *(Vittoria, 2023)*	The passenger ferry is a vessel with the sole task of transporting people from A to B and come in a wide array of shapes and sizes.
Roll-on/Roll-off passenger (RoPax)  Picture 18: RoPax ferry build by Westcon in Norway *(westcon, 2023)*	The RoPax is a type of ferry that carries vehicles in addition to people, like the RoPax produced by Westcon yards in Norway.
Cruiseferry  Picture 19: Cruiseferry produced by Rauma Marine Constructions in Finland *(rmcfinland, 2022)*	Ferries that combine futures of a cruise vessel to a Ro-Pax ferry, like shopping and restaurant facilities, are referred to as cruiseferries.

Tourism segment

According to the book (Lamb, 2003), cruise ships are defined as “vessels that transport passengers and operate in oceanic services primarily driven by the tourism market”. In this thesis, we have expanded this definition to include vessels that serve inshore services as well. The key distinction between a ferry and a cruise ship lies in the target segments they cater to. Ferries primarily function is transportation of people with or without cargo, with scheduled routes, while cruise ships cater to the tourism industry. Hence, for the purpose of this thesis, this segment is referred to as the tourism segment. It is worth noting that several prominent shipbuilders in Europe, such as Chantiers de l'Atlantique, Fincantieri, Meyer Turku, and Meyer Werft, have specialized in constructing larger cruise ships. The main categories of vessels can be seen in table 11.

Table 11: Tourism segment

Vessel type	Description
Offshore cruise ship  Picture 20: Offshore cruise ship produces by Meyer Turku in Finland *(meyerturku, 2023)*	Generally large and luxurious vessels with the intent of carrying passengers for pleasure. It can be compared to a floating hotel, with varying degrees of additional services to cater to the needs and wants of the passengers.
Inland cruise ship  Picture 21: Inland cruise vessel produced by WestSea in Portugal *(WestSea, 2023)*	The inland cruise ships offer may of the same functions and services as the oceangoing cruise ships, but are generally smaller in size, and operate in rivers and lakes.

Luxury segment

This segment is defined as vessels for recreational purposes that are not expected to generate income and are therefore regarded as luxury objects. Many shipbuilders in Europe have chosen to specialize in offering luxury yachts, which includes shipbuilders like Princess, Sunseeker, Heesen, and Baglietto. The main categories of vessels can be seen in table 12.

Table 12: Luxury segment

Vessel type	Description
Yacht  Picture 22: Yacht produced by Abeking & Rasmussen in Germany *(abeking, 2023)*	A yacht can be defined as "a large and usually expensive boat, used for racing or for traveling around for pleasure (cambridge, 2023)".
Yacht support vessel  Picture 23: Yacht support vessel produced by Damen Yachting in the Netherlands *(damenyachting, 2023)*	Another vessel type that falls under the luxury segment category for this thesis are yacht support vessels, often referred to as shadow boats. They are usually luxurious vessels specialized in providing support and auxiliary functions for larger yachts. These functions can include extra guest accommodation, dive operations, helicopters, and chase boats.

Offshore cargo segment

Defined in the book (Lamb, 2003) to be “commercial, oceangoing ships that are primarily designed to carry the world's trade”. These are usually quite large and simple vessels, and as can be seen in figure 7, a genre of vessels that’ve seen a heavy decline in demand from European shipbuilders. The book also divides the cargo segment into the three main categories tankers, bulkers, and general cargo vessels.

Table 13: Offshore cargo segment

Vessel type	Description
Tanker  Picture 24: LNG Bunker/Feeder produced by Royal Bodewes in the Netherlands ***(royalbodewes, 2023)***	Tankers are liquid cargo carriers that carry cargo like oil, refined petroleum products, chemicals and liquified gas in bulk.
Bulker  Picture 25: Self-discharging bulker produced by 3. Maj Brodogradilist in Croatia ***(3.Maj, 2023)***	Bulkers are dry bulk carriers that carry dry goods like grain, coal, and ore in bulk.
General Cargo Carrier  Picture 26: Autonomous container ship produced by Vard Group in Norway ***(Vard, 2023)***	General cargo carriers are ships that carry cargoes in other forms than bulk like packaged, containerized, palletized, and wheeled. Typical vessels in this genre includes container and Roll-on/Roll-off (RoRo) ships.

Inshore cargo segment

This segment (Lamb, 2003) defines as “inland barges, river-trading vessels, and a range of miscellaneous floating structures”. Europe has more than 37,000 kilometres of waterways, which connect hundreds of cities and industrial regions. Inshore cargo transportation is by the EU also regarded as a competitive and environmentally friendly alternative to road and rail transport (EuropeanCommission, 2023). In other words, the inshore cargo segment competes on a regional level restricted by the flow of rivers and large lakes, which separates it from the ocean-going cargo segment. The vessels in this segment are constructed quite differently from that of ocean-going vessels, and vessels are often quite narrow in comparison to their length with a limited draft. Thus, reflecting the waterways of which they operate in. Inshore cargo transportation is either conducted by self-propelled cargo vessel or pushed by an inland pusher vessel, and comes in a wide variety of different sizes and applications. Some shipbuilding companies, like the Veka group, is specialized in producing these kinds of vessels. The main categories of vessels can be seen in table 14.

Table 14: Inshore cargo segment

Vessel type	Description
Inshore cargo vessel  Picture 27: Self-propelled inland chemical tanker produced by Veka Group in the Netherlands ***(vekagroup, 2023)***	As the ocean-going cargo segment, the inshore cargo segment can be divided into tankers, bulkers, and general cargo vessels. Some shipbuilders in Europe are focused on building these types of vessels, like Veka group in the Netherlands.
Inland pusher  Picture 28: Inland pusher produced by Veka Group *in the Netherlands* ***(vekagroup, 2023)***	Inland pushers are vessels specialized in pushing non-propelled barges on rivers and lakes.

Security segment

This segment is called naval vessels by (Lamb, 2003)and is defined as “ships, boats, and crafts operated by navies, coast guards and other military or quasi military agencies”. For this project, search & rescue vessels (SAR) will also be included. This segment incorporates all vessels for the military, coast guard, police, other governmental agencies, as well as SAR. The segment is therefore referred to as the security segment for the purpose of this thesis, and it’s comprised of a wide array of vessels, and some examples can be seen in table 15.

Table 15: Security segment

Vessel type	Description
Search And Rescue (SAR)  Picture 29: SAR vessel produced by Baltic Workboats in Estonia ***(BalticWorkboats, 2023)***	SAR vessels are vessels specialized in conducting search and rescue operations. This includes responding to emergency situations like accidents, vessels in distress, or missing persons.
Patrol vessels  Picture 30: Border security patrol vessel produced by Rodman in Spain ***(rodman, 2023)***	Patrol vessels are vessels designed for patrolling with the purpose of enforcing laws, regulations, and security in given areas. They are used by both the military, coast guard, police, border security and other maritime law enforcement.
Aircraft carriers  Picture 31: Aircraft carrier produced by Sedef shipyard in Türkei ***(sedef, 2023)***	Aircraft carriers are large vessels designed to act as mobile airbases for military aircraft. The most prominent feature is the flight deck, and they are equipped to launch, recover, and maintain aircraft.

2.2 Competitive Strategy

This master thesis will explore the field of strategy related to products, and if certain competitive strategies amongst shipbuilders in Europe can be linked to better financial performance. Consequently, implying a potential competitive advantage. The term "product" will for the remainder of this thesis refer to the output of an industry, which includes both "products and services", to avoid needless repetition (Porter, 1998).

This chapter is based upon Michael E. Porters book "Competitive Strategy: Techniques for Analyzing Industries and Competitors", first published in 1980. More precisely, Porters model "Forces Driving Industry Competition" will be utilized to describe the mechanisms behind the need of a competitive strategy. Whilst Porters Generic Strategies Model (PGSM) will be utilized to explain the main strategies a company might consider, as well as being the foundation of an adapted model for the mapping and analysing of the competitive strategy amongst European shipbuilders.

The reason for primarily using the models of Michael E. Porter for this thesis is because Porters Generic Strategies are deemed to be well suited for the purpose of this thesis due the applicability to shipbuilders and shipbuilding, due to the generic nature of the model of not being industry specific. To better understand the generic strategies defined by Porter, it's considered beneficial to get insight into the "Forces Driving Industry Competition" which Porter describes as being the foundation of the generic strategies. The established Ansoff matrix (Ansoff, 1957) and Miles & Snow's organizational strategies (Miles, et al., 1978) were also considered, but both were ultimately deemed to be more difficult to adapt to open-source KPIs than PGSM. Overall, Porter describes the goal of a competitive strategy as the following:

"The goal of competitive strategy for a business unit in an industry is to find a position in the industry where the company can best defend itself against these competitive forces or can influence them in its favor (Porter, 1998)*."*

He further states that the key for developing a strategy is to understand the sources of each force. Consequently, highlighting the strengths and weaknesses of the company providing a clarification of its position in the industry, which strategic changes has the greatest potential for a payoff and opportunities/threats amongst industry trends (Porter, 1998).

2.2.1 Forces Driving Industry Competition

To better understand the competitive strategies of European shipbuilders, one should first get insight into the underlying mechanisms that create the need. For this purpose, we will utilize the model "Forces Driving Industry Competition" by Michael E. Porter (see figure 8), often referred to as "Porters Five Forces".

Porter describes that the essence of formulating a competitive strategy is relating a company to its environment, and that the industry structure has a strong influence in determining the competitive rules of the game as well as the strategies potentially available to the company

(Porter, 1998). This can be interpreted as if a given company wants to alter their competitive strategy, they need to be aware of the limitations that have already been pre-determined by the industry in which it competes. Meaning that the competition in each industry is generally not a matter of chance based upon the competitors it faces, but the underlying economic structure. Porter continues in defining these pre-determined limitations as five basic competitive forces, and that their collective strength determines the profit potential of the industry.

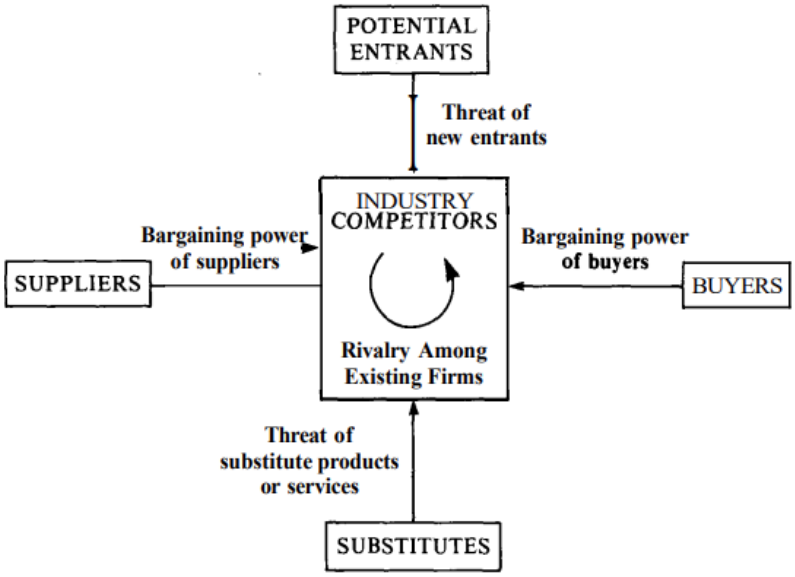


Figure 8: Porters Five Forces *(Porter, 1998)*

Threat of new entrants

New entrants bring with them new capacity, a desire for market share and resources which can result in lower prices and reduced profitability. Porter also describes the six major sources of barriers one need to overcome which are:

- Economies of scale: refer to declines in unit costs of a product (or operation or function that goes into producing a product) as the absolute volume per period increases.
- Product differentiation: means that established firms have brand identification and customer loyalties, which stem from past advertising, customer service, product differences, or simply being first into the industry.
- Capital requirements: is the need to invest large financial resources to compete.
- Cost disadvantages independent of scale: means that established firms may have cost advantages not replicable by potential entrants no matter what their size and attained economies of scale. These include proprietary product technology, favourable access to raw materials, favourable locations, government subsidies, learning or experience curve.
- Government policy: can limit or foreclose entry into industries with such controls as licensing requirements and limits on access to raw materials (like coal lands or mountains on which to build ski areas).

From a shipbuilding perspective, it is generally considered difficult for new entrants to compete, due to the capital-insensitive nature of shipbuilding regarding both the construction of the ship itself and the infrastructure/facilities needed (Varela, et al., 2017). The significant technical expertise needed is also a considerable barrier, and some shipbuilders might be able to compete based upon factors like lower labour costs and/or access to government subsidies.

Pressure from substitute products

In a broad sense, one can say that all firms in an industry are competing with the industries producing substitute products. If one looks at the shipbuilding industry, the pressure from substitute products is assumed to be modest. For instance, for the shipping of cargo, the main alternative modes are rail, air and roadgoing transportation.

Bargaining power of buyers

Buyers can drive down prices and are affected by how many buyers a company has, the importance of the buyer, and how much it would cost to find new buyers or markets for its products. A small and powerful client base means each buyer has significant power to negotiate for lower prices, whilst a company with many smaller independent buyers can more easily charge higher prices and increase profitability.

For shipbuilders, the buyer often has considerable power in determining the price, because of the global reach of the industry.

Bargaining power of suppliers

The power of suppliers determines how easily a supplier can drive up the costs of its products and is generally affected by the quantity of suppliers of a given product, the uniqueness of these products, and the cost of switching to other suppliers. A small supplier base of a given product will usually increase the dependency a company has on a given supplier. Many suppliers on the other hand increase the competition amongst suppliers, and thereby lower the price.

The bargaining power of suppliers varies considerably depending on their importance, but main equipment suppliers (see chapter 2.1.2) will generally have significant bargaining power, and probably more so if they are requested by the buyer.

2.2.2 Porters Generic Strategies Model

To succeed in a highly competitive business landscape, it is crucial for a company to devise a strategy that can provide a sustainable competitive advantage. This requires the consideration of the company's market position and the competitive landscape within the relevant industry. Positioning in relation to competitors is a key factor for a company's profitability. A company's relative position within an industry can greatly impact its ability to achieve above-average profitability. Even in an unfavourable industry structure with moderate average profitability, a company that positions itself well can potentially achieve strong profitability (Porter, 1998).

Achieving a lasting competitive advantage is crucial for sustained profitability. To cope with the five competitive forces discussed in chapter 2.2.1, Porter defines three generic strategies a company can select to outperform other companies. These strategies include overall cost leadership, differentiation, and focus. The focus strategy can also be split into cost focus and differentiation (Porter, 1998). Figure 9 shows Porters original generic strategies model and will be the foundation for the mapping of European shipbuilder's generic product strategies. It was chosen because it's well established in the scientific community, with documented applicability. The paper (Solberg & Durrieu, 2008) investigated the impact of different classes of strategy (generic and international) on firm performance in international markets, and findings lend support to the fact that PGSM still plays a pivotal role in forming company strategies. In the paper (Ormanidhi & Stringa, 2008), the following reasons for why one should choose the PGSM to evaluate company's competitive behaviour was specified:

- **Popularity**: PGSM has had a significant impact on the field of business strategy and industrial economics. It is widely cited and referenced in academic papers, with (Miller & Dess, 1993) finding that nearly half of the papers in the Strategic Management Journal referred to Porter's work from 1986 to 1990.
- **Well-defined structure**: The framework of the three generic strategies provides a clear and structured approach to understanding competitive advantage and strategy. It presents a general rule for firms' strategies, suggesting that firms that follow the recommended strategy will achieve competitive advantage and outperform those that do not. This well-structured model offers criteria and benchmarks for analysing and comparing firms in real-life situations.
- **Feasibility for empirical analyses**: The model is suitable for empirical analysis as it allows for the identification and selection of firms that have achieved competitive advantage and pursued relevant strategic targets. Placing these firms within the framework facilitates the assessment of their alignment with the recommended alternatives. The feasibility of the model simplifies the comparison of firms and facilitates conclusions about competitive advantage and performance, particularly in data-rich empirical settings.
- **Clarity of the main concepts**: The model of generic strategies offers a clear and easily understandable framework for analysing how a firm can attain competitive advantage and improve performance, as well as identifying instances where it may fail to do so. The concepts of competitive advantage, lower cost, and differentiation (in terms of quality) are straightforward and accessible to both theorists and practitioners.
- **Combination of simplicity and generality**: Porter's 1980 model is designed to be applicable to any industry and firm. Its generality allows for broad applicability, while its notable simplicity in terms of the core elements of competitive strategies makes it easy to grasp and apply.

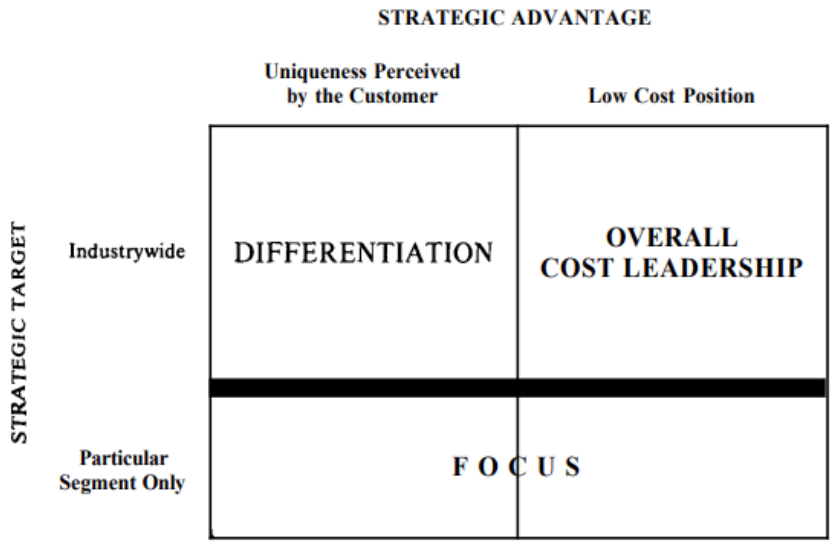


Figure 9: Porters generic strategies model *(Porter, 1998)*

The three main generic strategies can be described as the following:

- **Cost leadership**: is a strategic approach that involves providing a product that is like that of the competitors, but at a lower cost. This strategy aims to create value within the company through either maintaining the same price as competitors while reducing costs, or offering a lower price and achieving higher sales volume. To achieve cost leadership, businesses must heavily invest in measures to minimize costs and effectively manage cost drivers throughout the value chain, surpassing their competitors. However, it is crucial for a cost leader not to overlook differentiation, as neglecting it can lead to a loss of market share. For cost leadership to be a sustainable competitive advantage, the company must consistently have the lowest costs within its industry.
- **Differentiation**: means offering products and/or services that distinguish themselves from those of the competitors within the same industry, and which customers are willing to pay a premium for. The factors that can contribute to a unique product or service can vary between industries and may include characteristics of the product itself, technological systems, marketing approaches, or customer service (Porter, 1998). Companies that achieve sustainable differentiation have the potential to achieve higher profitability than the industry average, if the price of the product exceeds the additional costs associated with offering a unique product. Therefore, companies following a differentiation strategy must also maintain good cost control to avoid pricing themselves out of the market.
- **Focus:** is focused on serving/specializing on a specific segment in the most effective manner possible. This approach involves targeting a specific buyer group, a part of the product range, or a particular geographical area. When combined with the other two generic strategies, we get cost focus and focused differentiation. Companies that follow a focus strategy gain a competitive advantage by catering to their narrow customer segment better than those who attempt to serve multiple and larger customer segments at the same time.

In (Porter, 1998), it is discussed that the three generic strategies are viable approaches to deal with the competitive forces discussed in chapter 2.2.1. However, failing to develop a strategy within these three directions can result in a detrimental situation known as being "**stuck-in-the-middle**." Porter describes this as an extremely poor strategic position for a company. Such companies lack the market share, capital investment, and determination to compete based on low cost, industrywide differentiation that can eliminate the need for a low-cost position, or the focus required to create differentiation or a low-cost position within a specific market segment. As a result, these companies are highly likely to experience poor performance. In essence, Porter argues that stuck-in-the-middle companies will either lose customers who prioritize low prices or fail to provide the perceived value offered by differentiated companies. The “stuck-in-the-middle” theory will be examined in this thesis, to see if the lack of a clear strategy consequently results in lower performance.

PGSM have been subject to criticism, primarily centred around Porter's claim that the three strategies are mutually exclusive (Murray, 1988). Scholars have identified cases where successful combinations of low-cost and differentiation strategies have been implemented, thus challenging Porter's assertion (Hendry, 1990). Another limitation of the theory lies in its limited practical guidance regarding implementation, as it fails to provide detailed insights into the specific processes, programs, and organizational structure necessary for the effective execution of these strategies (Murray, 1988).

2.2.3 Horizontal Axis (customer perceived value)

The horizontal axis of the PGSM is as described in chapter 2.2.1, based upon the competitive advantage of uniqueness perceived by customer (differentiation) or low-cost position. To identify a single KPI for the horizontal axis that can be collected from open sources, the assumption was made that a suitable definition of the competitive advantage based upon strategic advantage is the level of customer perceived value. For a cost-oriented product offering, the product offering must be limited to make it efficient enough to lower the price of the products. For a differentiated approach, the companies must offer a product portfolio perceived to be unique by the customer.

In the doctoral dissertation (Sauerhoff, 2014), Sauerhoff investigates the importance of services in shipbuilding industry and the connection between service offering, market expertise, its practical experience, and its cooperative activities. The objective of the dissertation was to examine these activities, resources and capabilities constituting the basis of a shipbuilder’s competence in the field of services. The most important finding in the dissertation for this thesis was that **service offering was equivalent to customer perceived value.** The underlying background and motivation for the dissertation is the same as for this thesis, providing useful research that can aid European shipbuilders in regaining a competitive advantage.

Due to the explanatory nature of the dissertation and the need for increased insight, a series of focused interviews with 26 experts from the shipbuilding industry representing 14 different nations was conducted. After the interviews were concluded, Sauerhoff stated that the definition of the word service covered a broader range than first anticipated, and more importantly that the regional origin of the representatives had an influence on their perception of what constitutes as a service. Respondents from the more established shipbuilding nations generally had an understanding of a service being supplementary technical services, whilst for the emerging shipbuilding nations, the focus was on core technical services that the established shipbuilding respondents perceived as self-evident. Other results from the focused interviews included:

- The importance for shipbuilders to enter cooperation with third parties to exchange resources needed for the development of new service offerings.

- The data suggests a relationship between a shipbuilder's market expertise, practical experience, and the competence in the field of service, and that such competences in the field of service have a positive effect on the customer value, shipbuilders' competitiveness, and the order situation.

The relevancy of the dissertation Sauerhoff stated was emphasized by the findings of the interviews, which concluded that there was no consensus of the future location of modern shipbuilding. Representatives from established shipbuilding nations stated that it would be European shipbuilders that'll build the highly sophisticated vessels and Asia regarding more standardized ships. Representatives from emerging shipbuilding nations, however, argued that the cost of the vessels will determine the future locations of modern shipbuilding. In other words, it seems to be a **cost versus customer perceived value (Porters generic strategies) discussion that will shape European shipbuilding in the future** according to these statements.

Based upon the findings of the interviews, Sauerhoff conducted an international survey which was sent to 360 shipbuilders in 51 countries. After having sent several notifications to the shipbuilders to increase the response rate, Sauerhoff ended up with a response from 40 shipbuilders from 18 countries. The distribution of respondents, as well as what counties were defined as established and emerging shipbuilding nations can be seen in figure 10.

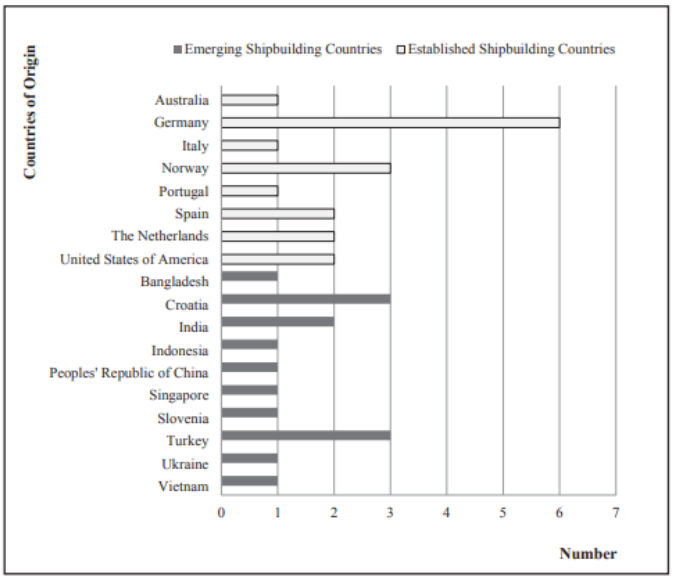


Figure 10: Distribution of respondent's international survey *(Sauerhoff, 2014)*

The data provided by the 40 shipyards, was then analysed using regression analysis and mediator analysis in the program SPSS. The most important finding of the analysis related to this thesis, was the positive relation between the service offering and the increase in the perceived customer value due to increasing competence in the field of service (see figure 11). The assumption deducted from this is that the numbers of services offered by a shipbuilder is a suitable way to measure the customer value of a shipbuilder's product offering, which indicates the level of differentiation. This assumption is also supported by statements from the shipbuilders, which Sauerhoff concluded as:

"Regarding the commercial relevance of service offerings, it was found that they are more and more perceived as a differentiation factor with the potential to attract customers and to secure the order situation of shipyards that cannot win the price competition (Sauerhoff, 2014)"

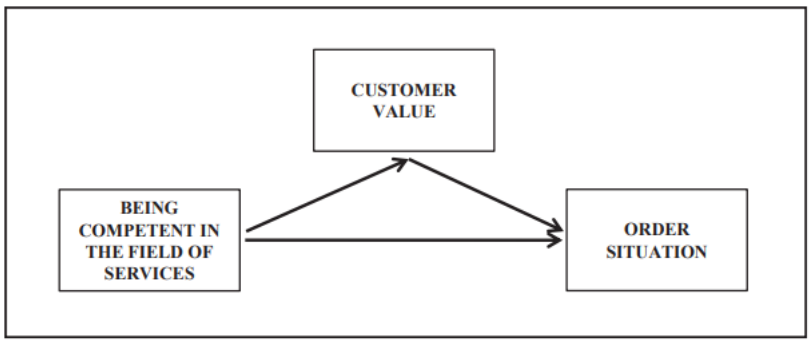


Figure 11: Mediation model linking service offering (competence in the field of service) to customer value *(Sauerhoff, 2014)*

The link between numbers of services offered, as a way of assessing differentiation by customer value, is on par with the definition of the horizontal axis of PGSM as described in chapter 2.2.2. From the data provided by the 40 shipyards, 15 different services were identified as seen in figure 12. These 15 services will be the foundation of the horizontal axis KPI for perceived customer value, which can also be referred to as the level of differentiation. The service offering data will be collected from the webpages of the shipbuilders, with the assumption that if a service is not mentioned, it is not an important part of their service offering. In addition to the 15 services, an additional service called "other" was added. This service is defined as an additional service offering meant to cover the shipbuilders that have a vertical integration of being a "**main equipment supplier**", as defined in chapter 2.1.2, which can increase the perceived customer value. Examples of this include the manufacturing of maritime or military equipment. The other main actors of shipbuilding are covered in the remaining services, where the **ship designer** is covered by the service Design/construction planning, the **ship owner** is covered by Financing/Leasing and possibly Port operations, and the **shipyard** by the remaining services. The 16 services that forms the horizontal axis KPI are defined in table 16.

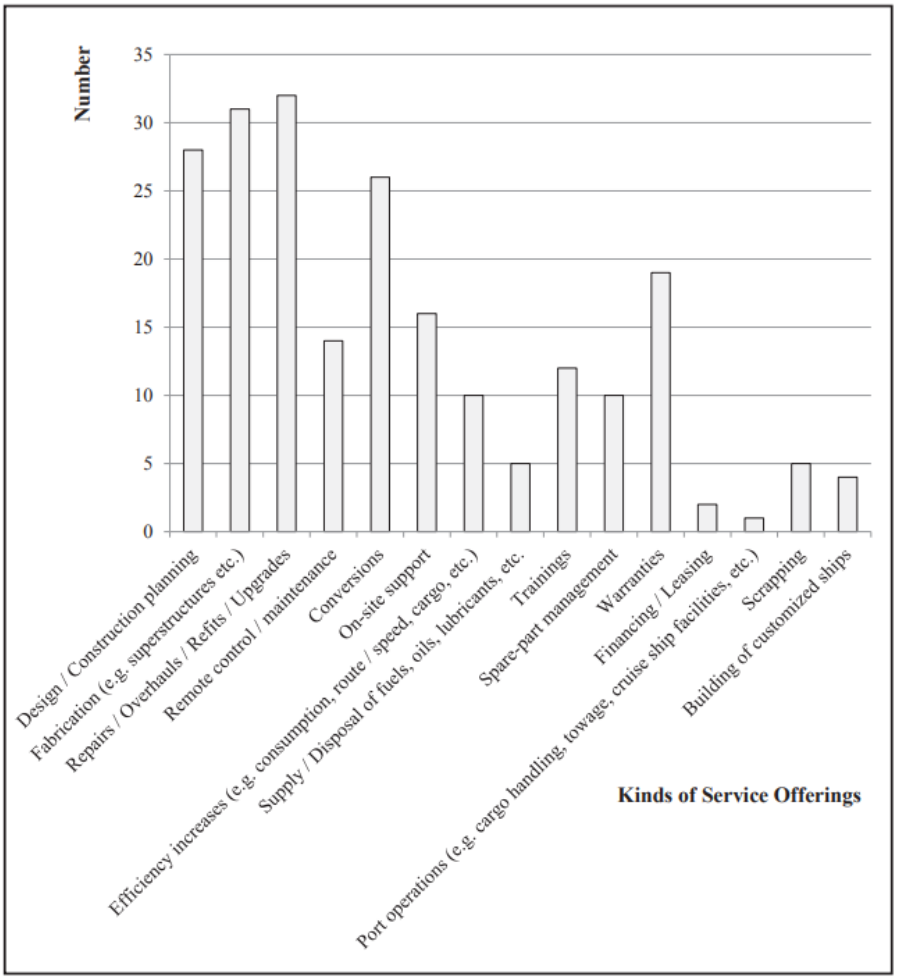


Figure 12: Kinds of Service Offerings from international survey respondents *(Sauerhoff, 2014)*

Table 16: Definition of service offerings utilized for the horizontal axis of adapted model

Service offering	Description
Design/ construction planning:	Service offering that entails that the shipbuilder states that they have design capabilities, which usually implies that they have a design department.
Fabrication	The shipbuilder has the capabilities to build ship blocks, hulls and/or other superstructures.
Repairs/ Overhauls/ Refits/ Upgrades	The shipbuilder has the capabilities to support ship owners to keep their ship operational during its life cycle.
Remote control/ Maintenance	Refers to the use of advanced technology and systems to monitor, control, and maintain ships from a remote location
Conversions	The capability to conduct substantial changes to the ship's structure/layout, usually to change it in such a manner that it serves a different function.
On-site support	This means that the shipbuilder has personnel that can travel to the location of a ship, when assistance is required.
Efficiency increases	Refers to improvements in vessels performance, like its operational effectiveness or energy utilization. Examples include optimizing consumption, route/speed, cargo etc., and is increasingly becoming more important with new environmental requirements like SEEMP III (DNV, 2023).
Supply/Disposal of fuels, oils, lubricants etc.	This mean offering the supply and/or disposal of necessary fuels, oils, and lubricants.
Trainings	Refers to the offering of training ship crews, which means mechanical/technical aspects of the ship and/or service functions (like yacht crews)
Spare-part management	This service means that the shipbuilder offers the systematic planning, procurement, inventory, and/or maintenance of spare-parts necessary for maintenance and repair of the ship.
Warranties	Refers to the contractual guarantees offered by the shipbuilder to ensure the customer that the ship they will receive has the agreed upon quality, performance and/or condition.
Financing/ leasing	The shipbuilder offers the possibility of financing and/or leasing of ships.
Port operations	This refers to capabilities like towing, cargo handling, cruise ship facilities, and other port operation related activities.
Scrapping	The shipbuilder offers the possibility of the end-of-life service scrapping, which means breaking up a ship for scrap.
Building of customized ships	The service refers to being able to offer the customers the ability to offer one-of-a-kind customized ships, and/or extensive customization of standardized ship platforms.
Other	Refers to shipbuilders that are suppliers of equipment assumed to be of importance for customers, like for instance producing cargo handling equipment, propulsion systems and military weapons.

2.2.4 Vertical Axis (industry width)

Industry width in this context is meant by the scope of segments the company targets and is by Porter divided into the two categories focused and industrywide (Porter, 1998). Porter continues to describe focused strategy as being focused on a particular segment, whilst being industrywide can be defined as "happening or existing in all or most parts of a particular industry (CambridgeDictionary, 2023)". In other words, industrywide companies are involved in several segments, whilst focused companies have specialized in a specific segment.

Since there is no established way of defining the degree of industry width, and the fact that this thesis relies on the availability of open-source data, it was decided that the most sensible approach to assess the industry width is by seeing how many vessels a given shipbuilder has delivered within the vessel segments defined in chapter 2.1.3. The vessel information can be obtained from reliable maritime databases such as SeaWeb, which often can be crosschecked with the vessel-references stated on the shipbuilder's official webpage. To ensure a fair comparison between different segments, the total gross tonnage (GT) of delivered ships within a segment was deemed more suitable than simply counting the number of delivered vessels. This approach takes into consideration the size and scale of the ships, recognizing that it would not be reasonable that the influence of a 500GT vessel would be the same as a 50,000GT vessel on the industry width. By considering the total gross tonnage, a more balanced and accurate assessment of the segments can be achieved. It was also considered to convert the GT of the vessels to Compensated Gross Tonnage (CGT) using the OECD definition (oecd, 2007), which would've taken vessel complexity into consideration. However, it was discovered that for certain vessel types it was difficult to decide which CGT unit category to utilize, which would be an additional source of error. When considering the uncertainty and the time constraints of the thesis, it was decided that the potential benefits of converting GT to CGT were limited, and not worth the extensive evaluation needed to provide every vessel with an appropriate CGT unit category.

To get a single KPI based upon the total GT of each segment, the diversity measure Shannon index was deemed fitting. A similar usage of the Shannon index can be seen in the master thesis (Jean, 2020), where it was utilized to create a KPI for product variety based upon vessels produced. The Shannon index is a recognized unifying measure of diversity, which originated from ecological diversity, but has later been adopted for business and economics as seen in (Patil & Taillie, 1982) and (Stirling, 1998). It takes the number of "species" and the evenness of the "species" into account. For this thesis, the Shannon index formula will be formulated in the following manner:

$$H = -\sum[(ni/N)\ ln(ni/N)])$$
$$H = Level\ of\ industry\ width$$
$$ni = Gross\ Tonnage\ produced\ within\ a\ given\ segment$$
$$N = Total\ Gross\ Tonnage\ produced\ by\ the\ shipyard/group$$

The total gross tonnage produced by the shipbuilder and the gross tonnage produced in the various segments first must be calculated. The individual segment values are then calculated,

before all the segments values are summarized. In table 17, one can see an example of how the industry width using the Shannon index will be calculated, and the value will be between 0 and 4. The industry width for shipbuilder X is 1.29, which is an indication that the shipbuilder is not within the focused product strategies because the value would be equal or close to 0.

Table 17: Calculation of the industry width for vertical axis adapted model of shipyard X example

Calculation of the industry width (Shannon index) of shipbuilder X		
Segments	GT	Diversity value $[(n_i/N)\ln(n_i/N)]$
All segments	100 000	n.a.
n1 Fishing/aquaculture segment	40 000	-0.37
n2 Offshore industry segment	15 000	-0.28
n3 Port operations segment	1 000	-0.05
n4 Public transport segment	35 000	-0.37
n5 Tourism segment	200	-0.01
n6 Luxury segment	8 800	-0.21
n7 Oceangoing cargo transport segment	0	0
n8 Inshore cargo transport segment	0	0
n9 Security segment	0	0
n10 Niche segment	0	0

$$\boldsymbol{H = -\sum_{n1}^{n10} [(-0.37) + (-0.28) + (-0.05) + (-0.37) + (-0.01) + (-0.21)] = 1.29}$$

3. Methodology

This chapter will first present the research strategy of this study, which connects it to previous work. This is then followed by the methodology regarding the literature study, data collection and analysis. The thesis will take advantage of both quantitative and qualitative approaches, to limit the disadvantages of the two approaches, and can in short be divided into three elements.

Firstly, a literature study was conducted to get sufficient insight into product strategy. The literature study conducted during the preliminary specialization project provided sufficient insight into shipbuilding, including the main activities, the main actors, and the vessel types, and therefore there was no need for a new literature study on this topic. The reason that a systematic literature review about the topic was not utilized, was the assumption that the findings of the review would lead to increased bias into which patterns to look for, and the time constraint of the thesis.

Secondly is the collection of data related to the service offering of shipbuilders, and the data of the vessels the shipbuilder has produced. The relevant shipbuilders and financial data collected during the specialization project, will be reused for this thesis.

Then thirdly is the analysis and discussion, which asses the suitability of the adapted model utilized to map the product strategies of European shipbuilders and tries to identify potential patterns between financial performance and product strategy. For this, both statistical analysis and qualitative interpretation will be utilized.

3.1 Research Strategy

This master thesis is a result of a specialization project conducted in the fall semester 2022, which is to be regarded as a preliminary study. The projects title was “Strategic factors affecting the financial performance of European shipyards”, and it explored if any links could be identified between financial performance and strategic factors that could be gathered from open sources. The identified potential links where mainly associated with product strategy, such as level of standardization of the vessels produced and if the shipbuilders had a certain specialization. Together with the supervisor Marco Semini, it was therefore decided that it would be of interest to focus on the product strategy of European shipbuilders for the master thesis, which could take advantage of some of the data previously collected. This data includes the selection and collection of relevant shipbuilders in Europe, as well as their financial data. Using the data of the collected shipbuilders as a starting point, the further research would be focused on mapping the product strategies of these companies, and seeing if certain product strategies seem to give a competitive advantage/disadvantage when compared to the financial performance.

For this thesis, the utilization of the artificial intelligence chatbot ChatGPT has proven to be a valuable tool. It was primarily used to enhance the text's flow and grammar, but also served as a helpful source of inspiration by providing suggestions. For instance, how to best structure the thesis, and relevant data analyses techniques to satisfy the needs for this thesis. The usage of ChatGPT in this thesis is in accordance with NTNU guidelines, which has been clarified by professors at the Department of Mechanical and Industrial Engineering (MTP).

3.2 Literature Study

To get sufficient insight into the topic of product strategy, and how it relates to shipbuilding, it was necessary to conduct a literature study. From the specialisation project, relevant literature related to the topic of shipbuilding will be utilized for this thesis and was found using the search engine Oria (NTNUs library search engine), lecture presentations made available by NTNU, Science Direct, and maritime transport reports in the UNCTAD database. The utilized findings from the specialisation project literature study includes the following:

1. Shipbuilding
    a. Definition
    b. European shipbuilding development
    c. Main actors
    d. Shipbuilding activities
    e. Vessel types

The literature study conducted during the work of the master thesis was primarily collected using Oria and Science Direct, but also reports from relevant shipbuilding association (like SeaEurope), as well as reports from EU and UN databases. The relevance assessment of articles was primarily based upon their titles and abstracts, as well as stated key words (see table 18). Articles deemed worth reading were further exploited to identify relevant literature employing a snowball sampling technique. The credibility of the articles was assessed by checking the credibility of the publisher and its cited sources. Its topics include:

2. Product strategy
    a. Definition
    b. Product strategy models
    c. Porters' Generic strategies
    d. Customer perceived value
    e. Industry width

Table 18: Main and additional key words product strategy literature study

Main search words (product strategy)	**Additional key words**
Product strategy	Shipbuilding
Generic strategy	Shipyard
Product portfolio	Shipbuilder
Product mix	Engineer-to-order
Product variety	ETO
Porters' generic strategies	Definition
Differentiation	KPI
Focused Differentiation	Measure
Cost focus	Performance
Cost Leadership	Metric
Service offer	Customer value
Industry width	

3.3 Data Collection

The data collection for this study follows the same key principle as with the preliminary study, which is that the data collection should be focused on open and publicly available data. Despite the limitations of the type of data that can be collected, this approach was chosen due to the assumption that the response rate of companies would likely be too low to get a sufficient data foundation. The experience of my supervisor Marco Semini and his former students also implies that response rate would be low, and this might be rooted in the fact that shipbuilding is a highly competitive global industry making sharing of data a sensitive topic. This assumption is also furtherly confirmed in the dissertation (Sauerhoff, 2014), which is used in this thesis. He states the following in his dissertation regarding a survey he sent to 360 shipbuilders from 51 countries on the 4th of April 2011:

"*In order to increase the response rate within the following weeks until the survey ended on August 31st, 2011, several reminder messages were sent to the shipyards by email and mail. In detail, 3 follow-up contacts were sent by email to those shipyards who had not respond so far or who had started filling in the questionnaire but had not finished it. Apart from these emails also a "thank you postcard" was sent to 322 shipyards in calendar week 16. At the end of May another follow-up was shipped by mail to 89 shipyards from 25 countries. Until July, the questionnaire in hard copy together with a postage-paid return envelope was sent to 128 shipyards from Germany (25), Italy (12), Spain (20), The Netherlands (33), Turkey (18), and to the United States of America (20) that had not participated in the survey so far. The reason for using alternative modes of contacting and responding was to encourage response and therewith increase the response rate. Therewith, it was also used as an approach to reduce the coverage and nonresponse error. Due to the sensitive topic of the survey, the difficulty of achieving a sufficient response rate was realized quite early.*"

In the end, 40 shipyards from 18 countries responded to the survey after roughly four months of sending reminders by email and conventional mail. Thus, resulting in a response rate of ca. 11%. Given that the researcher for this thesis did not have four months to collect data and send reminders, as well as having a smaller sample of 158 relevant European shipbuilders from the preliminary study, it's reasonable to assume that the thesis wouldn't have had a sufficient data foundation if it didn't focus on open and publicly available data.

3.3.1 Collection of Relevant Shipbuilders and Financial Data

This data was collected from the specialization project "Strategic factors affecting the financial performance of European shipyards", and the process described in this section is as described in the study. The full process of selection, collection and cleaning of data that resulted in the financial database of European shipbuilders, can be seen in table 19.

All accessible measures from all reported years were collected, and the financial data available at Orbis spanned from 2011 to 2021, and the measures collected includes:

- P/L before tax
- ROE using P/L before tax (%)
- ROA using P/L before tax (%)
- Number of employees
- Operating revenue (Turnover)
- Cash flow
- Total assets
- Shareholders' funds
- Current ratio
- Solvency ratio (Asset based) (%)

Two key performance indicators (KPIs) were considered particularly suitable before the data collection process started, which was Return on Assets (ROA) using profit/loss before tax (%) and EBITDA margin (%). These KPIs are commonly utilized for benchmarking companies within the same industry as they focus solely on the profitability of the company, excluding the influence of capital structure (debt and equity). The decision to select a specific KPI was made after the collection process was concluded, as it was necessary to assess whether opting for one or the other would result in the exclusion of many shipbuilders due to insufficient data availability. This was the case with EBITDA margin (%), where shipbuilders, particularly in the Netherlands, often did not report this metric. Consequently, ROA using profit/loss before tax (%) was chosen due to a high degree of available data, ensuring that few shipbuilders had to be excluded based on data availability.

The utilization of average data was necessary to smooth out the impact of fluctuations within the shipbuilding industry, both in the specialization project and in this master thesis. ROA is also stated to be a suitable metric to assess financial performance in (Porter, 1998), which further supports the suitability of ROA for this thesis and comparability with PGSM.

Table 19: Process to establish financial data set of suitable European shipbuilders

Process to establish financial data set of European newbuild shipyards		
Platform	Step nr.	Description
Seaweb	1	Find all companies in individual countries in Europe registered as shipbuilders in Seaweb.
TrustedDocks	2	Check if companies provided by Seaweb includes the newbuilding shipyards posted on TrustedDocks (only includes larger shipyards), add if missing.
Company website	3	Control each company to check if they are a newbuild shipyard because the list from Seaweb also included miscellaneous companies like for instance ship designers, main equipment suppliers, service/modification focused shipyards etc.
Orbis	4	Enter the company name in Orbis and choose the right company.
	5	Check whether the company is still active, bankrupt companies (up to 2021) are excluded.
	6	Add the company to a common list of approved newbuild shipyards for the country in question.
	7	Download the list of companies with financial measures to a common excel file.
Excel	8	Companies with less than a $10m in turnover are excluded.
	9	Companies with less than 3 years of available data (turnover) are excluded.
	10	Compile the data from individual countries to a single list for each region.
	11	Check if the shipyards meet the requirements of the study.

3.3.2 Product Strategy Data

As mentioned before, the product strategy data will be exclusively collected through open sources, primarily through the shipbuilders' websites and maritime databases. The services offered data will be collected using the approach seen in table 20, and the industry width data will be collected using the approach seen in table 21. If the information of the service offering and/or produced vessels is not sufficient, the shipbuilder will be excluded.

Table 20: Collection of services offered data

Collection of services offered data		
Platform	Step nr.	Description
Excel	1	Utilize the shipbuilder database established in the specialization project to find relevant shipbuilders.
Google search engine	2	Use the search engine Google chrome to find the company webpage, exclude shipbuilders where it can't be identified.
Company webpage	3	Try to identify the key words associated with each service, and if mentioned on the webpage, register it as a service offering.
	4	If the company has a service offering that correlate to the company being a main equipment supplier, for example if the shipbuilder also produces maritime or military equipment, add it as an "other service" and specify what the service implies.
Excel	5	Add the services offered to a designated excel-document by stating Yes/No if it offers a given service or not. If other, specify the service.

Table 21: Collection of industry width data

Collection of industry width data		
Platform	Step nr.	Description
Excel	1	Utilize the shipbuilder database established in the specialization project to find relevant shipbuilders.
Seaweb	2	Look up a relevant shipbuilder and download as an excel-document the overview of vessels produced with affiliated information like GT.
Company webpage	3	If the company has a reference list of produced vessels on their webpage, use it to crosscheck the vessels collected from SeaWeb, and add missing vessel to the SeaWeb excel-document.
Excel	4	Transfer the vessel information from the shipbuilder into a common excel-document for all the shipbuilders, and divide the vessels produced by the shipbuilder into fitting segments.
	5	Summarize the total GT produced by a shipbuilder and the GT of the associated segments and calculate the Shannon index for the shipbuilder.

3.4 Analysis

The selection of appropriate techniques to analyse the data will be based on the specific nature of the data under investigation. Given the highly complex nature of the shipbuilding industry, it is expected that the characteristics of shipbuilders will vary based on factors such as their size and geographical location. Additionally, the data collection process relies solely on open-source data, which introduces inherent uncertainty.

To identify meaningful patterns within the collected open-source data, the analysis techniques will need to be adapted. To analyse the characteristics of the mapped European shipbuilders, that will form the foundation to assess the suitability of the model, cluster analysis is regarded as the best technique. To test the hypotheses created to identify potential relationships between product strategy and financial performance, regression analysis and cluster analysis will be used to test and assess hypothesis 1, and cluster analysis to assess hypothesis 2.

For the execution of the analysis, the programs SPSS and Excel will be utilized. A similar study where the usage of cluster analysis and regression analysis was utilized to assess the effect of a company's product strategy (based upon Porter) on performance, is (Gibcus & Kemp , 2003).

3.4.1 Techniques

Two-step cluster analysis

A cluster analysis is an analysis technique for identifying data items that closely resemble one another, assembling them into clusters (Oxfordreference, 2023). Several studies have recommended cluster analysis as a suitable technique for classifying companies according to the strategy they employ. One example of this is (Dess & Davis, 1984), which employs cluster analysis to analyse differences in performance amongst clusters to see if Porters three generic strategies and "stuck-in-the-middle" theory affect the competitiveness of the companies. Performance in this context was measured as Return on Assets (ROA) and Annual Sales Growth. Similar analysis's where cluster analysis is used to assess the impact different strategies has on performance, can be seen in (Galbraith & Schendel, 1983), (Harrigan, 1985) and (Robinson Jr. & Pearce II, 1988). In the paper (Kerr & Lassar, 1996), cluster analysis was identified to be more useful than other multivariate techniques in developing empirical classifications, and as an appropriate technique for classifying businesses by Porters generic strategies.

In short, one can say that the main benefit of cluster analysis is the ability to treat strategy as a holistic set of characteristics. This means that one can divide companies into fitting clusters based upon these characteristics and analyse the difference of this clusters. Two-step cluster analysis is a tool found in the statistical program SPSS designed to reveal natural clusters within a dataset that would otherwise not be apparent. The creator IBM states that the algorithm employed by this procedure has several desirable features that differentiate it from traditional clustering techniques (IBM, 2021), which it states as the following:

Handling Categorical and Continuous Variables: to handle both categorical and continuous variables, we can assume their independence and use a joint multinomial-normal distribution. This approach allows us to model and analyse the relationship between these types of variables effectively.

Automatic Selection of Number of Clusters: that can automatically determine the optimal number of clusters by comparing model-choice criteria across different clustering solutions. This automated procedure helps us identify the most suitable number of clusters for the given data.

Scalability: to analyse large data files, we can employ the TwoStep algorithm, which constructs a cluster features (CF) tree summarizing the records. This technique enables efficient analysis of extensive datasets, providing scalability for clustering tasks.

Distance Measure: The selection of a distance measure determines how similarity between two clusters is computed. The two commonly used options are Log-likelihood measure and Euclidean measure. Log-likelihood measure places a probability distribution on the variables and assumes continuous variables follow a normal distribution, while categorical variables follow a multinomial distribution, and considers all variables as independent. The Euclidean measure calculates the straight-line distance between two clusters, but it is only applicable when all variables are continuous, which doesn't make I viable for this thesis.

Number of Clusters: determines the number of clusters, and can be done either automatically or fixed. By doing it automatically, the software identifies the optimal number of clusters based on the chosen clustering criteria. One can also specify a fixed number of clusters, meaning you manually fix the number of clusters in the solution. This is a useful option when trying to identify characteristics based upon the company's generic strategy, because you can alter the number of clusters and see if any certain characteristics appear.

Considerations and Assumptions: of importance include considering the order of cases, because it might impact the resulting clusters and final solution. To mitigate order effects, one could randomize the case order or run multiple analyses with cases sorted in different random orders for stability verification. The procedure also assumes independence amongst variables in the cluster model, and that the continuous variables are normally distributed, whilst the categorical variables follow a multinomial distribution. In general, the procedure is robust regarding violations of these assumptions, but it's essential to be aware of their relevance to the specific dataset being analysed.

Linear regression analysis

In statistics, regression analysis is a quantitative method that aims to uncover possible relationships between two or more variables, and lets you examine how changes in one variable correspond to changes in another variable. The regression technique that will be employed in this thesis is linear regression, and the reason for choosing this technique is due to the type of relationship being examined.

For this thesis, we will utilize one dependent variable and one independent variable and examine the relation between the two (single relationship). As described in (Hair Jr., et al., 2010), a linear regression model can be used to model the dependency between a single dependent variable, and independent variables. For the analysis, the dependent variable will be non-metric (binary) or metric.

The most widely used type of regression analysis is simple linear regression, employing the least squares method, which allows us to establish a relationship between two variables. The formula for the simple linear regression analysis is the following:

$$\boldsymbol{Y = a * x + b}$$

Here, **Y** represents the dependent variable, **x** is the independent variable, **a** is the coefficient indicating the rate at which y changes with respect to x, and **b** is the intercept.

If the y-intercept significantly deviates from zero, it indicates the presence of a constant systematic error between the two analysis methods. Additionally, we may encounter proportional systematic error, where the curves of the two analysis methods gradually diverge from each other on the graph, indicating a varying degree of inconsistency or bias between them. By examining such deviations, we can gain insights into the nature of the relationship and identify any systematic errors that may impact the results.

To examine the statistical relationship between the dependent variable **Y** and the independent variable **x**, we can formulate a null hypothesis H_0 which assumes no relationship between the two (**a** = 0). To evaluate the null hypothesis H_0 and the overall statistical significance of the model, we can conduct an F-test which assesses whether we can reject the null hypothesis based upon the calculated F-value and the observed significance level (p-value). The p-value should be compared to a predetermined significance level α, below which we can reject the null hypothesis. This significance level α represents the threshold for accepting the presence of a statistically significant relationship between Y and x (Hair Jr., et al., 2010).

When assessing the null hypothesis H_0, (Hair Jr., et al., 2010) describes the following four scenarios as seen in figure 13:

- Type 1 error: is the probability of falsely discarding the null hypothesis, meaning that one says there is a significant correlation between the dependent and independent variable when there isn't.
- Type 2 error: is the probability of falsely accepting the null hypothesis, meaning that one says there is no significant correlation when it exists.
- Power: is correctly discarding the null hypothesis because of a significant correlation.
- Correctly accepting the null hypothesis due to no significant correlation.

According to (Hair Jr., et al., 2010), the statistical significance α (p-value) required to discard the null hypothesis is usually set to 0.01 or 0.05, but can be to a less stringent value such as 0.1 resulting in an increased power. In the book they also state that the Power level $(1 - \beta)$, which is the probability of correctly rejecting the null hypotheses, should exceed 80%.

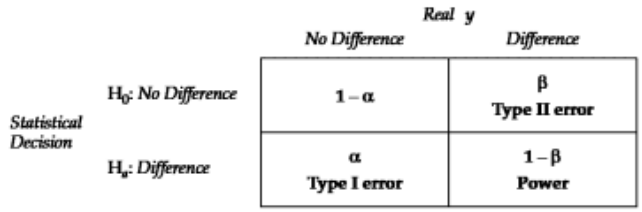


Figure 13: Statistical decisions regression analysis *(Hair Jr., et al., 2010)*

By conducting such a statistical test, we gain insights into the relationship between the variables and determine whether the observed results can be considered statistically significant. This approach, as described by Hair et al. (2010), allows us to make informed decisions about the presence or absence of a meaningful relationship between X and Y. To analyse the results from the simple linear regression analysis, and decide whether the H_0 should be rejected, partly rejected, or accepted, the following characteristics will be assessed:

Significant (p-value): is the most important value to be assessed because it determines whether the H_0 should be accepted or rejected. If the p-value lies above 0.1, H_0 will be accepted due to the high degree of uncertainty. If the p-value is between 0.1 and 0.05, it will be partly rejected because there is some evidence to accept the hypothesis, but still associated with substantial uncertainty. The reason that we don't reject the models with p-values between 0.05-0.1 in this is thesis, which is common, is because of the embedded uncertainty of the data founded on it being collected from open-source data and used to generate non-established KPIs for this thesis as discussed in chapter 2.2.3 and 2.2.4. In other words, it is the uncertainty of the data that is the reason for the acceptance of higher probability of errors. If the p-value lies bellow 0.05, H_0 will be rejected because there is strong evidence to support a correlation.

Standardized Coefficients (Beta): represensts how much a one standard deviation increase in the independent variable affects the dependent variable. This means that if the Beta is equal to two, a single standard deviation of the idependent variable will increas the dependent variable by two.

R^2-value: is a statistical measure that provides an evaluation of how well the idependent variable can predict the variability in the dependent variable. An R^2-value equal to 0 indicates that the model offers no explanatory value, and consequently has no predictive power. An R^2-value equal to 1 indicate that the independent value perfectly eplains variability of the dependent variable. These two scenarios are usually just theoretical, and the value lies between 0 and 1, which indicates the portion of variability in the dependen value that is explained by the independent varible.

Durbin-Watson: is a measure used to test the idependency of the dependent and idependent value, and can also be referred to as the level of autocorrelation. If there is a high degree of autocoorelation between the independent and dependent variable, the model should be rejected. This is because the values can not be regarded to be idependent, and the results cannot be trusted, because one value seemingly affect another. A Durblin-Watson close to 2 indicate no autocorrelation, a value less than 2 indicates a positive autocorrelation, and a value above 2 indicate a negaive autocorrelation.

If there are more than one independent varibale, the Variance Inflation Factor (VIF) is a good measure to test the multicollinearity in a regression model. Multicollinearity occurs when there is a high correlation between independent variables, that consequently can lead to unreliable estimates of the coefficiant. For the regression analysis that will be employed for this thesis, there is only one independent varibel, which eliminates the need to asses multicollinearity.

3.4.2 Analysis Framework

The frameworks that will be utilized to conduct the analyses, in order to answer the RQs, are explained in this subchapter.

RQ1

In table 22 one can see the framework for analysing the mapped product strategies, to later decide on the adapted model's suitability based upon the correlation between the findings and established understandings of product strategies of European shipbuilders. The identified classification of the shipbuilders into a suitable product strategy seen in step nr. 1 in table 22, will later be utilized for further analysis.

Table 22: Framework to assess the mapped product strategies

Framework to assess the mapped product strategies			
Platform	Step	Step nr.	Description
SPSS	Analyse data	1	Conduct a two-step cluster analysis with a preset number of five clusters using the industry width and service offering as independent variables. Comment on the cluster quality.
		2	Establish a fitting distribution of the shipbuilder's product strategies from the results. Give the companies a numeric value to represent their placement in the PGSM, and comment the product strategy characteristics.
		3	Conduct a two-step cluster analysis with the size classification of the shipbuilders as the dependent value, and use the service offering and industry width as independent variables. Comment on the cluster quality, and the product strategy characteristics of the three different size-definitions.
		4	Conduct a two-step cluster analysis with the region classification of the shipbuilders as the dependent value, and the service offering and industry width as independent variables. Comment on the cluster quality, and the product strategy characteristics of the four regions.
		5	Based upon the observed characteristics, assess the fit of the model against established understandings of European shipbuilder's product strategies.

RQ2

To address RQ2, it was decided to define two hypotheses that could be tested and analysed. The framework to test hypotheses 1 can be seen in table 23, and it is formulated as the following:

"The right balance between diversification and size increases the probability of better financial performance"

The hypothesis suggests that the degree of diversification, represented by the two axes discussed in chapter 2.2.3 (horizontal axis) and 2.2.4 (vertical axis), should correspond to the size of the company. Specifically, for small shipbuilders, the degree of diversification should be relatively low to ensure they can effectively manage complexity and maintain knowledge. The assumption is that the smaller the shipbuilders are, the less capable it is to maintain a good quality on a high degree of diversification due to its limited resources, and it's therefore more reasonable to have a more focused strategy to sustain a competitive advantage over your competition. As the shipbuilders' size increases, the degree of diversification should also increase to avoid vulnerability to market fluctuations.

It can also be assumed that the bigger the size of the company, the more global is the competition and market, and shipbuilders should therefore increasingly diversify to reduce the impact of fluctuations in certain vessel segments.

Another assumption is that to sustain a competitive advantage over your competition, European shipbuilders should increasingly offer more services to increase the perceived customer value, because European shipbuilders generally can't compete on labour and raw material cost in comparison to Southeast Asia. In short, the hypothesis states that finding the right balance between diversification and size is related to good financial performance.

Table 23: Framework to test Hypothesis 1 (RQ2)

Framework to test Hypothesis 1			
Platform	Step	Step nr.	Description
Excel	Create product strategy index	1	Normalize the x-values (industry width) and y-values (services offered) by employing the Excel formula standardization. The standardization formula utilizes the mean and standard deviation of a data set to normalize values.
		2	Calculate the average value of the x-value and y-value of the product strategy model to create a single index for diversification.
	Normalize size-values (turnover)	3	Normalize the size-values of the shipbuilders by utilizing the Excel standardization formula.
SPSS	Scatter plot	4	Create a scatter plot, with the new diversification index as the y-axis and the normalized size-values as the x-axis.
		5	Add a reference line to the scatter plot created in step 4.
		6	Identify plots in proximity to the reference line, and designate these with the value 1, and the remaining plots as 0s.
Excel	Analyse data	7	Calculate the average AROA of the shipbuilders identified in step 6 and compare it to the average AROA values of shipbuilders above and below the reference line.
SPSS		8	Conduct a linear regression analysis to assess the quality of the model, where the proximity to the reference line (1 or 0) is the independent, and AROA as the dependent value.
		9	Comment on the significance level of the model to reject, partly accept or accept the null hypothesis. Further on, assess the R-square value to see how well the model fits the data, the Beta-value to see the effect the independent value has on the dependent, and the Durblin-Watson to assess the autocorrelation.
		10	Conduct a two-step cluster analysis, with the relationship values used in the regression analysis as the dependent variable, and the AROA values as the independent value. Use a set number of two clusters.
		11	Assess the cluster quality of the model, and comment on the characteristics of the two clusters.

The framework to test hypotheses 2 can be seen in table 24, and it is formulated as the following:

"The product strategy associated with higher financial performance will vary depending on the geographical location, but hybrid strategies will not be associated with a competitive advantage in any region".

Due to the cultural and demographic differences within Europe, it is assumed that this impacts the product strategy. During the literature study for the specialisation project, it was discovered that there are differences between the European regions regarding their manufacturing strategy. In other words, how they construct the vessel. For instance, in Norway where the labour costs are very high, the shipbuilders in general choose to get much of the steel work and early outfitting done in another country where labour costs are lower, such as Poland, Romania and Turkey. The reason for this is to focus on the complex and most value-adding tasks, whilst the simpler steel work and outfitting tasks are offshored to low-cost countries. In Turkey however, if they're making a turnkey ready ship, they generally construct the entire ship from keel-laying to the final outfitting and commissioning. This difference in manufacturing strategy is also a factor contributing to the assumption that the ideal product strategy changes with geographical location. However, based upon Porter's theory of being "stuck-in-the-middle", there is an assumption that the shipbuilders without a clear strategy will generally have a lower financial performance.

Porter claims that the three generic competitive strategies are mutually exclusive, and that companies who tries to combine them will get "stuck-in-the-middle", which increases the probability of low profitability (Porter, 1998). As discussed earlier in chapter 2.2.2, this claim is highly debated, as there are many examples of companies that are highly profitable and combine strategies.

Table 24: Framework to test Hypothesis 2 (RQ2)

Framework to test Hypothesis 2			
Platform	Step	Step nr.	Description
Excel	Establish table	1	Utilize the findings from the "Framework to assess the mapped product strategies", to establish a table of summarized financial performance and distribution data of the shipbuilders divided by region and product strategy.
SPSS	Analyse	2	Comment on the characteristics of the regions by their focused versus industry wide approach, and cost-orientation versus differentiation approach. Also comment on the characteristics of the shipbuilders with hybrid strategies.
		3	Based upon the observed characteristics, assess if hypothesis 2 is accepted, partly accepted, or rejected.

4. Data Analysis and Findings

In this chapter, we will initially examine the product strategies employed by European shipbuilders, and possibly identify potential patterns related to size and geographical location. These findings will subsequently be discussed to address RQ1. Furthermore, the data will be analysed and tested against two hypotheses, which will be discussed in relation to answering RQ2. The collected data can be seen in Appendix 3.

4.1 Mapping of European Shipbuilders' Product Strategy

The shipbuilders examined during this thesis were collected during a preliminary study, as described in chapter 3.3.1. Some of the shipbuilders from the original data set had to be excluded for this thesis because of the following reasons:

- To little information available regarding the vessels produced and/or services offered.
- Bankrupt shipbuilders were excluded (MV Werften group, Lloyd Werdt Bremerhaven, Factorias Vulcano).
- Shipbuilders with a complicated financial structure, where the AROA couldn't be accurately assessed (Damen group, Vard group, Astilleros Armon group).
- Yards that only produces blocks, hulls, partly outfitted hulls, and not turnkey vessels.
- Russian shipbuilders were excluded due to the reduced relevance to the European shipbuilding industry because of the Ukrainian-Russo war, that includes heavy sanctions.
- Shipbuilders with outlier characterises of financial data, that would heavily affect the results (Oyster Yachts).

After the data collection was concluded, 93 European shipbuilders remained, which is considered a reasonable data set. The vessel information of ca. 2900 vessels was also collected to establish the industry width. After the data collection process was concluded, it was decided to remove the services "Supply/Disposal of fuels, oils, lubricants etc" and "Warranties" from further analysis. This decision was made because few shipbuilders mentioned it as offered services, but it is assumed that many shipbuilders offer these services but consider them self-evident. This assumption was shared by the thesis's supervisor.

To divide the European shipbuilders into their respective generic product strategy, a twostep cluster analysis (see table 22) utilizing the standardized values of industry width and services offered was conducted, using a locked number of five clusters based upon the PGSM described in chapter 2.2.1. The quality of the formed clusters is deemed to be satisfactory, with a silhouette measure of cohesion and separation of 0.6 as seen in figure 14. Due to the satisfactory quality of the clusters and seeming fit of the location of the clusters as seen in figure 15 when compared to PGSM (see figure 9), it is deemed to be a suitable division of the product strategies of European shipbuilders.

To divide the strategies more clearly, reference lines of the mean x-values and the mean y-values of the data, were added to the scatter plot of the product strategy clusters.

Most of the shipbuilders falls within the cost-part of the matrix, as well as the majority falls within the industry broad part of the matrix. As seen in table 25, the biggest cluster is the Cost Focus with 31.2% of the total population, followed closely by Cost Leadership (24.7%), Hybrid strategy (22.6%), Differentiation Focus (13%) and Differentiation (7.5%). The descriptions and independent variable distribution of the various product strategies can be seen in figure 25.

Table 25: Characteristics description of European shipbuilder's product strategy

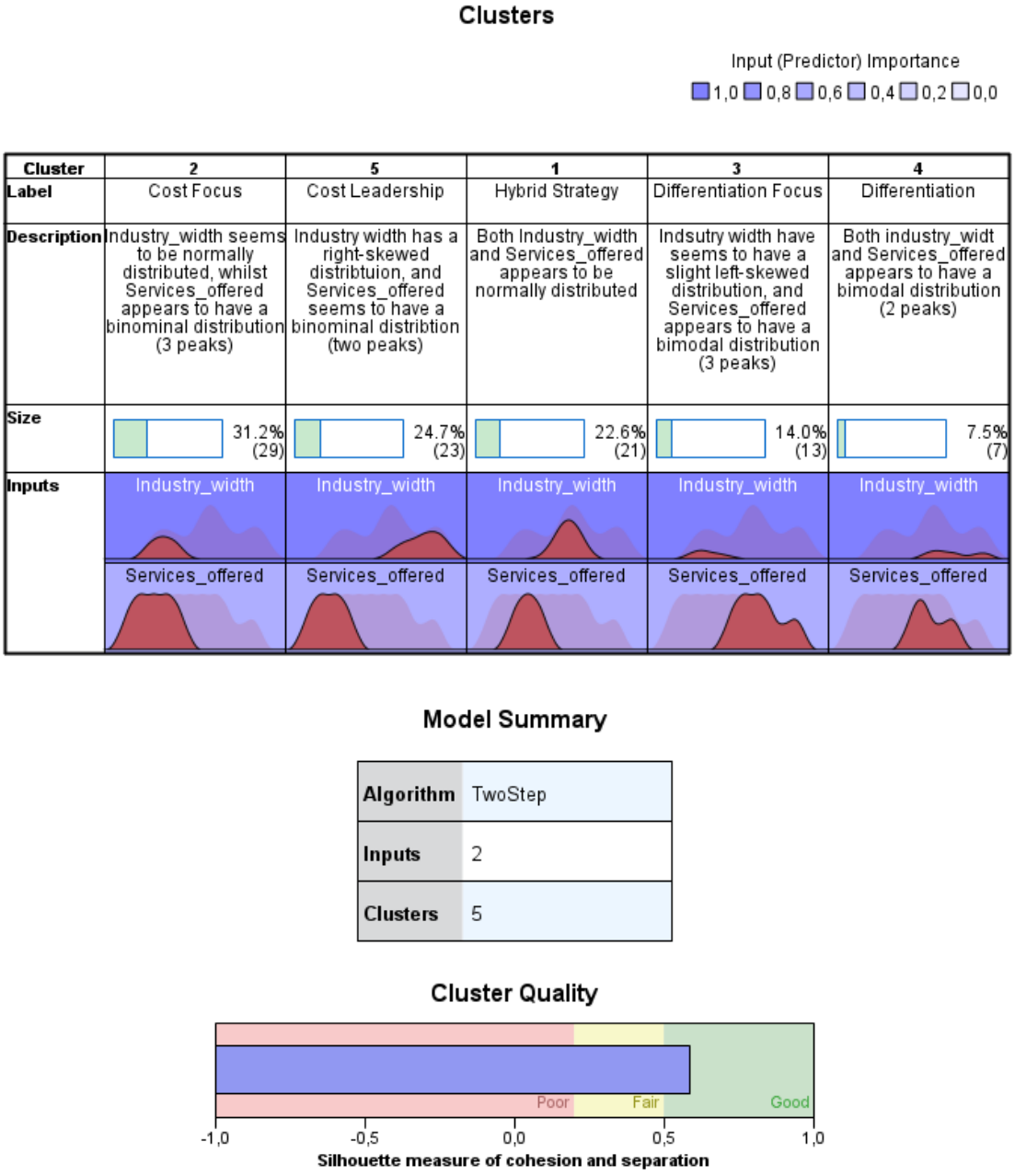


Figure 14: Model summary for identifying shipbuilder's product strategy

One important thing to keep in mind is that this is the division of product strategy from a European standpoint. If one would have included shipbuilders from other parts of the world, the European shipbuilders might have ended up on different areas of the matrix then in figure 15.

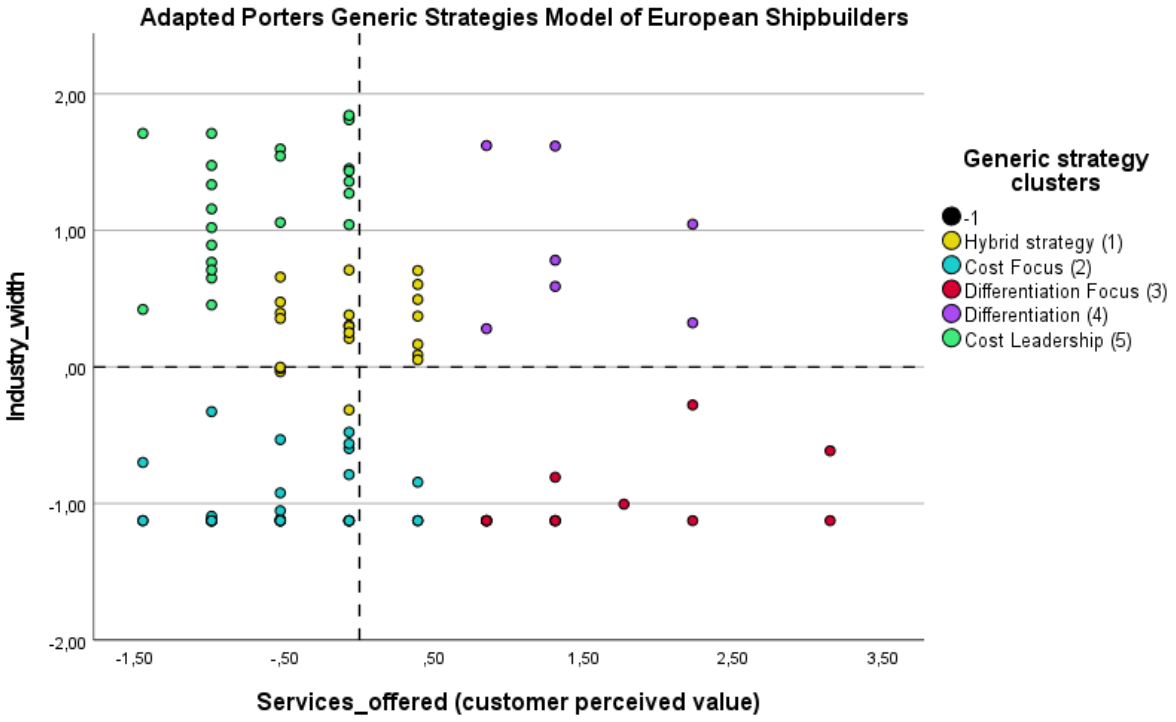


Figure 15: Scatter plot visualizing European shipbuilder's product strategy

4.1.1 Size vs. Product Strategy Distribution

The distribution of the companies in accordance with their respective size can be seen in figure 17, which shows that most shipbuilders are characterized as small with the definition employed by this thesis, followed by medium and then large-sized shipbuilders. When discussing European shipbuilders, it also important to keep in mind the size aspect, because some shipbuilders dominate the industry regarding turnover as seen in figure 16. The biggest shipbuilders are mainly focused on producing cruise ships (Turku Meyer, Chantiers d'Atlantique, Fincianteri), military vessels (NAVAL group, BAE system surface ships) and yachts (Azimut-Benetti and Feretti). These are all segment where customers in general are willing to pay more for high-quality products, which makes sense because Europe struggles to compete in the cost aspect. As seen in the calculation below, 20 % of the biggest shipbuilders account for 83 % of the total average turnover, which is in line with Pareto's 80/20 rules. The 80/20 rule states that 20% of the causes, accounts for 80% of the consequences.

$$93\ shipyards * 0.2 \approx 19\ shipyards$$

$$Average\ turnover\ of\ the\ 19\ largest\ shipyards\ = \ 19\ 559\ 194\ 000\$$$

$$Average\ turnover\ of\ all\ shipyards = \ 23\ 597\ 406\ 000\$$$

$$20\%\ of\ the\ largest\ shipyards = \left(\frac{19\ 559\ 194\ 000\$}{23\ 597\ 406\ 000\$}\right)$$

$$\approx 83\%\ of\ the\ total\ average\ turnover$$

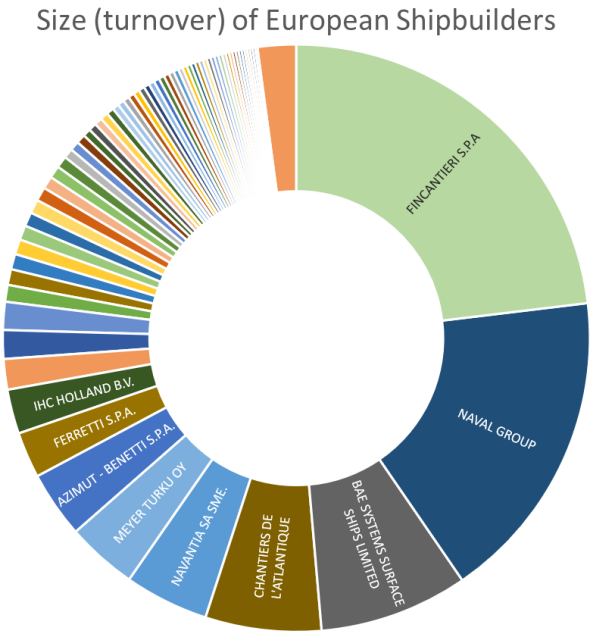


Figure 16: Size comparison of European shipbuilders

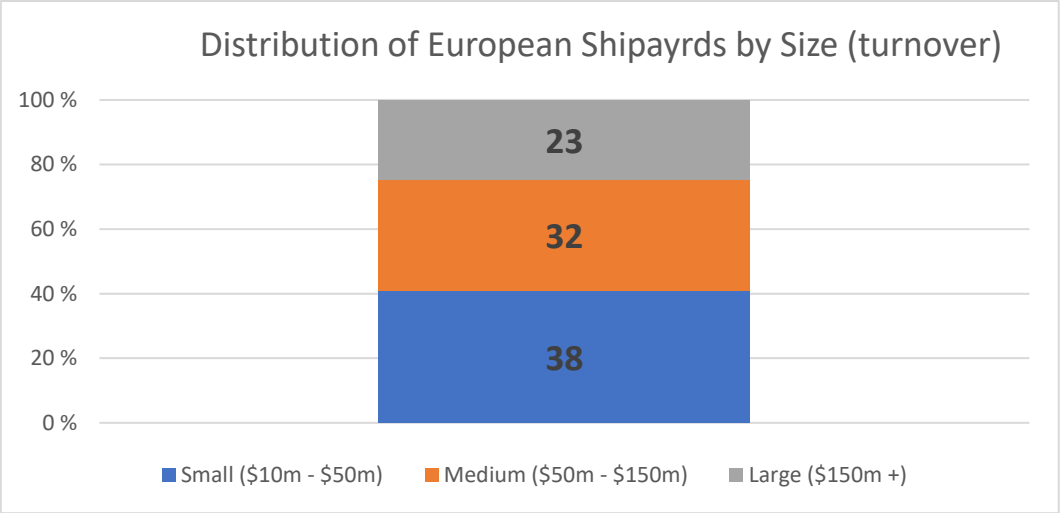


Figure 17: Distribution of European shipbuilders by size

The quality of the formed clusters when size is the dependent in PGSM, is deemed to be a reasonable value to assume that there might be some weak links, with a silhouette measure of cohesion and separation at 0.4. When the cluster description in table 26 is examined, some trends related to the offered services and industry width can be observed. It seems to be a trend regarding the size of the the company, and the number of services it offers. Large shipbuilders in general offer more services when compared to small and medium-sized shipbuilders. It also seem to be trend that medium-sized shipbuilders are generelly more industry wide, and large-sized shipbuilders are more focused.

Table 26: Characteristics description of European shipbuilder's product strategy by size

Cluster	1	3	2
Label	Small	Medium	Large
Description	Seems to be a trend that small shipyards offer fewer services than the larger shipyards, no obvious trendcan be seen regarding industry_width	Seems to be a trend that medium shipyards offer slighlty more services than the small yards, and the industry width seems to be slightly skewed to the right	There is a trend that large shipyards in general offer more services than other yards, seems to be a trend that the industry_width is slightly left-skewed
Size	40.9% (38)	34.4% (32)	24.7% (23)
Inputs	Size_number Services_offered Industry_width	Size_number Services_offered Industry_width	Size_number Services_offered Industry_width

4.1.2 Geographical Location vs. Product Strategy

The geographical division of Europe is based upon "United Nations geoscheme for Europe" (UNSTAT, 2022), and is described in chapter 1.3.1. The distribution of shipbuilders by region can be seen in figure 18, which clearly indicates that most companies are found in Southern and Northern Europe, followed by Western Europe and lastly Eastern Europe. However, it is important to state that these are the shipbuilders identified for this thesis and don't necessarily provide a completely accurate representation of the shipbuilding industry in Europe. For instance, it was observed during the data collection process that there are many shipbuilders, predominantly in Eastern Europe, that are focused on producing blocks, hulls, and partly outfitted vessels. Consequently, excluding them from this thesis.

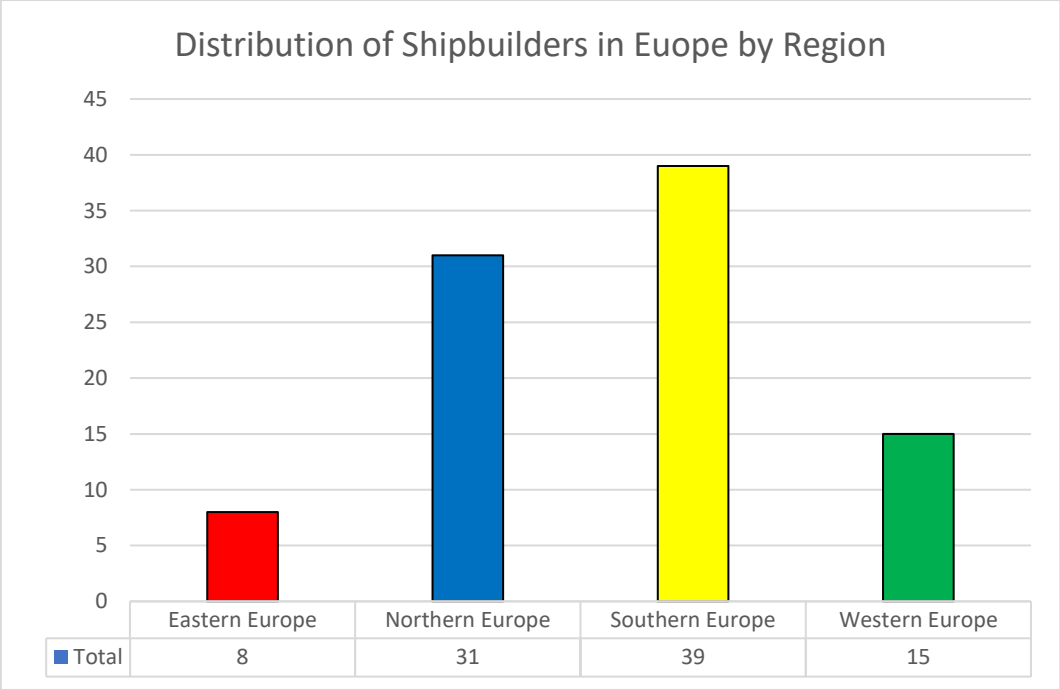
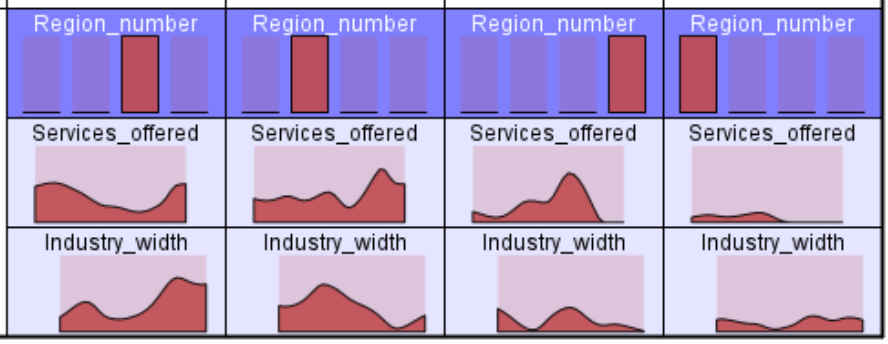


Figure 18: Distribution of European shipbuilders by region

The quality of the formed clusters when region is the dependent in PGSM is deemed to be low but acceptable with a silhouette measure of cohesion and separation at 0.3, which indicates that there might be some weak links. When the cluster description in table 27 is examined, some weak trends related to the offered services and industry width can be observed. It seems to be a trend that shipbuilders in Southern Europe are generally more industry wide, Northern European shipbuilders more focused and western shipbuilders more prominent to the mean of PGSM. When looking at services offered, the Northern and Western shipbuilders seems to generally offer more services than the other regions, whilst especially Eastern European shipbuilders generally offer few services.

Table 27: Characteristics description of European shipbuilder's product strategy by region

Cluster	4	1	3	2
Label	Southern Europe	Northern Europe	Western Europe	Eastern Europe
Description	No obivious trends can be spotted regarding Services_offered, and it seems that Southern shipyards have a tendency of being more industry wide	Seems like there is a slight trend that the services_offered are right-skewed, and it seems that Northern shipyards have a tendenacy of being more focused	Seems to be a trend that these shipyards generally offer many services, and the industry width is a bit more prominant around the mean y-value	Seems to be a trend that these shipyards generally offer fewer services than other regions, and no obvious trends can be seen regarding the industry width
Size	41.9% (39)	33.3% (31)	16.1% (15)	8.6% (8)
Inputs				

4.2 Relationships Between Product Strategy and Financial Performance

In this subchapter, the two hypotheses will be tested using the framework established in chapter 3.4.2.

4.2.1 Hypothesis 1

"The right balance between diversification and size increases the probability of better financial performance"

To test H1, the structured approach discussed in table 23 was utilized. After having standardized the values of the industry width-axis and services offered-axis using Excels Standardization formula, the average values of the of the two units were calculated, which provided a single unit for diversification. The size (average turnover) values were then standardized, also utilizing Excels standardization formula.

A scatter plot was then created in SPSS using the new unit for diversification as the y-axis, and the standardized size values as the x-axis. Since Excels standardisation formula utilizes the mean- and standard deviation values of the data set you want to standardize, it makes the scatter plot created in SPSS also based upon the mean and standard deviation. This means that the in-built reference line function in SPSS illustrates the linear relationship between product strategy and size.

To test if there is any relationship between financial performance and shipbuilders close to the reference line, shipbuilders close to the line had to be identified as seen in figure 19. The identified shipbuilders were given the value 1 to symbolize relationship to the reference line, whilst the other shipbuilders are 0s. A linear regression analysis was then run in SPSS, using the relationship values as the independent values, and the AROA as the dependent value.

For this test, only small and medium-sized shipbuilders were utilized because the large sized shipbuilders distort the datapoints due to the substantial differences in size as discussed in chapter 4.1.1. It is also assumed that its sufficient with the small and medium-sized shipbuilders, because of the sample size of the two categories and the assumption that if a pattern exists it should be prominent in these categories. In table 28, the descriptives of the dependent and independent value can be seen. The most important takeaways are that 67 companies are part of the regression analysis, and the AROA varies between ca. -20% to 14% with a standard deviation of 6.3 %.

Table 28: Descriptive statistics of the variables for regression analysis to test hypothesis 1 (RQ2)

Descriptive statistics of the variables					
	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	0.435	3.358	1.525	1.425	67
Residual	-20.751	14.098	0.000	6.300	67
Std. Predicted Value	-0.766	1.286	0.000	1.000	67
Std. Residual	-3.269	2.221	0.000	0.992	67

The main results of the regression analysis can be seen in table 29, and the full analysis in appendix 2. The main results can be summarized as the following:

Sig (p-value):

- The p-value associated with the idependent variable is 0.072, which means there is a 7.2 % chance of observing the t-value 1.832 or more extreme values by chance if there were no relationship between the dependent and independent variable.
- The p-value lies below the significance level of 0.1, which suggests that there is some evidence to reject the H_0. However, since the p-value lies above the conevntional significance level of 0.5, it is associated with a relativly high probability that the findings are random.

Standardized Coefficients (Beta):

- The Beta is 0.222, and represents that a one-standard-deviation increase in AROA is equal to a 0.222 change in standard deviation increase regarding the reference line location. In short this means that an increase in AROA increases the possibility that the shipbuilder is located within the reference line area, which indicates a postive corrolation between product strategy, size (turnover) and financial performance (AROA).

R^2-value:

- The R^2-value is 0.049, which indicates that a relatively low degree of the variance is explained by the model. This consequently suggests that the model have limited predictive power over the depdent value.

Durbin-Watson:

- The Durblin-Watson statistic is 2.029, which indicates that there might be some degrees of autocorrelation present, but the autocorrelation is not considered to be espescially significant.

Based upon the affermentioned values, H_0 is partly rejected, because there seems to be a weak trend between diversification, size and financial performance. It's only partly rejected due to the high degree of uncertainty.

Table 29: Results regression analysis to test hypothesis 1 (RQ2)

Results regression analysis to test Hypothesis 1							
(Independent value: Reference line location)	Sig. (p-value)	F	t-value	Standardized Coefficients Beta	R^2	Adjusted R^2	Durbin-Watson
Dependent variable: AROA	0.073	3.323	1.823	0.221	0.049	0.034	2.029

The second test of H1 includes conducting a cluster analysis, where the relationship values used in the regression analysis are used as the depedent variable, and the AROA vales as the independent variable. The quality of the formed clusters is deemed to be good, with a silhouette measure of cohesion and separation at 0.8. There seems to be a trend that shipbuilders within the reference line has a stronger financial performance, than those outside as seen in table 30 and figure 19. This means that there seems to be a link between product strategy, size and financial performance.

Table 30: Characteristics description of cluster analysis to test Hypothesis 1 (RQ2)

Cluster	1	2
Label	Outside reference line	Within reference line
Description	There is a clear left-skewed pattern to the AROA distribtion, indicating that most shipyards are low performing. The average AROA = 0.43	The is a clear right-skewed pattern of the AROA distribution, indicating that shipyards generally tend to be better performing. The average AROA =3.36
Size	62.7% (42)	37.3% (25)
Inputs	Reference location number_2	Reference location numb
	AROA	AROA

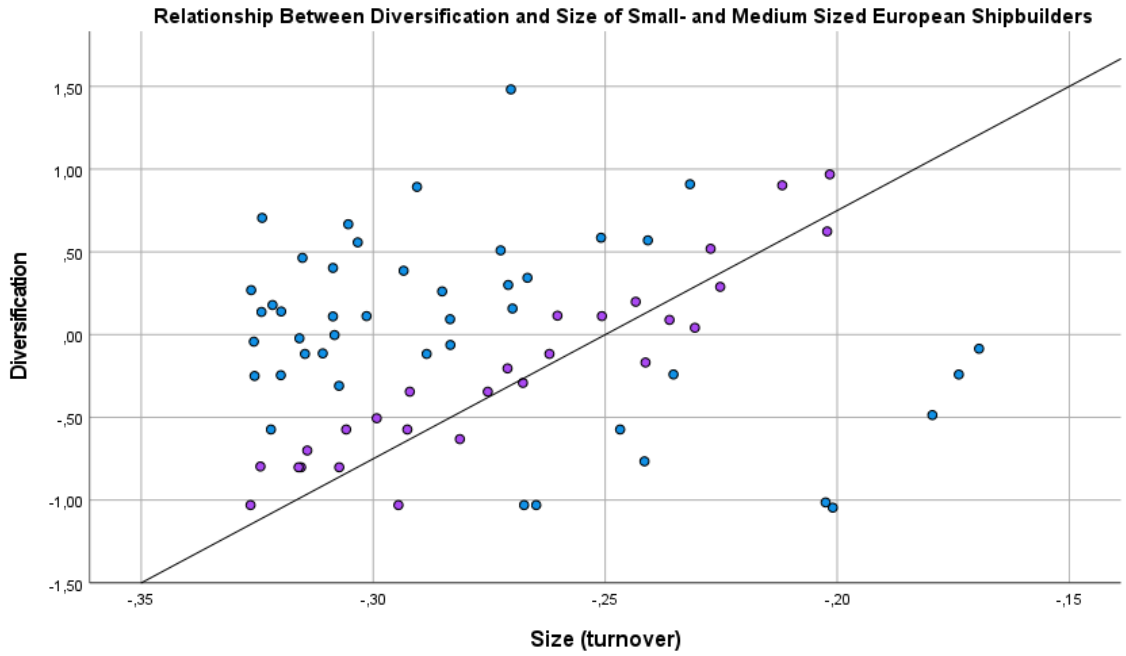


Figure 19: Scatter plot visualization of relationship between diversification and size of small- and medium sized European shipbuilders

4.2.2 Hypothesis 2

"The product strategy associated with higher financial performance will vary depending on the geographical location, but hybrid strategies will not be associated with a competitive advantage in any region".

To test this hypothesis, the framework described in table 24 was utilized. The location of the shipbuilders in the adapted PGSM as seen in figure 15 determined the product strategy of the shipbuilders. Further on, the financial performance of each region and the subsequent strategies within each region, was then collected as well as the distribution which is visualized in table 18. The test will be based upon the assessment of the financial performance and distribution within the cost-oriented and differentiated approach, and whether the shipbuilders generally are focused or industry wide. The sample size will also be considered during the assessment.

When comparing the financial performance of the product strategies of all the regions, it seems to be a trend that the industry-wide approaches provide the greatest competitive advantage. No clear trend could be observed when comparing the cost-oriented versus differentiated strategies. However, it is a clear trend that the shipbuilders following a hybrid strategy generally has a weaker financial performance compared to the other regions.

It was considered to conduct a linear regression analysis of weather low financial performance is related with hybrid strategy based upon the results, but it was decided to not include it due to the low suitability of the model. The regression model would try to find a pattern between low financial performance and hybrid strategy, not considering regional differences and size.

The regional differences can be seen in table 31, which also shows that in certain regions the hybrid strategy is not the worst performing product strategy.

Also, the hypothesis did not state that the lowest performing shipbuilders follow a hybrid strategy, but rather that following a hybrid strategy increases the possibility of lower performance than comparable companies as described by Porter.

Eastern Europe

The region adds up to roughly 9% of the accepted shipbuilders in this thesis, and the differences between the different regions is therefore associated with a high uncertainty due to the minimal sample size of 8. What we can conclude is that the region generally has a more cost-oriented shipbuilding industry, since 6 of the 8 shipbuilders lie within the cost-oriented strategies Cost Focus and Cost Leadership. It also seems to be a trend that industry wide shipbuilders have stronger performance than the focused shipbuilders, when comparing the performance of the Cost Leadership (3), Differentiation (1) and Hybrid strategy (1) against Cost Focus (3).

Northern Europe

The region adds up to 33% of the accepted shipbuilders in this thesis, and is therefore the second biggest region. As previously discussed, the shipbuilders in this region tend to be focused, which is also evident in table 31. Ca. 55% of the shipbuilders follow a focused strategy, 26% follow a hybrid strategy and 19% follow an industry wide approach. No obvious trend could be spotted from table 31 regarding the distribution between the cost-oriented and differentiated strategy approaches, but as seen in in distribution in table 27, the services offered seems to be slightly right-skewed towards differentiation rather than focused.

The shipbuilders following the hybrid strategy generally have the lowest financial performance, and it also seems to not be regarded to be a competitive advantage to be cost focused.

Southern Europe

The region ads up to 42% of the accepted shipbuilders in this thesis, and is therefore the biggest region. There is a clear trend that the shipbuilders generally are cost-oriented, because 72 % follows either a cost-focus or a cost leadership approach, as well as 15 % follows a hybrid strategy. No obvious trend could be spotted from table 31 regarding the shipbuilder's preference of following a focused or industry wide approach, but as seen in the distribution in table 27, the product strategies seem to be slightly skewed against an industry wide approach in the matrix.

Also, worth mentioning that the region generally has lower performance than the other regions, but the shipbuilders focused with cost-oriented strategies seem to be doing better than the ones following a differentiate approach. Especially the cost focus strategy seems to be the one associated with higher performance. The shipbuilders following a hybrid strategy approach do not seem to have a competitive advantage, and generally performs below the average.

Western Europe

The region adds up to 16% of the accepted newbuilding shipbuilders in this thesis and is therefore the third biggest region. From table 31, no clear trend of whether the shipbuilders follow a cost-oriented or differentiated approach can be observed, but when looking at the distribution in table 27 there seems to be a trend that the shipbuilders are generally more differentiated. When looking at the focused versus industry wide aspect, there is no clear trend of the shipbuilders being one or the other. It is however worth mentioning that hybrid strategy is the biggest strategy, and 40% of the shipbuilder follow this product strategy.

The financial performance is generally higher in this region, and it seems that the shipbuilders with a clear product strategy generally has a strong financial performance. However, the shipbuilders following a hybrid strategy seems to have a significant disadvantage, with substantially lower financial performance than the other product strategies.

Table 31: Financial performance (AROA) and distribution of European shipbuilders by Porters generic strategies and region

Average AROA	**Hybrid** Strategy	**Cost** Focus	**Differentiation** Focus	**Cost** Leadership	**Differentiation**	Distribution
		Focused		**Industry wide**		
All Regions	0.35% (21)	1.67% (29)	1.12% (13)	1.71% (23)	2.90% (7)	100% (93)
Eastern Europe	0.74 % (1)	-0.27 % (3)	n/a (0)	3.90% (3)	2.94 % (1)	9% (8)
Northern Europe	1.00% (8)	1.88% (11)	2.62% (6)	2.32% (3)	4.70 % (3)	33% (31)
Southern Europe	0.13 % (6)	1.77 % (14)	-3.23% (3)	0.28 % (14)	0.07 % (2)	42% (39)
Western Europe	-0.38% (6)	3.87% (1)	2.15% (4)	5.56% (3)	3.12% (1)	16% (15)

4.3 Discussion of Findings

In this chapter the research questions established in chapter 1.2 will be answered, based upon the findings in chapter 4.1 for RQ1, and the findings in chapter 4.2 for RQ2.

4.3.1 Research Question 1

"How can an established model of product strategy be adapted to map the strategies of European shipbuilders using open-source data, and do the characteristics of the mapped strategies fit with established understandings of European shipbuilder's product strategies?"

Adaptation of the model

The established model for product strategy, PGSM, was selected as a suitable model in chapter 2.2. However, to adapt the model for mapping the product strategies of European shipbuilders using open-source data, it was necessary to redefine the horizontal and vertical axes. The goal was to find suitable metrics that could be collected through open-source data. For the horizontal axis, the services offered by the shipbuilders emerged as a relevant measure to determine the level of differentiation. To evaluate the vertical axis, industry width was chosen as the metric. It was determined that examining the vessels produced by a particular shipbuilder, based on the vessel segments defined in Chapter 2.1.3, would be a suitable indicator of industry width. By redefining these axes, the assumption is that the adapted PGSM could effectively map the product strategies of European shipbuilders using available open-source data.

Fit of horizontal axis (services offered)

When analysing the product strategies of European shipbuilders, it becomes evident that the landscape is highly diverse, but exhibits some general characteristics. Table 25 shows that most shipbuilders (56%) adopt a cost-oriented approach to product strategy, indicating a limited-service offering. This tendency is attributed to the fact that small- and medium-sized shipbuilders, which account for approximately 75% of the shipbuilders in this thesis, generally have a distribution of service offerings skewed towards more cost-oriented product strategies (see table 26). Limited resources, such as the number of employees, are generally conceived to be a limiting factor to the number of services a company can offer. Meaning that smaller companies often don't have the capacity to offer as many services as larger companies, which is confirmed by the findings in this thesis.

Given this finding, the metric of "services offered" has proven to be a suitable key performance indicator (KPI) for evaluating the level of differentiation in a company's product strategy using readily available data sources.

Fit of vertical axis (industry width)

Regarding industry width, there appears to be a slight trend among shipbuilders that the focused strategy is the most prominent. Approximately 45% of the shipbuilders demonstrate a focused strategy, 21% follow a hybrid strategy, and 32% maintain an industry-wide approach. This pattern is aligned with the European shipbuilding industry's characteristic, which is to target niche markets such as cruise vessels, offshore industry vessels, and luxury yachts. This is supported by the observations made during the data collection process, by the statistics seen in figure 7, and in the reports (LeaderSHIP2020, 2013) and (Mickeviciene, 2011). Notably, many small- and medium-sized shipbuilders operate on an industry-wide basis, while larger shipbuilders generally exhibit a more focused strategy. One possible explanation for this is that larger shipbuilders build larger vessels, that are more exposed to competition from shipbuilders in Asia, because they generally focus on larger vessels like cargo ships.

Given the fit of the findings against established perspectives of European shipbuilder's industry width, which is that the industry generally is quite focused, the definition of industry width utilized for this thesis is deemed suitable.

Regional differences

An interesting observation from the mapped product strategies is the regional differences in preferred approaches.

Northern shipbuilders generally demonstrate a higher degree of focus and differentiation compared to other regions. This is supported by the fact that the labour cost in many of these countries is very high (especially Norway), as seen in figure 20, which has resulted in a product strategy that focuses on more value-adding activities like outfitting and service offerings. In the paper (Semini, et al., 2018), the typology of offshoring strategy was introduced to describe Norwegian shipyards strategy to offshoring. It is divided into four categories, which are based upon the amount of work that is conducted in a low-cost country. Based upon this typology of offshoring strategy, the data collection process in the paper (Semini, et al., 2022) showed that no large shipbuilders in Norway builds the entire vessel in Norway, and that the companies offshore either the building of blocks, the ship hull, or partly outfitted hulls. When considering the fact that most of the shipbuilders in Northern European are Norwegian as well, it can be concluded that the findings made from the adapted PGSM is supported.

The Eastern shipbuilders predominantly adopt a cost-oriented strategy with limited-service offerings, lacking a clear preference for industry width. The sample size of these regions is quite low (8) in comparison to other regions, which makes the findings less credible due to the lack of data. However, because one of the main reasons for the low samples size was due to the exclusion of shipbuilders based upon their strategy of only building ship blocks, hulls, and partly outfitted hulls for other shipbuilders in for instance Norway, it gives some credibility to the findings. It seems credible to assume that the lower labour cost of this region, as seen in figure 20, has resulted in strategies more focused on the process of shipbuilding and steel work, instead of increasing the service offering of the companies.

Southern shipbuilders lean towards a cost-oriented approach with slight tendencies towards industry-wide strategies. In this region, the shipbuilders generally build the entire ship from keel-laying to commissioning. The only exception is that during the data collection process it was discovered that many companies in Turkey also produce hulls, blocks, and partly outfitted hulls for other shipbuilding companies. It seems like the cost of labour is connected to the choice of product strategy, which is supported by the fact that the labour cost in Turkey is for instance lower than that in Spain and Italy. As seen in figure 20, the labour cost in the southern region is generally quite low, which gives support to the finding that the companies are more cost oriented.

Western shipbuilders exhibit a slight inclination towards differentiation, with no clear preference for industry width, and a considerable number of shipbuilders falls under the hybrid strategy category (40%). A credible explanation for why many shipbuilders fall under the hybrid strategy in this region is that they have a lower labour cost than some of the Northern shipbuilders which are more differentiated, but higher than Southern and Eastern shipbuilders which are more cost-oriented as seen in table 27. Ultimately it seems to give the shipbuilders in this region a bit of a dilemma of which strategy to focus on, and based upon the findings seen in table 31, the companies that manages to have a clear product strategy generally has a higher financial performance than those stuck-in-the-middle. The differences in product strategy in this region were also observed during the data collection process because some shipbuilders build the entire vessel themselves, whilst others relied on having significant steelwork conducted in lower-cost countries like the Norwegian offshoring strategies (Semini, et al., 2018).

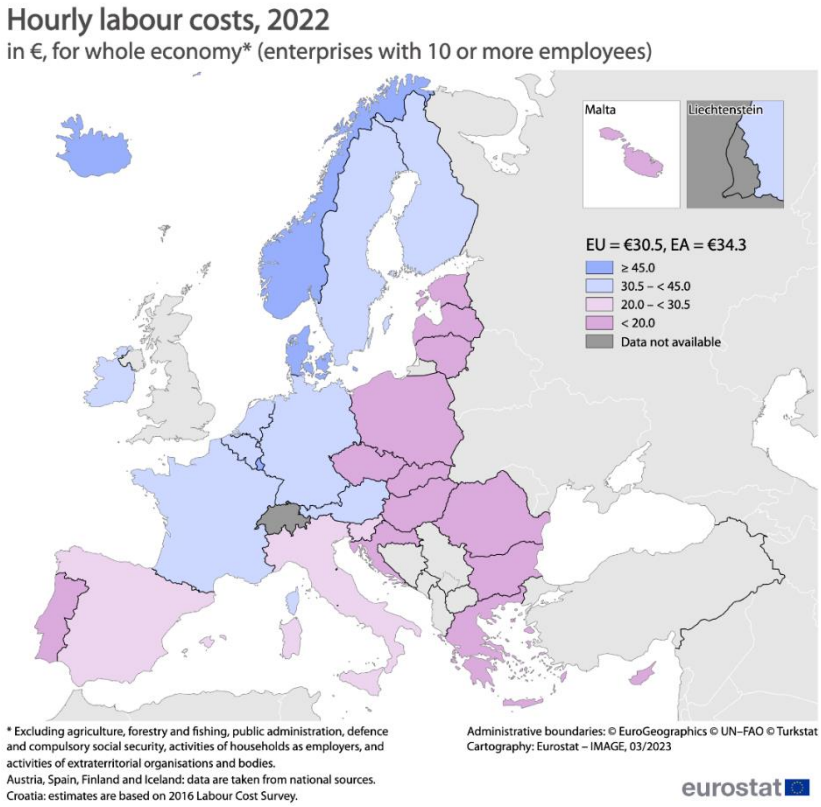


Figure 20: Hourly labour costs 2022 Europe *(eurostat, 2023)*

Based upon the findings of the mapped European product strategies using the adaptation of PGSM, and the support of these findings from literature and the observations made during the data collection process, it can be concluded that the defined KPIs utilized for the horizontal- and vertical axis were suitable for purpose of this thesis. Thus, confirming the suitability of the adapted PGSM.

4.3.2 Research Question 2

"Are there any links between product strategies and financial performance amongst European shipbuilders, that consequently indicates a competitive advantage or disadvantage?"

To get an answer to RQ2, it was decided to test two different hypothesis that would provide sufficient insight to come to a conclusion.

Hypothesis 1

"*The right balance between diversification and size increases the probability of better financial performance.*"

The findings from the regression analysis indicates that there is seemingly a weak trend between diversification and size, and the associated financial performance. However, due to high degree of uncertainty with a p-value between 0.10 - 0.05, hypothesis 1 is only partly accepted. One plausible explanation for this finding is that financial performance is affected by many variables like labour cost, material cost, working culture, government subsidies etc. It also does not take into consideration, the possible competitive disadvantage of being "stuck-in-the-middle", as was discovered in table 31. In short, the regression model used to test H1 seems to have been too simple because there are more variables in play that seem to affect the financial performance. There does however seem to be weak trend between product strategy, size, and financial performance, which is also supported by the findings of the cluster analysis.

Hypotheses 2

"The product strategy associated with higher financial performance will vary depending on the geographical location, but hybrid strategies will not be associated with a competitive advantage in any region".

Based upon the findings made in table 31, it can be concluded that product strategy associated with higher financial performance will vary depending on the geographical location. This is however not surprising when considering the differences in product strategy across regions, which most like is rooted in demographic differences like the cost of labour and political incentive programmes. The findings regarding the financial performance of shipbuilders following the hybrid strategy indicates that it can't be regarded a competitive advantage.

The shipbuilders following the hybrid strategy are consistently below the average financial performance, independent of region, which is supported by the "stuck-in-the-middle" theory by (Porter, 1998). Hypothesis 2 is accepted.

The acceptance of H2, possibly explains the weak results in the regression analysis to test H1. It seems that analysing Europe as one region is not recommended, due to the seemingly significant differences of the various regions. Since it also seems that the hybrid strategy consistently underperforms other product strategies, it comes into conflict with H1 which assumes a linear correlation between the financial performance and the relationship between size and product strategy.

The seemingly negative affect hybrid strategies have on financial performance on shipbuilders in Europe, should be an incentive for shipbuilders to consider a more distinct strategy. This could mean becoming more differentiated, more cost-oriented, more focused, and/or more industry wide, and the strategic fit will vary from company to company. However, the findings in the thesis (Jean, 2020) indicate that whilst there is no unilateral relation between ship type variety (industry width) and financial performance, the ship type variety can be a strategic advantage. This is because when a market downturn happens there is a greater risk with having a focused strategy, which is emphasized by the offshore vessel market downturn following the oil crisis in 2014 which showed that shipbuilders in Norway with a wider portfolio were more resilient than those focused on building offshore industry vessels. As seen in table 31, the shipbuilders with an industry wide strategy generally didn't have a weaker financial performance than those with a more focused strategy, but rather a slightly higher financial performance. Thus, supporting the findings in (Jean, 2020), and consequently it can be argued that having an industry wide portfolio of vessels is a competitive advantage.

On possible solution for increasing a shipbuilders industry width, with a limited need for new capabilities/resources, is by following a similar approach of standardization as the Damen group headquartered in the Netherlands. The company offers a wide selection of customizable vessel platforms, and from certain platforms like the 5009, it creates derivates that targets different segments. This can be seen in table 33, which shows the 5009 platform as a versatile patrol vessel (FCS 5009) that falls under the security segment, a crew/supply vessel (Fast Crew Supplier 5009) that falls under the offshore industry segment, and a yacht support vessel (YS5009) that falls under the luxury segment. With this approach Damen manages to target three different segments with the same vessel platform, consequently increasing its industry width considerably, and reducing the risk posed by a downturn in the market.

Damen group was excluded from the data analysis due to its complex financial structure, but the collected data seen in appendix 3 shows that is a highly differentiated shipbuilding company with the highest industry width measured in this thesis, and a high service offering. If one looks at the financial performance of some of the subsidiaries of the Damen group, they generally have a strong financial performance, as can be seen from the subsidiary data in table 32.

In short, the relatively unique strategy Damen Group has chosen by being a large shipbuilder with a very industry wide portfolio that mostly builds customizable platforms instead of unique one-of-a-kind vessels, does seem to be a competitive advantage. Especially when compared to comparably sized shipbuilding companies in Europe like Fincantieri. Another large industry wide shipbuilder with high performing subsidiaries worth mentioning, that also was excluded due to its complex finance structure, is Astilleros Armon headquartered in Spain.

Table 32: Financial performance of Damen Group subsidiaries

Damen Subsidiary	**AROA**
Damen Yachting B.V	14.0%
Damen Schelde Naval Shipbuilding B.V.	7.5%
Scheepswerf Damen Hardinxveld B.V	6.2%
Damen Shipyards Gorinchem B.V	0.02%
Damen Shipyards Maaskant B.V	-1.2%
Damen Shipyards Antalya	3.9%
Damen Shipyards Gdynia S.A	8.9%
Santierul Naval Damen Galati S.A	3.7%

Table 33: Examples of derivates from a standardized platform (Damen 5009)

Examples of derivates from a standardized platform (Damen 5009)
 *Picture 32: Damen YS5300 (damenyachting, 2023)*
 *Picture 33: Damen Fast-crew-supplier-5009 (damen, 2023)*
 *Picture 34:Damen Stan Patrol 5009 (damen, 2023)*

5 Conclusion

This thesis was aimed to explore the product strategies of European shipbuilders, with the goal of gaining deeper insights and understanding. To achieve this, two primary objectives were formulated. (1) Establish a suitable framework to map the product strategies of European shipbuilders using open-source data, and (2) see if any links between financial performance and product strategy could be identified.

To accomplish these objectives, a literature study was undertaken to identify an appropriate product strategy model and determine how to adapt its axes to facilitate the collection of key performance indicators (KPIs) from open sources. The decision to solely focus on open sources in this thesis stems from the challenges associated with obtaining sufficient data directly from shipbuilding companies, as previous research has encountered low response rates. The literature study concluded that Porters generic strategies model (PGSM) was a suitable model. The KPI of the horizontal axis (customer perceived value), was defined as the services offered by the shipbuilders based upon the findings linking service offering and customer value in the doctoral dissertation (Sauerhoff, 2014). The KPI of the vertical axis (industry width), was defined to be the total GT of vessels produced in predefined vessel segments, which was unified into a single measure of diversity using the Shannon index formula.

The financial data was collected in the previous semester as part of a specialization project, and was gathered from the financial database Orbis. The number of services offered (horizontal axis) was collected from the company websites, and vessel information (vertical axis) was primarily collected from the maritime database SeaWeb. In the end, the data was gathered for 93 shipbuilding companies in Europe. To identify possible relationships between product strategy and financial performance, two hypotheses were formulated. H1 was tested using linear regression and cluster analysis, and H2 was tested using cluster analysis.

Regarding objective 1, the adapted PGSM is considered suitable, enabling the identification of product strategies employed by shipbuilders in predefined regions through the utilization of open-source data. The suitability of the adapted PGSM is attributed to the fit between the characteristics of the identified strategies in the model, with established research and observations made during the data collection process.

Regarding objective 2, the regression model used to test H1 seems to have been too simple because there are more variables in play that effect the financial performance resulting in a high degree of uncertainty of the model with a p-value between 0.1-0.05, but there seems to be weak trend between diversification, size, and financial performance. Regarding H2 it can be concluded that the product strategy associated with higher financial performance will vary depending on the geographical location, and that following a hybrid strategy generally doesn't provide a shipbuilding company a competitive advantage. The companies following a hybrid strategy were consistently below the average financial performance independent of region, thus giving legitimacy to Porters stuck-in the-middle theory.

5.1 Contribution to Research

The contribution to research from this master thesis includes the following points:

- The thesis contributes to the theory by introducing an adaptation of PGSM to map product strategies of shipbuilding companies, with defined KPIs that can be extracted from open sources, thus removing the risk of a low response rate from companies to map product strategies of predefined regions. The adapted model might also be applicable to map the product strategies of similar industries.
- The thesis provides increased insight into the differences of European shipbuilder's product strategies, by highlighting the fact that the product strategy associated with higher financial performance vary from region to region. The findings of the thesis also support Porters "stuck-in-the-middle" theory, which implicates that certain European shipbuilders should aim at creating a more distinct product strategy.

5.2 Limitations

Limitations of this master thesis includes the following points:

- The usage of open sources is subject to considerable uncertainty. Especially the services offered, which is collected from the company webpage with the assumption that the company does not offer the service if it isn't mentioned. The information on SeaWeb was occasionally insufficient, which creates some uncertainty of the data collected. The financial data does not take into consideration the financial structure of the company, meaning that for certain companies' other areas of business was included with the shipbuilding aspect of the company.
- Due to the time constraint of this thesis, only one model of product strategy could be investigated in depth, and Porters model was chosen due to its generic structure and the assumption that it would make it easier to redefine its axis's. More in-deep research on other models such as the established Ansoff matrix (Ansoff, 1957) and/or Miles & Snow's organisational strategies (Miles, et al., 1978), could have showed a fit of these models as well.
- The usage of cluster analysis is subject to considerable subjectivity due to the lack of a test-statistic like in regression analysis, which provides a clear answer on whether the results are supported (Shook & Ketchen Jr., 1996). Instead, it's the researcher that decides the meaning of the result after a cluster analysis, meaning that the results from a cluster analysis is heavily reliant on the judgment of the researcher.
- Due to the time constraint, there was not sufficient time to conduct a Systematic Literature Review (SLR) to map the knowledge gaps within the field of product strategies of European shipbuilders.

5.3 Recommendation for Further Research

Recommendation for further research includes the following points:

- The difference between the regions implies that for further research on European product strategy, the focus should be on a single region or country, to limit the implication of demographic differences like labour cost.
- The inclusion of additional variables is recommended to thoroughly assess the factors that contribute to a company's competitive advantage. The findings of this thesis emphasize the complexity of attaining a competitive advantage in the European shipbuilding industry, with product strategy being identified as only a partial explanatory factor. One of these variables could for instance be the level of standardization of the vessels constructed by a given company.
- Conduct a Systematic Literature Review (SLR) to map the knowledge gaps of European shipbuilding companies' product strategies, and its consequent effect on the competitive advantage.

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Appendix 1: StatCode 5 Shiptype Coding System (IHSMarkit, 2023)

Level 5	Level 4	Level 3	Level 2	Level 1	
LNG Tanker	LNG Tanker	Liquefied Gas	Tankers	Cargo Carrying	Ship Structures
LPG Tanker	LPG Tanker				
LPG/Chemical Tanker					
CO2 Tanker	CO2 Tanker				
Molten Sulphur Tanker	Chemical Tanker	Chemical			
Chemical Tanker					
Chemical/Products Tanker	Chemical/Oil Products Tanker				
Wine Tanker	Wine Tanker				
Vegetable Oil Tanker	Vegetable Oil Tanker				
Edible Oil Tanker	Edible Oil Tanker				
Beer Tanker	Beer Tanker				
Latex Tanker	Latex Tanker				
Shuttle Tanker	Crude Oil Tanker	Oil			
Crude Oil Tanker					
Crude/Oil Products Tanker					
Products Tanker	Oil Products Tanker				
Tanker (unspecified)					
Asphalt/Bitumen Tanker	Bitumen Tanker				
Coal/Oil Mixture Tanker	Coal/Oil Mixture Tanker				
Water Tanker	Water Tanker	Other Liquids			
Molasses Tanker					
Glue Tanker	Glue Tanker				
Alcohol Tanker	Alcohol Tanker				
Caprolactam Tanker	Caprolactam Tanker				
Fruit Juice Tanker	Fruit Juice Tanker				
Bulk Carrier	Bulk Carrier	Bulk Dry	Bulk Carriers		
Bulk Carrier, Laker Only					
Bulk Carrier (with Vehicle Decks)					
Ore Carrier	Ore Carrier				
Bulk/Oil Carrier (OBO)	Bulk/Oil Carrier	Bulk Dry/Oil			
Ore/Oil Carrier	Ore/Oil Carrier				
Bulk Cargo Carrier, self discharging	Self Discharging Bulk Carrier	Self Discharging Bulk Dry			
Bulk Cargo Carrier, self discharging, Laker					
Cement Carrier	Cement Carrier	Other Bulk Dry			
Wood Chips Carrier, self unloading	Wood Chips Carrier				
Urea Carrier	Urea Carrier				
Aggregates Carrier	Aggregates Carrier				
Limestone Carrier	Limestone Carrier				
Refined Sugar Carrier	Refined Sugar Carrier				

Level 5	Level 4	Level 3	Level 2	Level 1	
Powder Carrier	Powder Carrier	Other Bulk Dry	Bulk Carriers	Cargo Carrying	Ship Structures
General Cargo Ship (with Ro-Ro facility) General Cargo, Self-discharging Open Hatch cargo Ship General Cargo/Tanker (Container/oil/bulk - COB ship) General Cargo/Tanker General Cargo Ship	General Cargo Ship	General Cargo	Dry/Cargo/Passenger		
Palletised Cargo Ship	Palletised Cargo Ship				
Deck Cargo Ship	Deck Cargo Ship				
General Cargo/Passenger Ship	Passenger/General Cargo Ship	Passenger/General Cargo Ship			
Container Ship (Fully Cellular) Container Ship (Fully Cellular with Ro-Ro Facility)	Container Ship	Container			
Passenger/Container Ship	Passenger/Container Ship				
Refrigerated Cargo Ship	Refrigerated Cargo Ship	Refrigerated Cargo Ship			
Ro-Ro Cargo Ship Rail Vehicles Carrier	Ro-Ro Cargo Ship	Ro-Ro Cargo			
Vehicles Carrier	Vehicles Carrier				
Container/Ro-Ro Cargo Ship	Container/Ro-Ro Cargo Ship				
Landing Craft	Landing Craft				
Passenger/Ro-Ro Ship (Vehicles) Passenger/Ro-Ro Ship (Vehicles/Rail)	Passenger/Ro-Ro Cargo Ship	Passenger/Ro-Ro Cargo			
Passenger/Landing Craft	Passenger/Landing Craft				
Passenger/Cruise	Passenger (Cruise) Ship	Passenger			
Passenger Ship	Passenger Ship				
Livestock Carrier	Livestock Carrier	Other Dry Cargo			
Barge Carrier	Barge Carrier				
Heavy Load Carrier Heavy Load Carrier, semi submersible Yacht Carrier, semi submersible	Heavy Load Carrier				
Nuclear Fuel Carrier Nuclear Fuel Carrier (with Ro-Ro facility)	Nuclear Fuel Carrier				
Pulp Carrier	Pulp Carrier	Fish Catching	Fishing		
Factory Stern Trawler Stern Trawler Trawler	Trawler				
Fishing Vessel	Fishing Vessel				

Level 5	Level 4	Level 3	Level 2	Level 1	
Fish Factory Ship	Fish Factory Ship	Other Fishing	Fishing	Work Vessel	Ship Structures
Fish Carrier	Fish Carrier				
Live Fish Carrier (Well Boat)	Live Fish Carrier				
Fish Farm Support Vessel Fishery Patrol Vessel Fishery Research Vessel Fishery Support Vessel	Fish Farm Support Vessel				
Seal Catcher	Seal Catcher				
Whale Catcher	Whale Catcher				
Kelp Dredger	Kelp Dredger				
Pearl Shells Carrier	Pearl Shells Carrier				
Crew/Supply Vessel Pipe Carrier Platform Supply Ship	Platform Supply Ship	Offshore Supply	Offshore		
Anchor Handling Tug Supply Offshore Tug/Supply Ship	Offshore Tug/Supply Ship				
Offshore Support Vessel Diving Support Vessel Accommodation Ship	Offshore Support Vessel	Other Offshore			
Drilling Ship	Drilling Ship				
Pipe Layer Crane Vessel Pipe Layer	Pipe Layer				
Production Testing Vessel	Production Testing Vessel				
FPSO, Oil Gas Processing Vessel	FPSO				
Well Stimulation Vessel	Well Stimulation Vessel				
Standby Safety Vessel	Standby Safety Vessel				
FSO, Oil	FSO (Floating, Storage, Offloading)				
Trenching Support Vessel	Trenching Support Vessel				
Pipe Burying Vessel	Pipe Burying Vessel				
Research Survey Vessel	Research Vessel	Research	Miscellaneous		
Tug	Tug	Towing/Pushing			
Articulated Pusher Tug Pusher Tug	Pusher Tug				
Bucket Ladder Dredger Cutter Suction Dredger	Dredger	Dredging			

Level 5	Level 4	Level 3	Level 2	Level 1	
Grab Dredger Backhoe Dredger Bucket Wheel Suction Dredger Suction Dredger Dredger (unspecified)	Dredger	Dredging	Miscellaneous	Work Vessel	Ship Structures
Bucket Hopper Dredger Grab Hopper Dredger Suction Hopper Dredger Trailing Suction Hopper Dredger Hopper/Dredger (unspecified)	Hopper Dredger				
Hopper, Motor Stone Carrier	Motor Hopper	Other Activities			
Crane Ship	Crane Ship				
Pile Driving Vessel					
Icebreaker Icebreaker/Research	Icebreaker				
Cable Repair Ship Cable Layer	Cable Layer				
Incinerator Waste Disposal Vessel Effluent carrier	Waste Disposal Vessel				
Fire Fighting Vessel	Fire Fighting Vessel				
Pollution Control Vessel	Pollution Control Vessel				
Patrol Vessel	Patrol Vessel				
Crew Boat	Crew Boat				
Training Ship	Training Ship				
Utility Vessel	Utility Vessel				
Search & Rescue Vessel	Search & Rescue Vessel				
Pilot Vessel	Pilot Vessel				
Salvage Ship	Salvage Ship				
Buoy Tender Buoy & Lighthouse Tender Lighthouse Tender	Buoy/Lighthouse Vessel				
Supply Tender	Supply Tender				
Mooring Vessel	Mooring Vessel				

Level 5	Level 4	Level 3	Level 2	Level 1	
Work/Repair Vessel	Work/Repair Vessel	Other Activities	Miscellaneous	Work Vessel	Ship Structures
Hospital Vessel	Hospital Vessel				
Tank Cleaning Vessel	Tank Cleaning Vessel				
Trans Shipment Vessel	Trans Shipment Vessel				
Anchor handling Vessel	Anchor Hoy				
Log Tipping Ship	Log Tipping Ship				
Bunkering Tanker	Bunkering Tanker				
Exhibition Vessel Theatre Vessel Mission Ship	Leisure Vessels				
Bulk Dry Storage Ship Bulk Cement Storage Ship	Dry Storage				
Mining Vessel	Mining Vessel				
Power Station Vessel	Power Station Vessel				
Vessel (function unknown)	Vessel (function unknown)				
Sailing Vessel	Sailing Vessel				

Appendix 2: Hypothesis 1 linear regression analysis SPSS

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	,221[a]	,049	,034	6,3487066661	,049	3,323	1	65	,073	2,029

a. Predictors: (Constant), Reference location number_2

b. Dependent Variable: AROA

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	133,955	1	133,955	3,323	,073[b]
	Residual	2619,895	65	40,306		
	Total	2753,850	66			

a. Dependent Variable: AROA

b. Predictors: (Constant), Reference location number_2

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	,435	,980		,444	,659					
	Reference location number_2	2,924	1,604	,221	1,823	,073	,221	,221	,221	1,000	1,000

a. Dependent Variable: AROA

Collinearity Diagnostics[a]

Model	Dimension	Eigenvalue	Condition Index	Variance Proportions	
				(Constant)	Reference location number_2
1	1	1,611	1,000	,19	,19
	2	,389	2,035	,81	,81

a. Dependent Variable: AROA

Residuals Statistics[a]

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	,43455916643	3,3581862450	1,5254647951	1,4246469541	67
Residual	-20,75089264	14,098316193	,00000000000	6,3004268273	67
Std. Predicted Value	-,766	1,286	,000	1,000	67
Std. Residual	-3,269	2,221	,000	,992	67

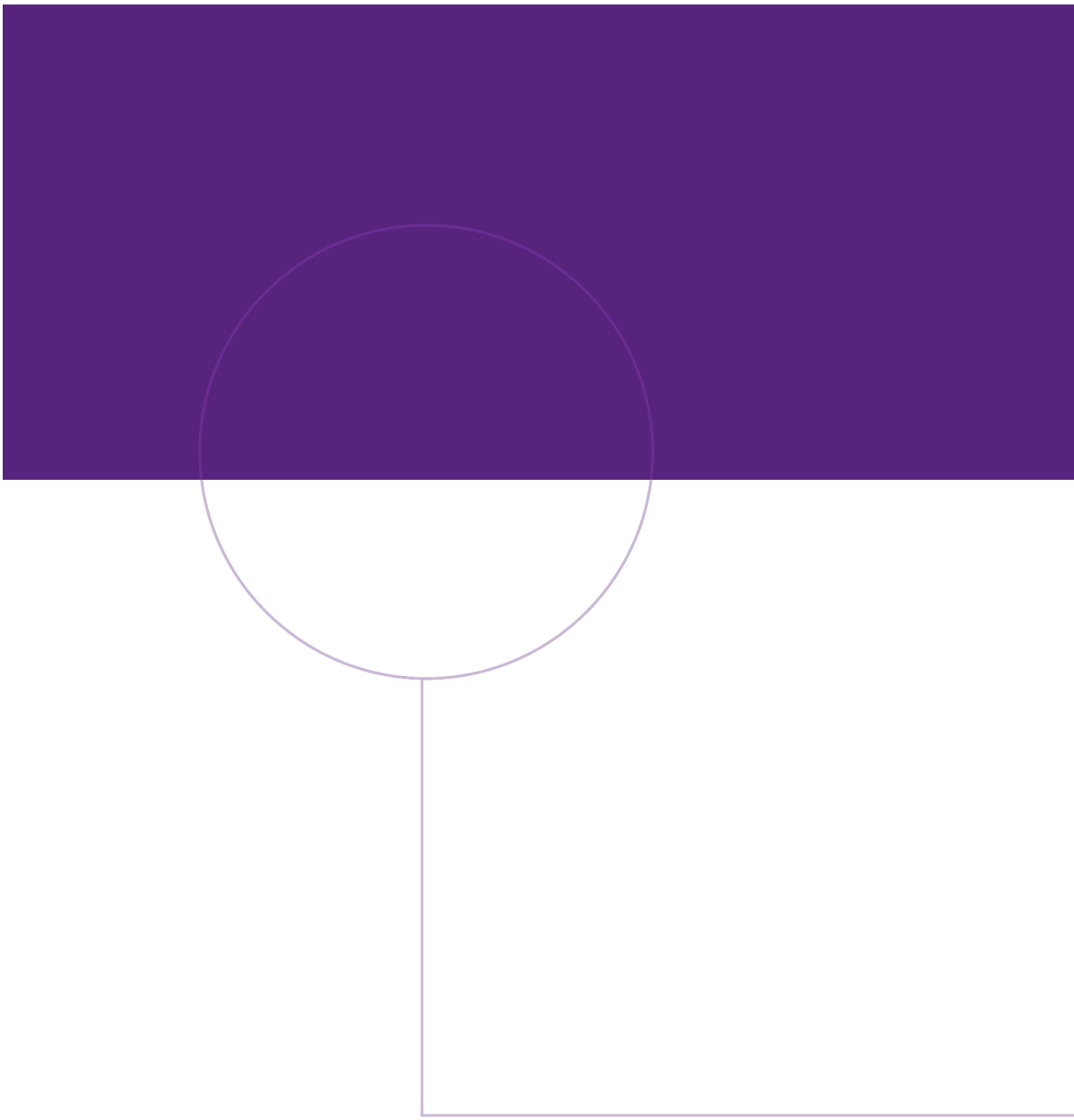
a. Dependent Variable: AROA

Appendix 3: Product strategy data and financial data of European shipbuilders

Grey = Excluded due to financial structure

Shipyard	Services offered (uniqueness perceived by customer)	Industry width (shannon index)	AROA	Average turnover	Region
AAS MEK VERKSTED AS	4	0.03	21.7	73163	North
SLETTA VERFT AS	4	0.09	14.0	19550	North
SWEDE SHIP MARINE AKTIEBOLAG	4	0.73	10.5	23881	North
MACDUFF SHIPYARDS LIMITED	4	0.27	10.1	30592	North
P/F MEST	8	0.00	8.7	66392	North
PENDENNIS SHIPYARD LIMITED	7	0.00	8.3	58057	North
FITJAR MEKANISKE VERKSTED AS	7	0.64	8.1	66258	North
WESTCON YARDS AS	8	0.87	7.2	218361	North
BALTIC WORKBOATS AS	3	1.29	6.9	34865	North
UMOE MANDAL AS	6	0.68	5.8	23636	North
SALTHAMMER BAATBYGGERI AS	5	0.29	5.5	11170	North
FOSEN YARD AS	5	0.61	5.1	42256	North
PROMEK AS	3	0.00	3.4	10529	North
BAE SYSTEMS SURFACE SHIPS LIMITED	12	0.00	3.4	1936437	North
OMA BAATBYGGERI AS	5	0.69	1.7	14023	North
KARSTENSENS SKIBSVAERFT A/S	5	0.15	1.1	204681	North
FISKERSTRAND VERFT AS	5	0.84	1.0	54555	North
HELSINKI SHIPYARD OY	5	1.34	0.4	95069	North
PRINCESS YACHTS LIMITED	2	0.00	0.2	364016	North
BABCOCK MARINE (ROSYTH) LIMITED	10	0.00	0.2	397075	North
MYKLEBUST VERFT AS	3	0.86	-0.3	126363	North
ULSTEIN VERFT AS	10	0.99	-1.3	195557	North
ALICAT WORKBOATS LIMITED	7	0.00	-1.6	19182	North
MEYER TURKU OY	10	0.39	-3.3	920801	North
UUDENKAUPUNGIN TYOVENE OY	5	0.65	-3.5	12264	North
CAMMELL LAIRD SHIPREPAIRERS & SHIPBUILDERS LIMITED	4	0.50	-3.7	161136	North
SUNSEEKER INTERNATIONAL LIMITED	2	0.00	-4.6	372776	North
RAUMA MARINE CONSTRUCTIONS OY	4	0.00	-5.2	178881	North
GRIFFON HOVERWORK LIMITED	5	0.24	-5.3	24601	North
FJELLSTRAND AS	6	0.55	-8.7	40994	North
WIGHT SHIPYARD COMPANY LIMITED	4	0.00	-20.3	18167	North
OYSTER YACHTS LIMITED	8	0.00	-43.4	28973	North
MTG-DOLPHIN AD	5	1.13	5.5	26069	East
SAFE CO LTD SP. Z O.O.	3	0.92	4.6	18301	East
MARINE PROJECTS LTD SP. Z O.O.	3	0.36	3.2	43812	East
REMONTOWA HOLDING S.A.	7	1.25	2.9	200255	East
Crist S.A.	3	0.81	1.7	153200	East
SEVERNAV S.A. SHIPYARD DROBETA TURNU SEVERIN ROMANIA	5	0.65	0.7	15399	East
SANTIERUL NAVAL CONSTANTA SA	6	0.13	-0.7	51390	East
BULYARD SHIPBUILDING INDUSTRY EAD	4	0.00	-3.3	12098	East

HEESEN YACHTS BUILDERS B.V.	8	0.00	9.4	162292	West
GEBR. KOOIMAN HOLDING B.V.	5	0.63	5.5	59328	West
ABEKING & RASMUSSEN SCHIFFS- UND YACHTWERFT SE	6	0.54	5.0	181084	West
OCEA	6	0.79	4.2	83682	West
SOC CONSTRUCT REPARAT NAVALE & MECANIQUE	5	0.99	4.0	50295	West
BODEWES GROUP B.V.	3	0.00	3.9	34042	West
FHL NEDERLAND B.V. (Veka group)	2	0.70	3.3	118939	West
CONSTRUCTIONS MECANIQUES DE NORMANDIE	8	0.78	3.1	102634	West
CHANTIERS DE L'ATLANTIQUE	8	0.14	0.9	1508206	West
NAVAL GROUP	7	0.00	0.6	4095884	West
IHC HOLLAND B.V.	9	0.05	-2.4	577116	West
KONINKLIJKE NIESTERN-SANDER B.V.	6	0.59	-5.5	51499	West
CHANTIER NAVAL COUACH - CNC	4	0.67	-17.1	42304	West
SOCIETE DES ETABLISSEMENTS MERRE	5	1.16	9.4	12370	West
LUX WERFT UND SCHIFFFAHRT GMBH	6	0.74	5.7	18785	West
YONCA ONUK ADI ORTAKLIGI	6	0.00	22.8	35854	South
SANMAR DENIZCILIK MAKINA VE TICARET ANONIM SIRKETI	3	0.01	14.5	101968	South
WEST SEA - ESTALEIROS NAVAIS, UNIPESSOAL, LDA	5	0.37	12.1	73328	South
SEFINE DENIZCILIK TERSANECILIK TURIZM SANAYI VE TICARET ANONIM SIRKETI	4	1.21	9.6	189344	South
CIMTAS GEMI INSA SANAYI VE TICARET ANONIM SIRKETI	5	0.00	6.9	25735	South
NODOSA SL	5	1.34	6.8	36994	South
CEMRE TERSANESI GEMI INSAA SANAYI ANONIM SIRKETI	3	1.04	5.4	23632	South
CONSTRUCCIONES NAVALES P FREIRE, SA	5	1.35	5.2	80403	South
CANTIERE NAVALE VITTORIA S.P.A.	8	1.25	4.1	51931	South
OVERMARINE GROUP S.P.A.	3	0.00	3.8	54020	South
TERSAN TERSANECILIK SANAYI VE TICARET ANONIM SIRKETI	5	1.17	3.7	181446	South
ASTILLEROS GONDAN SA	3	1.12	3.7	71775	South
BRODOTROGIR D.D.	5	0.26	3.3	53838	South
ARCADIA YACHTS S.R.L.	4	0.00	3.0	18560	South
BRODOSPLIT D.D.	5	1.09	2.5	102213	South
ADA DENIZCILIK VE TERSANE ISLETMECILIGI ANONIM SIRKETI	4	0.69	2.1	11057	South
CANTIERI NAVALI UGO CODECASA - S.P.A.	5	0.00	1.9	13768	South
PALUMBO SUPERYACHTS ANCONA SRL	6	0.00	1.8	48250	South
BALENCIAGA, SA	2	1.29	1.2	52180	South
OZATA TERSANECILIK SANAYI VE TICARET ANONIM SIRKETI	4	1.24	1.2	27572	South
FRANCISCO CARDAMA SA	4	0.51	0.9	15346	South
ASTILLEROS ZAMAKONA SA (Pasaia, Santurtzi)	4	0.99	0.7	85208	South
TEHNOMONT - BRODOGRADILISTE PULA D. O. O.	3	1.18	0.6	10629	South
FINCANTIERI S.P.A	12	0.23	0.0	5455723	South
AZIMUT - BENETTI S.P.A.	8	0.00	-0.5	866652	South
CANTIERE DELLE MARCHE S.R.L.	5	0.00	-0.6	35462	South
ASTILLEROS DE MURUETA SOCIEDAD ANONIMA	3	0.98	-0.9	81177	South
INTERMARINE - S.P.A.	4	0.51	-1.2	77775	South
TANKOA YACHTS S.P.A.	4	0.00	-1.9	24633	South
NAVANTIA SA SME.	10	0.66	-4.0	1095455	South
GBI S.P.A.	3	0.00	-4.7	55949	South
T. MARIOTTI SOCIETA' PER AZIONI	6	0.83	-5.6	73705	South
RODMAN POLYSHIPS SA	3	0.84	-6.9	22011	South
PERINI NAVI SOCIETA' PER AZIONI	5	0.00	-7.2	69289	South
SEDEF GEMI INSAATI ANONIM SIRKETI	4	0.81	-7.5	77146	South
FERRETTI S.P.A.	3	0.00	-9.1	598325	South
BAGLIETTO S.P.A.	7	0.00	-9.2	38531	South
3. MAJ BRODOGRADILISTE D.D.	2	0.19	-9.7	103105	South
ULJANIK BRODOGRADILISTE, D. D. U STECAJU	3	0.72	-28.9	123143	South
Damen Group	13	2.02	#N/A	#N/A	Mixed
Vard Goup	12	1.21	#N/A	#N/A	Mixed
ASTILLEROS ARMON GROUP	8	1.88	#N/A	#N/A	South



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