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Sustainability transition of shipping: drivers, requirements, and positions

Bachelor thesis for Marine Engineering Program

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DEPARTMENT OF MECHANICS AND MARITIME SCIENCES

CHALMERS UNIVERSITY OF TECHNOLOGY

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Cover:
Artist impression Orcelle Wind courtesy of Wallenius Wilhelmsen.

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PREFACE

From August to December 2019, I attended Chalmers University of Technology in Gothenburg as an exchange student from Holland. The main reason to choose this destination for the semester abroad was to participate in the course: ‘Environmental Impact from shipping’ which is not available at my home university: the ’Maritiem Institute Willem Barentsz’ on Terschelling. The interest and motivation for this subject lie in the ambition to contribute to the sustainability transition of shipping.

After completing the course Environmental Impact from Shipping, I proceeded to an internship with AIDA Cruises onboard the world’s first LNG cruise ship AIDA Nova. The goal of the internship was to complete my technical training tasks and simultaneously learn about the environmental compliance of the vessel to become Environmental Officer after graduating. Since there is no defined training for cadets about environmental compliance, I started to investigate what environmental knowledge could be relevant for the Nautical and Technical Cadet. This became the theme for my bachelor thesis at my home university. The thesis is called ’Environmental focus for Maritime Cadets’ and developed an environmental training plan for cadets. This environmental training plan for cadets is mentioned in the discussion of this thesis.

The internship inspired me to look beyond cruise ships and investigate if there is a demand for environmental knowledge within the shipping industry. Therefore, this research is dedicated to the challenges shipping companies face with sustainable development, how they meet the challenges, and if this requires more environmental knowledge for positions in shipping companies.

Thank you to Wallenius Wilhelmsen, Terntank, and ISKES Tugs for kindly providing information and participating in interviews. Furthermore, I want to thank Asa Burman, Kent Salo, and Ronald de Bloeme for their interviews as well. Finally, I want to give many thanks to my supervisor Ida-Maja, examinator Johan Eliasson, coordinator Emilio Suarez and librarian Lisa Nordfeldt from Chalmers University for their support and contribution to this research.

ABSTRACT

The Global Shipping Industry is facing enormous challenges in the next years. There is an urgent problem to be solved. Meeting the ambitious decarbonization goals is the biggest challenge shipping is facing. Traditionally seen as a large polluter, the shipping industry is not exempted from taking large steps to drastically decrease their CO2 emissions and contribute to reaching the Paris Agreement (2015). There are three main drivers for sustainable development:

1. Regulatory and Institutional pressures.

2. Market factors and resource availability issues.

3. Social pressure and ecological awareness.

This thesis investigates through qualitative research how shipping companies experience the drivers and how they react to them. The barriers to sustainable development are highlighted, and the requirements for companies to become more sustainable are identified and divided between technical and organizational requirements. Through interviews with key figures in the sustainable development of shipping companies, this research aims to demonstrate the need for positions with environmental knowledge and what the requirements are for these positions.

The new positions identified are the Sustainability Controller, the Environmental Officer, and Miscellaneous positions. In addition, Seamen and Officers onboard ships were found to require environmental awareness and knowledge. The current environmental knowledge included in the STCW requirements, and in maritime educations were compared with the requirements for these environmental positions. This made it possible to conclude if the current level of environmental knowledge in education is sufficient for the demands of the future.

Keywords: SDGs, Sustainable development, Shipping Companies, Sustainability, Controller, education, training, Environmental, positions.

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ACRONYMS AND TERMINOLOGY

UNSDG	United Nations Sustainable Development Goal
SDG	Sustainable Development Goal
GHG	Green House Gasses
MEAC	Marine Environmental Awareness Course
EGCS	Exhaust Gas Cleaning System
ZEOS	Zero Emission Ocean Shipping
FTE	Full-time employee
ECSA	European Community Shipowners Association
ULSFO	Ultra Low Sulphur Fuel Oil
EO	Environmental Officer
CCM	Company Compliance Manager

1 INTRODUCTION

During the Paris Convention in September 2015, the 193 Member states of the United Nations signed a Sustainable Development Agenda for 2030. The Agenda contains 17 sustainable development goals (SDGs) and 169 related targets that aim to end poverty, protect the planet, and improve the lives and prospects of everyone, everywhere.

Figure 1 The UNSDGs

The SDGs are based on pathways to limit global warming to 1.5°C calculated by the Intergovernmental Panel on Climate Change (IPCC). The IPCC: 'provides regular assessments of the scientific basis of climate change, its impacts and future risks, and options for adaptation and mitigation.' (About the IPCC, 2020).

The IMO has adopted a roadmap for decarbonization and has publicly committed to the UN Agenda 2030 and its SDGs. More stringent environmental regulations are expected to be implemented on the road to decarbonization from the IMO, and in addition, we see the European Union (EU) taking matters into their own hands by voting to introduce shipping in the EU Emission Trading System (ETS) on 17 September 2020.

Shipping companies experience a drive to develop sustainable solutions. They must pursue sustainable development to: meet the environmental regulations, the changing market demands and to contribute to the UNSDGs. What requirements must shipping companies fulfill for sustainable development and do they need more positions with environmental knowledge? Is there enough environmental theory included in the education for Maritime Officers right now compared to what environmental resource shipping companies demand for their environmental positions?

1.1 Background

This section shapes the background and context of the thesis work. It gives a background about how international regulations drive shipping innovations. In addition, it presents two companies that have a leadership position in current shipping developments. Both companies are referred to later in the text. In addition, it gives more background about the bachelor work: 'Environmental focus for Cadets', which was written by the author of this research in Holland.

1.1.1 Regulation driven change

Before the UN Agenda 2030 and the Paris Agreement, the IMO has introduced regulations to mitigate the emissions to air from international shipping. In 1997 ANNEX IV was adopted to MARPOL, to minimize airborne emissions from ships. Certain parts in the world were dedicated as emission control areas (ECA's), to limit the amounts of SO_X, NO_X, and PM in the exhaust gases from ships. Alternative fuel to Heavy Fuel Oil (HFO) or exhaust gas cleaning systems such as Scrubbers, were to be used in these areas to comply with the regulations. On the 1st of January 2020, the most recent emission regulation was implemented: to limit the Sulphur content of marine fuels globally to 0.5%.

To comply with the 2020 'Sulphur Cap' most ships will start to use ultra-low sulfur fuel oils (ULSFO). Another possibility is to install a Scrubber system that cleans the exhaust gasses. The last option to comply with the global Sulphur Cap is to build a new vessel that runs on LNG fuel. (ING, 2020). The ING Bank has released a report about the consequences of the Sulphur Cap and says that the regulation will globally reshape shipping.

The UN Interagency Expert Group on Sustainable Development Goal Indicators considers shipping as a critical factor for the effective realization of eight goals and 11 targets, both directly and indirectly (UNCTAD 2016). This highlights the central role the shipping industry must play in reaching the UNSDGs globally. The IMO is seen as the international secretary to guide the shipping industry towards sustainable development and make the regulatory framework to achieve the goals (Eisenmenger et al., 2020).

1.1.2 Pioneers of Sustainable Shipping

The Carnival Corporation and Wallenius Wilhelmsen both claim a leading position in the development of the Global shipping industry. According to Lloyds List, the Carnival Corporation is leading and influencing shipping in terms of environmental technology, safety innovation, and their approach to design and operational efficiency. Wallenius Wilhelmsen is pioneering an active approach that embraces sustainability, acknowledges the challenges of the future, and is turning them into opportunities. Furthermore, they received attention from the industry with their project to build the worlds-first full-size car and truck powered by wind: the Orcelle Wind (Bush, 2021).

1.1.2.1 Carnival Corporation

The Carnival Corporation and PLC is the world's largest leisure travel company. The Corporation employs over 150,000 people and hosts 12.9 million guests on board its 104 ships annually. However, the Corporation has witnessed problems with the environmental compliance of their vessels throughout the last two decades. These non-conformities have led to an environmental felony conviction in 2016, that forces the corporation to implement an Environmental Compliance Plan (ECP) to ensure compliance with all international environmental maritime regulations. To meet the requirements of the ECP, they welcomed to their company a Chief Ethics and Compliance Officer (CECO) and a Compliance Committee to oversee the ethics and compliance program (Carnival Corporation and PLC, 2019). In addition, The Environmental Officer (EO) became responsible to ensure compliance with the ECP and is a very important rank on board.

After a second conviction during the ECP period where the CEO of the Carnival Corporation, Arnold Donald, was threatened to go to jail (Walker, 2020), there was a turning point. The Carnival Corporation made a large commitment towards green cruising by pioneering the first fully LNG-driven cruise vessel AIDA Nova (Ship-Technology, 2020). It has ordered 10 more LNG-driven cruise vessels to be delivered in the period between 2020 and 2025 (Carnival Corporation, n.d.) and joined the Getting to Zero Coalition on their route to Zero-Emission Shipping (Ship & Shore, n.d.). Due to the planned new builds, the demand for Environmental Officers and compliance work also increases. Besides, decarbonization, the carnival corporation has committed to other environmental goals such as food waste reduction, eliminating single-use plastics on board, and the development of Advanced Air Quality Systems(Ship & Shore, n.d.).

1.1.2.2 Wallenius Wilhelmsen

The market leader in RORO shipping and vehicle logistics company Wallenius Wilhelmsen has embraced the idea of sustainable development and is deeply integrating it into the core of their business. According to Roger Strevens, Global Sustainability, it is not possible to view sustainability separate from the cardinal objectives of the business. Through building sustainable supply chains and imagining new, more efficient solutions for the changing world of mobility and transport on land and at sea, Wallenius Wilhelmsen wants to reach their goal of *zero-emission full-lifecycle supply chains* for vehicles, and *future-proof* their business while creating long term value for their stakeholders (Wallenius Wilhelmsen, n.d.).

On this journey, they have 4 priorities that are further described on their website, where they explain how they contribute to the UN SDGs (Wallenius Wilhelmsen, n.d.). Furthermore, Wallenius Wilhelmsen is participating in the 'Getting to Zero Coalition' together with the Carnival Corporation. This coalition is committed to getting commercially viable deep-sea zero-emission vessels powered by zero-emission fuels into operation by 2030' (Global Maritime Forum, 2020). Apart from the Getting to Zero Coalition, Wallenius Wilhelmsen has launched a significant sustainability project: 'the world's first full-size wind-powered pure car and truck-carrier: Orcelle Wind (Wallenius Wilhelmsen, 2021).' Wallenius Wilhelmsen thinks this vessel can be one of the great strides forward, which are required to reach zero emissions. Orcelle Wind will also function as a technical and operational test bed for zero-emission innovation according to Erik Noeklebye, EVP and COO of shipping services at Wallenius Wilhelmsen.

1.1.2.3 Environmental training for cadet

Together with AIDA, a project was established that aims to create a training plan for cadets on board cruise ships to offer them experience with environmental compliance and increase their awareness about the environmental impact of shipping. The project was started in 2019 during an Internship on board AIDA Nova. As a bachelor thesis for the Maritime Institute Willem Barentsz in the Netherlands, I researched to construct an environmental training plan for Cadets. The training plan is currently under revision and is planned to be presented in June 2020 (Bollweg, 2020).

The wider ambition for the project is to offer Maritime Academies an environmental training package for cadets on their internship vessels. The training package can become the practical extension for new environmental material in the education for Maritime Officers. It is relevant for this research because it can bridge the gap between the environmental knowledge required by shipping companies and the current education for Nautical and Technical students.

1.2 Aim of the study

This research is based on the hypothesis that shipping companies require environmental knowledge and resources in the form of environmental positions to face the challenges associated with the sustainable development of a shipping company.

The further aim is to compare the educational content, currently included in the courses for Marine engineers and Master mariners, with the environmental knowledge required for the sustainable development of shipping companies.

1.3 Research questions

1. What are the driving forces for shipping companies to pursue sustainable development?

2. What challenges do these companies face and do they require more positions with environmental knowledge to face the challenges?

3. If the answer to research question two suggests a need for environmental positions within shipping companies, what are the requirements to fulfill these new environmental positions?

1.4 Delimitations

For the assessment of environmental subjects in the education for Nautical and Technical students, only the two universities the author has followed courses at were assessed. It is not sure if these Universities can be the benchmark for environmental subjects in maritime education on a European or global level.

The companies that were interviewed do not represent the entire Scandinavian, Dutch, or global maritime industries. They are consulted as case studies, to demonstrate how companies that engage with sustainability tackle the challenges they face. To a large extent, these challenges are company-specific, and their approach and vision are unique and variable.

2 THEORY

The theory includes definitions of terms used in the research. In addition, it presents the required theory to understand the results from the thesis and to be used for comparison in the discussion chapter.

2.1 Main definitions

The following terms are central to this research. Therefore, it is important to clearly define what they mean. The definition of sustainable development is based on a peer-reviewed article. The definition of Sustainability challenges for the Shipping Industry is defined by the author.

2.1.1 Sustainable development

Sustainable Development was described in 1987 in the Brundtland Commission Report as: ‘Development that meets the needs of the present without compromising the ability of future generations to meet their own need’. (World Commission on Environment and Development, 1987). In other words: ’development to achieve sustainability in the economic, environmental and economical dimensions’

2.1.2 Sustainability challenges for the Shipping industry

In this thesis, sustainability challenges for shipping mean: challenges shipping companies face when pursuing sustainable development. This is the author's definition.

2.2 Climate change

In the year 2017, measurements have shown that the average temperature on planet earth has increased 0.8-1.2°C compared to temperatures before the industrial revolution. Earth is heating approximately 0.2°C per decade. With the rate of emission in 2018, the carbon budget to limit global warming to 1,5°C, would be spent within 4 years (IPCC, 2018). When the temperature increase surpasses 1.5°C, it will expose an additional 420 million people to extreme heatwaves. To minimize overshoot large, immediate, and unprecedented global efforts to mitigate greenhouse gases are required because the remaining CO2 budget available for emissions is very small (IPCC, 2018).

2.3 Emission reduction regulations

In the following paragraphs the IMO's emission reduction strategy and the inclusion of shipping in the European Emission Trading System. This theory is required as theoretical base to understand the regulation driven change of the industry.

2.3.1 The IMO's and GHG reduction strategy

As the main response to combat global climate change, the IMO released a GHG reduction strategy. The vision for the strategy is formulated as: 'The IMO remains committed to reducing GHG emissions from international shipping and, as a matter of urgency, aims to phase them out as soon as possible in this century.'(IMO, 2018). The main elements of the initial strategy are shown in Table 1.

Table 1: Initial strategy for GHG reduction IMO

1	Carbon intensity of the ship to decline through implementation of further phases of the energy efficiency design index (EEDI) for new ships
	to review with the aim to strengthen the energy efficiency design requirements for ships with the percentage improvement for each phase to be determined for each ship type, as appropriate;
2	Carbon intensity of international shipping to decline
	to reduce CO2emissions per transport work, as an average across international shipping, by at least 40% by 2030, pursuing efforts towards 70% by 2050, compared to 2008
3	GHG emissions from international shipping to peak and decline
	to peak GHG emissions from international shipping as soon as possible and to reduce the total annual GHG emissions by at least 50% by 2050 compared to 2008 whilst pursuing efforts towards phasing them out as called for in the Vision as a point on a pathway of CO2emissions reduction consistent with the Paris Agreement temperature goals.

2.3.2 Criticism on the IMO's response to combat climate change

In the article "Shipping body's climate plan 'ignores Paris Agreement'' published by Transport and Environment in 2020, the IMO GHG reduction strategy is strongly criticized. The article states that progress to tackle climate change is painfully slow and its reduction strategy is weak (Bowers, 2020). The proposed 40% reduction would itself fall a long way short of the Paris accord's commitment to limiting global warming to 1.5/2°C by 2100.'(Bowers, 2020). Therefore, the European Union is taken matters into its own hands and introduced a new European regulation.

2.3.3 Inclusion of Shipping in the European Emission Trading System (ETS)

The members of the European Parliament (MEP's) voted to include shipping in the European Emission Trading System (ETS) in 2023 if there is no comparable system implemented by the IMO by 2021. The secretary-general of the European Community Shipowners Associations (ECSA) said that: "putting unrealistic pressure on the IMO, is not the way ahead, and it will complicate the achievement of an effective and timely global agreement in the IMO that everyone in the end wants."(ECSA, n.d.) Lighthouse-Swedish Maritime Competence Centre completed research to assess the overall design and consequences of including maritime transports in the EU emission trading system.

2.4 Decarbonization

The following theory is based on an article about the decarbonization challenges and options for shipping. This article defines the main drivers for sustainable development of shipping, the emission reduction measures, and the barriers to implementation. This theory is an essential context to understand the challenges for sustainable shipping. In addition, this theory is used to make comparisons in the discussion section.

2.4.1 Decarbonization challenges for the shipping industry

The article: 'Towards the IMO's GHG Goals: A Critical Overview of the Perspectives and Challenges of the Main Options for Decarbonizing International Shipping by Patrizia Serra and Gianfranco Fancello (2020)', identify three main factors that drive the sustainable development of shipping, namely:

1. Regulatory and institutional pressures. Meeting the ambitious decarbonization goals is the biggest challenge shipping is facing.
2. Market factors and resource availability issues. These are traditionally the main drivers of innovation within shipping. The price and availability of crude oil always pushed shipping to search for alternative fuels or operations.
3. Social pressures and ecological awareness and responsiveness. Most shipping companies rely on their customer and investor demands to stay in business, being a strong incentive for shipping companies to become greener.

The most promising emission reduction measures the shipping industry can adopt to reach the IMO's emission reduction goals are classified into four groups, each divided into subgroups, which are presented in Table 1 below (Serra & Fancello, 2020).

Table 2: Emission reduction measures

Technological measures	Change to low sulfur fuel
	Change to alternative fuels
	Invest in cleaning equipment
	Ship design
Operational measures	Speed management
	Route planning and voyage optimization
Market-based measures	Tax, incentives, and green shipping practices
Management measures and decision support models	Network design, fleet deployment, berth allocation, scheduling optimization, vessels routing

The GHG reduction measures vary in difficulty to implement. For some reduction methods, the barriers to implementation are bigger. Table 3 shows the barriers to implementation divided into 8 obstruction categories.

Table 3: Barriers to the implementation of GHG reduction measures.

Economic barrier	Higher costs associated with cleaner fuel
	Limited capital resources for investment
	Long return on investment time
Technological barrier	Undeveloped infrastructure (bunker facilities)
	Electrification (Shore power and battery capacity)
	Storage capacity for gaseous fuels
Time barrier	Decision making
	Absence of planning
	Few incentives
Regulatory framework	Global regulations to not distort international competition
Side Effects	Increase of CO2 emissions due to shifting to land transport
	Reduction in the profitability of shipping
Split Incentives	Charter contracts to limit the implementation of Technical and Operational measures
	Split incentive between ship owners and charterers
Information	Lack of knowledge and information on abatement technologies
Inertia and Risk-Appetite	Financing risk
	Technical risk
	External risk (fuel prices, regulations, etc..)

2.5 Environmental training and education

The environmental impact from shipping is currently part of the training and education for Maritime students and seafarers. Environmental-related issues are part of the STCW for watch-standing officers and in the basic marine environmental awareness course. Also, the Maritime Institute Willem Barentsz and Chalmers University of technology have it incorporated in their curriculum. A summary of the environmental-related training material required by the STCW and currently included in the bachelor course: 'Maritime Officer' at the Maritime Institute Willem Barentzs, and included in the bachelor course 'Master Mariner' and 'Marine Engineer' at Chalmers University of Technology, is made in the following paragraphs.

2.5.1 STCW tasks with an environmental background

During the Project Environmental Training for Cadet, an analysis was made of the environmental tasks that are part of the training record book for Cadet. A review of the Training Record Book for marine engineers and master mariners of the Maritime Institute Willem Barentsz (Maritiem Instituut Willem Barentsz, 2019), finds the following tasks that relate to environmental impact:

- The procedure for handling garbage, rubbish, and other wastes.
- The procedure for handling sludge.
- The use of garbage compactor, incinerator, and such-like equipment.
- The procedure for handling cargo slops.
- The use of bilge water treatment equipment.
- The use of sewage treatment plants.
- The use of ballast water monitors and ballast water treatment installations.
- All relevant administration, such as garbage record book, oil-and cargo record book, and ballast water record book.
- Carriage of dangerous goods:
- Dangerous, hazardous, and harmful cargoes. Knowledge of:
- Procedure and Arrangements Manual
- Cargo data sheets, including Material Safety Data Sheets.
- Oil record book
- Cargo record book
- USCG compatibility list
- Dangerous goods in accordance with the international regulations and recognized standards and codes of safe practice.

In 2010, new amendments were adopted by the STCW conference and code that introduced new pollution prevention requirements (International Maritime Organization (IMO), 2012). This includes guidelines for member states to implement and offer a Marine Environmental Awareness Course (MEAC) based on the IMO Model Course (IMO, n.d.). The objectives of the course are to raise the knowledge and understanding of the importance of pollution prevention and can be divided into the following sub-objectives:

- The concept of sustainable shipping
- The complexity and diversity of the marine environment
- The impact of shipping on the environment
- The role, legitimacy, and credibility of regulations designed to protect the marine environment.
- The role of procedures and technical installations to protect the environment.
- The role of the human element to prevent pollution
- The intention to fully observe procedures for monitoring ship-board operations and ensure compliance with requirements for environmental protection

The course is given in private training centres in institutions, as well as maritime academies. The duration is two days from 09-1700.

2.5.2 Environmental education in maritime academies

In the full-time Bachelor Maritime Officer (Dual Purpose Officer) at the Maritime Institute Willem Barentsz (MIWB) in the Netherlands, the environmental impact from shipping is addressed during two courses:

- Maritime Law
- Marine Engineering Standard

During Maritime Law, students are taught about MARPOL. The history and design of the convention are covered. Under the Marine Engineering Standard course, a new subject was added in 2018. It covers MARPOL and the pollution from ships. The course runs for 6 weeks and includes presentations covering each MARPOL Annex independently. Each week a small report must be written about the Annex (MIWB, 2020).

In addition, the MIWB offers the Master Marine Shipping Innovations. This is not part of the Bachelor Maritime Officer but is a separate education. It is a supplementary Master Study, that builds expertise on the implementation of technological innovations in the student's operational field. The student must be employed and work closely together with their company during the learning process. Practical research, innovation, and sustainability are central to this education.

Chalmers University of Technology introduced a course solely dedicated to the Environmental impact from shipping was introduced: SJO571 - *Environmental impact from shipping* (Chalmers University, 2021). The course is valued at 7,5 Credits (ECTS) and is obligatory to follow for the bachelor *master mariner, marine engineer*, and *international logistics*. The aim is to increase the student's awareness and knowledge about:

- The concept of Sustainable development.
- The environmental impact of shipping, today and in the future.
- Instruments and analytical methods for environmental decision support.
- Technical solutions to reduce emissions from shipping to the sea and atmosphere.

The course covers five main areas:

- Sustainable development, the concept in general, for shipping and methods for analysis.
- Shipping emissions to the sea and their impact on marine ecosystems.
- Air Emissions
- Impacts on health and environment.
- Technology, regulations, and economic instruments to improve the environmental performance of ships.
- The view on sustainability and environmental issues in the shipping industry

The learning outcome of the course is:

- Explain the concept of sustainable development including the environmental, economic, and social dimensions.
- Apply methods for the analysis of sustainability.
- Compare the environmental impact of shipping to other ways of transport and the society and exemplify sustainable solutions.
- Explain the impact of shipping on the environment and describe available treatment techniques and solutions.
- Summarize the legal framework regulating discharges from shipping to air and sea.
- Describe the work with environmental issues on board.
- Relate to the ethical aspects linked to shipping and the environmental impact.
- Apply knowledge on the environmental impact from shipping in communication with authorities and consultants.
- Critically examine and summarize scientific papers related to the environmental impact of shipping.

2.5.3 Environmental training for Cadet

There is an apparent gap between the environmental compliance duties of a cruise ship and the STCW based training for Nautical and Technical Cadets. The project ’Environmental focus for Cadet’ investigated what the knowledge gap is and what should be included in environmental training for cadets to bridge this gap.

The gap was identified through analyzing the STCW training record book for Nautical and Technical Cadets, and compare them to the Environmental Officer responsibilities, the Environmental Officer Induction Portfolio, and the Environmental knowledge base required for Technical Officers.

Further, qualitative research was conducted through interviews with Environmental Officers, Instructors, and managers. The goal for the interviews was to receive an expert opinion about the required skills and competence for the EO and how to best conduct environmental training for cadets.

The results from the desk review and the interviews were put together to develop a training plan for cadets on board cruise ships. This training plan aims to increase the environmental awareness and knowledge of the Cadet, and gain experience with the technical operations and compliance related to the environmental impact from the ship. The full training plan as developed by the thesis: ’Environmental focus for maritime cadets’ is included in Annex-9.

3 METHOD

This research is based on quantitative and qualitative research methods. Therefore, three forms of data collection have been used: Literature review, Open Interviews, and a Questionnaire. In the discussion, results from the qualitative and quantitative methods are compared.

3.1.1 Literature review

The literature review demonstrates the regulatory challenges the IMO experiences with setting up the required regulatory framework and what the shipping industry can expect from the regulatory side. Further, sustainability drivers and barriers for the implementation of GHG reduction measures were identified from the academic papers as background for the interviews. The search engines used for the literature review were the online Chalmers Library and Google Scholar. Keywords used during the search were: Shipping, Environment, Officer, Sustainability, Challenges, Sustainable Development Goals, Maritime. The purpose of this literature review is to create a theoretical framework for the interview questions.

Finally, a text analysis was completed to determine the degree of environmental awareness and knowledge included in the STCW requirements and education for Nautical and Technical Officers. This assessment was based on:

- the Training Record Book for the nautical and technical cadet from the Maritime Institute Willem Barentsz,
- the educational statutes for the education of Nautical and Technical Officer,
- the course descriptions from the Chalmers University of Technology.

3.1.2 Open Interviews

Open interviews were conducted with four company representatives and two academic experts. The open interviews were designed to learn about what sustainability drivers' companies are experiencing, which challenges they face to become more sustainable, what the requirements are to reach the challenges if this requires new environmental positions, and experience from the environmental job. To gain this knowledge a qualitative research method was chosen. The companies that have been interviewed have taken the initiative to become more sustainable and are actively pursuing sustainable development. Therefore, they have already proceeded on the road to green shipping and can function as a case study to learn about the requirements of sustainable development.

Table 4: List of Interviews

Name	Position	Company	Validity & Contribution	Duration	Date
Marcus Jakobsson	Sustainability Controller	Terntank	As the first person to claim this position, Marcus is the right person to explain why it was introduced, what the job responsibilities are, and what the requirements are for his job.	36 minutes	29-4-2021
Roger Strevens	Vice President & Global sustainability	Wallenius Wilhelmsen	Roger Strevens is responsible for the sustainability of Wallenius Wilhelmsen. The interview gives an exclusive insight into their approach, and drive for sustainable development and how it is part of their company and business.	25 minutes	30-4-2021
Ronald Vergouwen	CEO	Iskes Tugs	As CEO, Ronald is responsible for the sustainability vision and development of the company. The interview explains the limitations and advantages of being a small family-owned business regarding sustainable development and the trends he defines within the Off-shore and towage sector.	45 minutes	05-11-2020
Kent Salo	Senior Lecturer	Chalmers	Interview about the thesis: Future skills for Mariners, about where companies find the knowledge they need for sustainable development. 47 persons working in Swedish shipping companies were interviewed.	46 minutes	28-4-2021
Asa Burmann	Director	Lighthouse Competence Centre	As head of the Lighthouse Competence Centre, Asa Burman is at the forefront of sustainable and technological developments in shipping.	24 minutes	1-12-2020
Ronald de Bloeme	Environmental Instructor	CSMART	Ronald de Bloeme was EO on board Carnival Corporations cruise vessels for many years and is now head of the environmental training for EO's. The interview aims to receive information about the competence and skills required for Environmental Officers	52 minutes	19-01-2021

The transcriptions of the interviews are presented in Annex-1 to Annex-6. The interviews were held through Microsoft Teams and transcribed by listening to the recordings. Text analysis was performed on the transcribed records of the interviews.

3.1.3 Questionnaire

Besides the Interview, a questionnaire was distributed among Swedish shipping companies. The purpose of the questionnaire was to get a quantitative representation of the number of environmental positions within the shipping industry. Another purpose was to get an indication of the importance of the sustainable development of shipping. The results from the questionnaire are included in Annex-10. The questionnaire contained the following questions:

1. What sector does your company operate in?
2. How important is the sustainability transition for the Shipping Industry?
3. Does your company have a plan to contribute to the United Nations Sustainable Development Goals (UNSDGs)?
4. How many environmental positions are there within your company?
5. What are the main sustainability challenges for your company?
6. Is there a gap between the sustainability challenges your company faces and the required resource?
7. If yes, how does your company want to bridge this gap?
8. Is there a demand for Maritime graduates with at least basic Environmental knowledge?
9. Do you currently have Environmental Officers (EO's) employed onboard or shore?
10. If yes, how many are working on board?
11. Are there any EO's working shore-side?
12. Does the company want to employ more EO's to face Environmental Challenges?
13. What background does the EO have?
14. The sustainability transition of this company will offer new positions for nautical and technical graduates.
15. To achieve sustainable development goals, the company requires personnel with environmental competence and interest to tackle the challenges of the future.
16. Are the questions in this questionnaire currently relevant and of interest to the company?
17. Do you have any thoughts about the questionnaire you want to share with me?

The questionnaire was made in google forms and distributed by email to various shipping companies. The total responses received was 4. The companies that have replied are Stena Line, Wallenius Wilhelmsen, Terntank & ISKES Tugs.

4 RESULTS

This section of the research contains the results and answer the research questions. The results are mainly based on the interviews. However, academic reports, journalistic articles, and corporate reports have also been included in the text. In addition, the questionnaire is also integrated into the text. Furthermore, the paragraphs are based on the research questions. The first paragraph answers the drivers for sustainable shipping. The second paragraph contains the requirements for sustainable development and the environmental positions. The third paragraph summarizes the requirements for these positions. The results are built on a combination of literature, the interviews, and the questionnaire.

4.1 What is driving the companies that were interviewed to pursue sustainable development?

From the interviewees' perspective, 3 main external sustainability drivers could be distinguished. All the companies consulted had the following drivers in common:

- New regulations
- Stakeholder pressure/customer demand
- Investor and financial pressure

All three company interviewees state that: new regulations are the dominant driver for sustainable development and most commonly address emission reduction and more specifically GHG reduction. An example is the global sulfur cap (International Maritime Organization , 2016) imposed on the 1st of January 2020, forcing shipping companies to use cleaner fuels or Exhaust Gas Cleaning Systems (EGCS). Since the sulfur cap is in force globally, competition is leveled in a global market. It is very hard to make the investment for abatement technologies and be competitive in a global market when not all competitors are required to make the same investment (Vergouwen, 2020).

The second driver for sustainable development identified from the interviews is the market demand. Wallenius Wilhelmsen experiences increasing demand for sustainable services from the industries they serve, and the trend is going in the direction of Zero Emission services (Strevens, 2021). Their clients are eager for partnerships in reducing total emissions across the complete supply chain. Furthermore, stakeholders, these days are interested in your emission profile and want to know what your approach is to sustainability. Roger Strevens says: 'we have passed the point that we just give them our latest results', they want to know how it is working out for us (Strevens, 2021). Furthermore, some clients also ask for the emission data of their shipment (Irish Times, 2013).

In the offshore industry, Ronald Vergouwen notices that fuel efficiency is becoming increasingly important to win tenders for a job. However, this is mostly for the cost picture. Sustainability is not yet very important in the Off-shore industry because it mainly takes place behind the horizon according to Vergouwen. In the port market, it is more important because customers value sustainability and there are more stringent regulations. However, at the end of the interview, Ronald Vergouwen mentions that they are eager to engage with sustainable developments because it is starting to become more important with the current tenders.

Stakeholders can also hold back the sustainable development of a shipping company. For example, Terntank has many long contracts with 'Oil mayors'. 10 from 13 ships they operate are sailing for 'Oil Mayors' on long contracts. These contracts do not take efficiency into account and counteract initiatives to save fuel and emissions. Marcus Jakobsson explains: 'If we slow-steam[1] because we know the harbor is occupied, we lose money with the current contracts because we get paid as soon as we drop anchor and send the notice.' Marcus Jakobsson is putting in the effort to negotiate new contracts with their clients. They are very willing to talk about new initiatives, however, most negotiations run aground when investments must be made since the parties are hesitant to cover the investment and transition costs for sustainable solutions. Therefore, funding is required. Small family-owned businesses normally don't have sufficient financial resources alone to make the transitional innovations. This refers to the financial barrier to the implementation of emission reduction measures (Wang et al., 2020). Ronald Vergouwen experiences the same with ISKES Tugs. They are very eager to innovate because they like to, and because they are a family-owned company, they can easily decide without shareholder involvement. However, in most cases, they do not have the financial means to cover the costs and depend on government funding to develop innovations.

Furthermore, the companies interviewed experience a drive from the financial side. According to the persons interviewed, the range of financial options available to raise a fund or borrow money largely depends on how sustainable you want to use that money. Marcus Jakobsson says that after the pandemic, the criteria for funding from the EU got very narrow and that you must be very green to receive money. Roger Strevens says that raising funding for a green cause is cheaper than for an investment that doesn't contribute to sustainable development. In a periodical article, he says that investors are looking at the environmental compliance record and see it as a health indicator: 'If companies are performing well environmentally, they are probably performing pretty well overall, they are pretty well run (Irish Times, 2013).' This is the influence the Financial Department and Investor Relations are experiencing. Wallenius Wilhelmsen cannot ignore this and therefore commits to sustainable development. In the case of ISKES Tugs, it works the other way round. Ronald Vergouwen and their company want to innovate however don't have the financial means to do so. Therefore, they need government funding to investigate and develop innovations.

[1] Sailing at low speeds to safe fuel

4.2 What challenges do these companies face and do they require more positions with environmental knowledge within their company to face the challenges?

The biggest challenge faced by Wallenius Wilhelmsen is emission reduction, and specifically decarbonization. Roger Strevens says: ‘We are humble before the challenge because we understand what it entails, it is already deeply affecting every aspect of our business’. The challenges they face in environmental, societal, and governance areas are of equal importance, however, they are not equal challenges. Marcus Jakobsson agrees with that and says that most challenges they must tackle, are based on the GHG reduction of their fleet. This is because of the IMO GHG reduction strategy (Organisation, 2018), the MRV (Council of the European Union, 2015), and the recent inclusion of shipping in the EU Emission Trading System (EU ETS) (Riviera News, 2020) all target GHG reduction. However, Marcus Jakobsson also says that they need to take a wider approach such as the SDGs and that is also what Wallenius Wilhelmsen is doing (Berhad, 2013).

A reply to the questionnaire answered that the three main sustainability challenges for shipping companies are: emissions to air, equality, and diversity, and ship recycling. Another thought shared through the questionnaire states: ‘It is very easy to regard sustainability just as carbon emissions but it’s wider than that’. Marcus Jakobsson and Roger Strevens both say the emissions to air are their main priority and acknowledge that the challenges related to sustainability are wider. Marcus Jakobsson said in his interview that concerns for him as sustainability controller also include gender equality and high standard working conditions for all employees, also on the ship-yards in China where their new vessels are built. Roger Strevens also mentions ship recycling as a challenge for Wallenius Wilhelmsen. The first challenge he mentions is: ‘What do we do with the existing fleet?’. The second challenge he mentions is new builds. They aim for zero-emission vessels. However, there are many challenges with designing zero-emission ocean-going vessels. The energy demand for their vessels is 16000 times larger than the current zero-emission vessel Yara Birkeland requires.

4.2.1 Technical requirements

From the interviews and the literature review, the following requirements to meet the sustainable development challenges could be identified. The requirements for the company are divided into Technical and Organizational. The technical challenges are:

- Data Recording
- Compliance
- Operational Efficiency
- Technological Innovations

4.2.1.1 Data Recording

The first step in decarbonization is knowing how much is being emitted (Lee et al., 2019). The MRV makes it mandatory for all ships above 5,000 GT calling ports in the European Economic Area (EEA) to deliver an emission report to the European Union. Every year since 2018, an emission report must be created to fulfill the requirements of the regulation. Monitoring emission data is also becoming increasingly important in the financial department, for stakeholders and clients as described in the paragraph above. This development required Terntank to introduce a new position. One of the main concerns for the sustainability controller of the Tern tank is to collect emission data from the fleet and produce emission reports in compliance with the MRV. This was not the only reason to introduce this position; due to all the developments regarding sustainability such as new fuels, reporting, and environmental indexes, they needed someone to: ’take the temperature of which developments could benefit the company environmentally and economically’ (Jakobsson, 2021).

4.2.1.2 Environmental Compliance

The Carnival Corporation is on the cutting edge of environmental compliance standards due to the compliance structure imposed by the ECP 2017. This compliance structure required the introduction of a corporate compliance manager (CCM) and compliance managers for each operating line (OLCM). The compliance managers report directly to the CEO, Arnold Donald. On board each vessel of a Carnival Corporation Operating Line, an Environmental Management System (EMS), an Environmental Control System (ECS), and an Environmental Officer (EO), are implemented. The shipboard compliance work and the operations themselves are periodically audited by a Carnival Corporation's Risk Advisory & Assurance Services (RAAS) department and randomly audited by a Third-Party Auditor (TPA) during ship visits. The TPA is monitored by the Court Appointed Monitor (CAM) that reports to the US Department of Justice. An illustration of the compliance structure is attached in Annex-6.

The Environmental Officer plays an important role in overseeing the environmental compliance on board. The EO is responsible that all activities with an environmental impact that are carried out according to the environmental regulations and company procedures. This includes the inspection of Logbooks, Engine Room rounds, the inspection of the Oily Water equipment, garbage room operations, and garbage disposal. The role of the EO is casually described as an additional pair of eyes to fill any gaps in compliance. In addition, the EO is a reporting point for environmental issues and reports directly to the Captain and the OLCM. The EO is also responsible for training crew members to raise environmental awareness (Carnival Maritime, 2019).

An article about the Carnival Corporation’s CEO Arnold Donald says that ‘The scrutiny currently being applied to Mr. Donald’s operations should be taken as a warning of what is coming to the rest of shipping’s executives and the pace of change that is now required to avoid similar pitfalls (Lloyd's List, 2019).’ Since environmental regulations will become increasingly strict (International Maritime Organisation, 2019), environmental compliance is also becoming increasingly important for other shipping companies and operators.

4.2.1.3 Operational Efficiency

One of the most straightforward measures to reduce CO2 emissions is operational efficiency. For Wallenius Wilhelmsen, this is the underpinning of how they compete. Fuel is the biggest marginal cost they have, which means there is already a permanent and central focus on operational efficiency. One of the measures for Wallenius Wilhelmsen to achieve this is through the digitalization of their fleet. Four of their vessels continuously stream live performance data from the vessel to a digital platform, which helps Wallenius Wilhelmsen to improve energy efficiency and route optimization.

4.2.1.4 Technological Innovations

Technological innovations are seen at 3 example companies:

1. AIDA/Carnival Group
2. Terntank
3. Wallenius Wilhelmsen

4.2.1.4.1 ADIA Nova

In December 2018, the first LNG cruise vessel AIDA Nova (Ship-Technology, 2020) as seen in Figure 1, was delivered to AIDA Cruises. This Ship with a length overall of 337 meters and a capacity of 6.600 passengers is the first in a line of the new generation Cruise ships for Carnival Group.

In the first year in operation (2019) it was recorded that the CO2 emissions per person per day on board had dropped 55% when compared to the fleet average in 2018 (AIDA Cruises, 2019).

Figure 1: AIDA Nova at sea (Source: AIDA Cruises)

4.2.1.4.2 Terntank

The first tanker of the AVIC Series, is running on LNG and was delivered to Terntank in 2016. It is recorded to emit 40% less CO2 than their conventional diesel-powered vessels, says Marcus Jakobsson, sustainability controller of Terntank. The Ternsund, a tanker of the AVIC series, can be seen in figure 2.

Figure 2: Ternsund of the AVIC Series at sea (Source: Terntank)

4.2.1.4.3 Wallenius Wilhelmsen

This innovative company from Norway is eager to take a big technological step towards Zero Emission Ocean Shipping (ZEOS). It is investigating the possibility to build a vessel based on the Oceanbird concept developed by Maritime Consultant Wallenius Marine (Wallenius Marine, 2020): using wind power to sail the ship. However, before they built that boat: it must make sense. Three full-time employees (FTE) of Wallenius Wilhelmsen are working in collaboration with Wallenius Marine to make a comprehensive viability evaluation based on the following five criteria:

- Is it *technically* possible?
- Is it *operationally* possible?
- Is it *regulation*-wise possible?
- Does it make *financial* sense?
- Can it be *commercially* competitive?

When all these requirements are met, we might see the first wind-powered RORO vessel, Orcelle Wind in figure 2, setting sail in 2025. Orcelle Wind is expected to reduce CO2 emissions by 90%.

Figure 3: Artist render of Orcelle Wind (Source: Wallenius Wilhelmsen)

However, technical innovations do carry a risk. Roger Strevens says: ‘we only want to spend the money once and want as much change with the minimum of inefficiency and critically, unattended consequences.’ However, it is very difficult to know on the forehand if the technology is going to deliver the desired outcome. That is a big question for companies: what technology should they invest in? ‘How do we work together with universities; how do we use institutes to get ourselves the knowledge?’ says Marcus Jakobsson. Kent Salo acknowledges that companies seek contact with universities because there is a knowledge gap. Kent Salo says: ‘Although sustainability managers are active on the technical knowledge front, there is still a lack and insecurity about the applicable technical solutions’

4.2.2 Organizational requirements

From the interviews, 7 organizational requirements to be met for sustainable development could be distinguished. These requirements are:

- Sustainable company culture
- Communication
- Employee and customer engagement
- Partnerships
- Green Funding

The organizational requirements are mostly linked to meeting the challenges the companies face in the economic and social dimensions of sustainability. However, some also connect with the technical requirements and supplement the main challenge shipping faces: decarbonization.

'Emission reduction is an entire company challenge' says Roger Strevens. 'It doesn't come down to one person or one department. Sustainability is impacting every corporate function and profoundly impacting it.' For example, Investor relations is impacted by sustainability in a way that investors want to know what your plan is to sustain the business in a sustainable society.

An example of how the organizational requirement of a sustainable company culture contributes to a technical requirement for sustainable development is compliance. The operators and crew members on board must be intrinsically motivated to adhere to the procedures and regulations. This requires basic knowledge and understanding of environmental matters and personal employee engagement, according to Åsa Burman. "Trying to achieve employee engagement, attracting talent and retention of talent without a strong approach to sustainability is not a good idea", says Roger Strevens. This demonstrates that it is important to have a strong sustainable company culture. Especially when: "for many functional groups it's (sustainability) dictating what is going to happen." according to Roger Strevens.

’Our purpose is to define sustainable logistics for a world in motion (Wallenius Wilhelmsen, 2020)’ is what Wallenius Wilhelmsen states on their webpage about the industries they serve. Their approach to realize their purpose is based on five pillars:

- *Taking the initiative.*
- *Partner up.*
- *Attract Innovators.*
- *Look for progressive and pragmatic outcomes.*
- *Broad-spectrum approach.*

According to Roger Strevens, it is important to partner up, because the challenges are far greater than one company on its own can achieve. In addition, you want to attract innovators to your business. Many heavy industry sectors face the same challenges and might have a solution that works for you too. Wallenius Wilhelmsen strives to be the engaged and willing industry dialogue partner.

At Terntank, a large part of the sustainability governance and communication is directed to the sustainability controller. One of his tasks is to translate the company’s vision into clearly defined objectives. Guidelines for this are mainly international and industry regulations, which are mostly based on GHG reduction as a benchmark. When the sustainability goals are set, they are communicated within the company as well as to the outside. In his own words: ’what is our appearance towards our customers, and to ourselves, what do we want to communicate and how do we communicate it?’ (Jakobsson, 2021). In Marcus’s effort to engage their clients (Oil mayors) in sustainable development, they also communicate what they are doing in terms of sustainability to try and inspire them. However, it is equally important to communicate your sustainability message towards your own company to create a strong sustainable company culture.

The goal for the sustainability controller is to secure the sustainability work: are we doing the right thing at the right time. Marcus Jakobsson tries to present any findings that could result in negative PR or situations where they can lose money since most of their funding has sustainability criteria. This leads to briefing employees and writing manuals for side managers. From the social perspective, he must assure the working conditions on board for the crew are not bad. Also, the working conditions on the shipyards in China, where their new vessels are built should not be bad either. There are more social questions to answer according to Marcus Jakobsson. Namely; how do we attract a woman to the business and how do we do fair recruiting while working on a global market?

Furthermore, an important organizational requirement for the sustainable development of shipping is green funding. According to Åsa Burman, the biggest gap to bridge sustainable innovation is a lack of money. Ronald Vergouwen says that they can hardly do any real innovation without government subsidies. The finance side is deeply impacted by sustainability. Roger Strevens says: 'If you want to raise money, borrow money or raise a fund, the range of financial services that are available to you and the price of them, depending on what you are trying to do is sustainably linked or green bond linked. It has come to a point that it is more expensive to raise a bond that isn't green than a bond that is.' Marcus Jakobsson agrees. He says that it is important to take a more active and broader approach such as the SDGs when setting goals for sustainable development. This is because; during the restart of the EU economy after the pandemic, the criteria to receive EU funding have become very narrow. To receive funding, you must be very green.

To summarize the section about the organizational requirements and environmentally engaged company positions, the following has been identified:

- It is important to take a broad approach to sustainability
- It is important to have a strong sustainable company culture
- The company culture and sustainability goals must be well communicated to the inside and outside
- Raise partnerships
- Attract innovators
- Green funding

The Organizational requirements demand the following positions with environmental knowledge:

- Employees with basic environmental awareness and knowledge
- A person or team responsible for setting sustainable development goals
- A person or team responsible for communicating the sustainable development goals
- A person or team securing the sustainability work
- Investor relations to foster sustainable investments
- Finance department to sources sustainable funding

The Technical requirements demand the following positions with environmental knowledge:

- Sustainability Controller
- Data Scientist
- Environmental Compliance Officer, Company Compliance Officer
- Operators with environmental awareness and engagement
- Research teams and academic trainees

These are the roles and functions that are identified as necessary according to the results from the interviews. However, Ronald Vergouwen says that: ‘At small companies, there are no positions that are specifically responsible for sustainability and the control thereof. At the large companies, there will certainly be a sustainability strategist and team to work on making the company more sustainable.’ According to the interviews that is correct. At Stena Line, 2 positions are specifically dedicated to sustainability full time. At the Port of Gothenburg, there are 4 positions engaged with sustainability work, and at Wallenius Wilhelmsen, there are 5 environmental positions apart from the 3 FTE’s working on the development of Orcelle Wind.

4.3 What are the requirements to take on environmental positions within shipping companies?

From the interviews, it is possible to briefly define which environmental knowledge is required for which corporate position. These findings are presented in Table 5.

Table 5: Environmental requirements for positions within shipping companies

Position	Environmental knowledge requirements
Operators and Crew Members	Basic environmental awareness
Shore-based departments	Specific sustainability knowledge and skills depending on the nature of the department
Sustainability Manager/Controller	Understanding of shipping, economy, data collection, and fundamentals of sustainability
Board of a company	Expert knowledge to make effective decisions for sustainable development

Kent Salo found that environmental awareness is often lacking throughout all layers of the company. This argues that all employees require basic environmental awareness. When pursuing sustainable development in all three dimensions throughout the company will impact every corporate function according to Roger Strevens. Therefore, all shore-based departments require sustainability knowledge to some extent depending on the nature of their work. Furthermore, the questionnaire found that there is a demand for Maritime Graduates with basic environmental knowledge.

The results have demonstrated two specific environmental positions that are required for the sustainable development of the companies consulted. These are the *Sustainability Controller* and the *Environmental Officer*.

4.3.1 Sustainability Controller

For the position of the sustainability controller, the following requirements could be identified from the interview with Marcus Jakobsson:

- Since it is a new position, it is very broad who is suitable for it.
- Environmental background / Sustainability principles
- Economic competence (although not so important)
- Understanding of shipping and the challenges ahead
- Shipping's regulatory framework
- Making environmental performance & economic calculations

The requirements for the job are very vague since it is a new position. Marcus Jakobsson had to figure out what he could do and what his goals were. He had to look from a sustainability perspective, what was necessary to work on and improve within the company. Therefore, he states that a sustainability background is necessary for this position.

Further on, Marcus Jakobsson says that this research is a perfect background for an environmental position in his company. You must know what the challenges are that lay ahead, what the solutions are for those challenges, and how to apply the knowledge to the company. He concludes his interview and say's that: 'a specific course about the sustainability challenges the shipping industry is facing is enough knowledge to start a career in this area'.

4.3.2 Environmental Officer

The following requirements for the Environmental Officer (EO) position on board Carnival Cruise vessels are based on the Job Description for EO's from AIDA Cruises (ANNEX-7):

- Competency/ Knowledge in Environmental Management (waste streams and processes, basics of sustainability, etc.)
- Engine Officer License or environmental/science-based bachelors degree

The interview with the Environmental Instructor at CSMART, Ronald de Bloeme, describes the following requirements for this position:

- Situational awareness of nautical and technical operations.
- Technical system understanding and diagram reading.
- Logbook keeping.
- Knowledge of international regulations and company procedures.
- Communication skills to communicate with all ranks and authorities.
- Tutoring skills.

Ronald de Bloeme says that Technical Knowledge is vital for an EO. Therefore the EO ideally comes from an Engineering rank to become EO. Furthermore, the character traits of the EO are resilience, precision, communication, resourceful, active, and disciplined.

4.3.3 Management Positions

The research about the future skills for mariners conducted by Kent Salo found that 50% of the people in environmental positions within shipping companies do not have an environmental education background. The environmental knowledge required for this position is in that case most commonly attained by attending industry conferences, seminars, and networking. According to Kent Salo, the latter can be a pitfall when shipping companies only talk to other people within the shipping industry and not learn or take an example from other industries. The required basic environmental awareness for crew members is most commonly attained by sending them to environmental courses or inviting guest lecturers, as well as introducing the company's environmental induction training and self-development courses.

Another way, the required knowledge for environmental positions is acquired, is by diverting the available resource in a company: 'A marine engineer can dedicate 70% of their time for their main objective and 30% to learning new valuable knowledge and skills. Chalmers University of Technology in Gothenburg and the Maritiem Institute Willem Barentsz in Holland offers Maritime Master studies dedicated to marine shipping innovations. Former Marine Engineers and Nautical Officers follow these studies to gain knowledge and expertise that can help their future careers at shipping companies. According to the research conducted by Kent Salo (Salo, 2020), companies demand that their future marine engineers and master mariners come from the academy with environmental knowledge.

5 DISCUSSION

The requirements for sustainable development are demonstrated and can be divided between *technical* and *organizational requirements.* These technical and organizational requirements, influence corporate positions, require workload, or demand new positions or skills.

5.1 Drivers for sustainable development

The drivers for sustainable development that the companies that were interviewed experienced were: *new regulations, stakeholder pressure/market demand, investor and financial pressure*. Investors and financial pressure are both a driver and a barrier to sustainable development. The three main factors that drive the sustainable development of shipping as identified by Serra and Fancello (2020) are *regulatory and institutional pressure, market factors and resource availability issues*, and *social pressure and ecological awareness and responsiveness.*

The article and the interviews both declare decarbonization of shipping, which is driven through regulation as the biggest driver for sustainable development. Market demand is identified by the interviews as the second main driver. The interviews mainly state that their clients and stakeholders are demanding environmental performance data and zero-emission services. However, the article suggests that market factors such as resource availability are traditionally the main drivers for sustainable development. It is difficult to determine if the article and the interviews mean the same driver. The third driver for sustainable development as identified from the interviews is equal to the driver stated in the article. Wallenius Wilhelmsen and Terntank both experience pressure from the finance and investor sides to pursue sustainable development. However, the phrasing of the driver is different in the article than as identified from the interviews. In the article, it is phrased as social pressures and ecological awareness and responsiveness. Social pressure and ecological awareness and responsiveness are what drives investors, stakeholders to demand sustainable development and the criteria for funding to be thoroughly green.

5.2 The environmental education for mariners compared to the required environmental knowledge by shipping companies

In paragraph 4.3, the requirements for positions within shipping companies that require environmental knowledge were made. These requirements are compared to the environmental knowledge included in the training and education as described in paragraph 2.3

5.2.1 Positions on board

For the seaman positions on board (O/S, A/B, Bosun) basic environmental awareness is required. The Environmental Awareness Course (EWC) required by the IMO for pollution provides the necessary knowledge to raise this awareness. However, a pitfall could be that because this course must only be completed once during the career of a seafarer, there is a risk of forgetting the knowledge. This will result in a decrease in environmental awareness. Refreshers or Environmental drills could be a solution to maintain a high standard of Environmental awareness.

The Nautical or Technical Officer has great responsibilities and control over the operation of the vessel, as well as management and leadership functions on board. The training record book based on the STCW requirements for watchkeeping officers unlimited includes the pollution prevention requirements according to MARPOL. However, for example, compared to the environmental knowledge base required for Technical Officers (Carnival Maritime) onboard a high-performing vessel of the Carnival Corporation fleet, the TRB holds insufficient environmental knowledge.

If pollution prevention, operational efficiency, and the environmental performance of the vessel are to be maximized the Officers need to have high environmental awareness. This includes but is not limited to an understanding of the environmental concerns and the vulnerability of marine ecosystems, expert knowledge about the environmental impact of all shipboard operations and machinery from the vessel operation, and the available treatment techniques and solutions. The environmental impact from the shipping course provides marine engineers with sufficient knowledge to meet these requirements. However, the master mariners are not given the chance to raise their environmental knowledge to the level described above. In addition, the students of the Maritime Institute Willem Barentsz will achieve a slightly increased awareness about the importance of each MARPOL Annex. However, they miss a practical counterpart for this course.

5.2.2 Sustainability controller

It is unsure if the requirements for the sustainability controller are met with the environmental impact from the shipping course. The course offers a good understanding of the challenges ahead for the shipping industry and the basic principles of sustainability and ecology. Marine engineers also have a good understanding of maritime law and regulations. However, the required proficiency in sustainable economical calculations, as well as the handling of data and production of emission reports is difficult to assess. In addition, the marketing and governance aspect requires a sensitivity for marketing and communication which may not lie like marine engineers. To determine if the ‘action’ and ‘movement’ of a company have a negative influence on their ‘Green’ reputation or damage the sustainability of the company, expert knowledge is required.

5.2.3 Environmental Officer

The requirements for the Environmental Officer position as per job description (Annex-8) are competency/knowledge in Environmental management (waste streams and processes, basics of sustainability, etc), and Engine Officer License or environmental/science-based bachelors degree. The latter is not considered very critically since there is a demand for EO's and not sufficient candidates. There are multiple EO's that have started this position after graduating with a Nautical Officer license and limited working experience. Furthermore, the Environmental Impact from Shipping course prepares a marine engineer sufficiently to meet the Environmental competency/knowledge requirement. In addition, technical knowledge and competence are very important for the EO, as well as knowledge about the international maritime environmental regulations. This makes marine engineers very suitable candidates for the Environmental Officer. However, they would be over-qualified with regards to technical competence. Nautical students, without the environmental impact from the shipping course, would be less attractive for this position.

5.2.4 Miscellaneous positions

Every corporate function is impacted by sustainability according to Roger Strevens. This suggests that in a hypothetically sustainable company all positions would require a certain level of environmental knowledge. An example would be the investor relations department. In addition, there will be more environmental positions implemented in shipping companies while the sustainability transition continues. It is difficult to say which positions they will be in and exactly what knowledge is required for them. Within Wallenius Wilhelmsen, there are currently 5 positions based on sustainability/environmental impact. Companies pursuing sustainable development must conduct extensive research to implement technical innovations, according to Roger Strevens. There is a demand for researchers and academia to work together with companies to find and develop solutions to sustainability issues. The Master Marine Shipping Innovation at the Maritime Institute Willem Barentsz offers experienced mariners with appropriate qualifications, a chance to study marine innovations and develop solutions together with their employer. This master's education offers people the possibility to acquire new knowledge and skill relevant for shipping companies and while conduct research to help shipping companies overcome the challenges they face.

5.3 Environmental training requirements compared to the Environmental training tasks for Cadets.

The Environmental training tasks for Cadets (Annex – 9) were developed to bridge the gap between the environmental operations and compliance of cruise vessels and the training standards for Nautical and Technical Cadets. Based on the comparison between the current educational material for Nautical and Technical students and the requirements for Officer positions onboard sustainable vessels, there is a gap consisting of:

- Environmental knowledge for all students of the Maritime Institute Willem Barentsz
- A practical counterpart for environmental education at the academy

The environmental training plan for Cadets as developed for AIDA cruises is dedicated for Cadets onboard cruise vessels. In addition, due to the size of the cruise vessels, the number of passengers on board, and the exceptionally strict environmental compliance requirements, the environmental impact and work are far greater onboard cruise ships than onboard cargo ships.

The environmental training plan for cadets could be adjusted to be more suitable for operations onboard cargo vessels and include the environmental aspects of operational tasks. In addition, a written detailed assignment from the academy to assess the operations linked to the environmental impact of the vessel should be included as well. Finally, attention should be paid to how vessels can improve their environmental performance and what the performance indicators are.

By giving the environmental aspect of shipping operations more attention during the education and training, the intrinsic motivation to improve the environmental performance of the vessel will increase. The environmental dimension of shipping seems invisible because it is hardly addressed. When addressing it in all aspects throughout the education, training, and work on board, the environmental dimension will become part of the work ethics, mentality, and culture. Without embracing sustainability and bringing it to the core of our purpose, true sustainability in all dimensions is not possible to realize.

6 METHOD DISCUSSION

With regards to the desired level of environmental awareness for Officers, it would have been better to structure the interview questions differently. The interview questions were set up in a way that did not target this information. There is a recommendation made for further research towards the disered level of environmental awareness for officers on board ships.

It was not possible to exactly define the requirements for the sustainability controller position at Terntank because the job description was not available. When Marcus Jakobsson started his job, it was not clearly defined what his job responsibilities were, not what the requirements for the candidates were. Since it is a new position, there is no fixed job description yet.

It was not possible to receive information about which environmental positions are currently active at Wallenius Wilhelmsen, because this question was also not foreseen while preparing the interview questions. Also, the planning of the research did not allow for additional time to collect missing data, which is something that should be considered when planning a thesis.

With regards to the questionnaire, the rate of responses disappointed. The final amount of responses was 4, which was not enough to draw representative conclusions from. The initial strategy for distribution failed because the European Shipowners Ascociation did not want to distribute the questionnaire to their members because of privacy policy. This required the questionnaire to be distributed by specifically approaching companies one by one. This is very time consuming and led to the low amount of responses.

The field of interview participants could have been broader, although the interviews gave an interesting insight into the sustainable development of leading shipping companies. The current interviews are a good ’example’ or ’case’ to study to learn about the sustainable development of a shipping company. Together with a larger group of respondents to the questionnaire, there would be more quantitative data to conclude from, and support the qualitative data.

In general, improvements for this research are to better define the desired out come of the interviews. In addition the interview questions should be the same for each interviewee. Planning wise, the timetable should have included more periodical meetings with the supervisor. This would have resulted in a better overall process, less delay, and more information.

Due to the fact that this research is part of an exchange, it was not possible to have any ’live’ meetings or attend lectures due to the Covid-19 travel restrictions. All interviews and communication was conducted via mail and Zoom. This had a negative effect on the process with regards to guidance, support and peer reviews.

7 CONCLUSION

This research concludes that sustainable development requires new knowledge and environmental positions within shipping companies. For example: due to the increasing demand for data monitoring and emission reports, there is a demand for sustainability controllers. Due to stringent environmental legislation, compliance is becoming increasingly important creating a demand for compliance officers or environmental officers (EO's). Also, the organizational requirements for sustainable development demand governance, marketing, and management positions. Since sustainability covers the environmental, social, and economical dimensions, it impacts almost every corporate function. Therefore, basic environmental awareness is required for all employees. To acquire the necessary knowledge and claim the new position the following can be concluded:

- It is difficult to assess if marine engineers with the Environmental Impact from the shipping course at Chalmers University would have sufficient knowledge about sustainability, economics, and emission report data to be qualified for the position of sustainability controller. The position of sustainability controller demands a high level of knowledge about sustainability according to Marcus Jakobsson. During his interview Marcus Jakobsson assumes that a practical research about sustainability in shipping could give the maritime student sufficient knowledge to be eligible as sustainability controller.
- The marine engineers with the environmental impact from the shipping course are very suitable candidates to become Environmental Officers. Although they are overqualified in terms of technical competence, this is very useful to carry out the EO position. The Environmental impact from shipping would provide enough knowledge about the sustainability principles, marine ecology, environmental technology, and solutions to function as a base for the EO position.
- Furthermore, the Master of Marine Shipping Innovations is a perfect solution for the continuous development of the current workforce to acquire any new skills required for sustainable development. In addition, the research conducted by the Master's student offers their employer's dedicated research towards the innovation of interest to the company. This education offers the student valuable new skills and the company research towards technical innovation.
- The Marine Environmental Awareness Course (MEAC) may be sufficient to reach the required level of environmental awareness for seamen on board sustainable vessels. However, due to the lack of practice and training, it is feared that the environmental awareness on board among seamen will decrease. It is recommended to conduct regular environmental awareness drills.

Finally, it can be concluded that an environmental training package with specific tasks for cadets onboard cargo vessels and addressing the environmental aspect during the education, would be sufficient to raise the environmental knowledge and awareness of future Officers. Heightened environmental knowledge and awareness for Nautical and Technical Officers should lead to the maximization of pollution prevention and the environmental performance of the vessel.

7.1 Recommendations for further research

This research was unable to perform a detailed investigation of the required level of environmental awareness and knowledge for Nautical and Technical Officers on board a ‘sustainable vessel’. Further research should be conducted to summarize what environmental knowledge/skill/awareness/competence is required for Officers on such a vessel to determine which STCW content in the current education for marine engineers and nautical officers is obsolete, and with what it should be replaced.

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9 APPENDIX

9.1 Annex - 1. Interview with Marcus Jakobsson, Sustainability Controller Terntank, 28-4-2021

1. **What were your first assignments as Sustainability Controller at Terntank?**

When I first got the position, it was still relatively loose and undefined what the duty and purpose would be of the Sustainability controller since it was a new position and the company didn't have it before. It was like;' work it out, what should I do, what should be done? What are the goals for my position?'

2. **How did you define this?**

What I identified that I should do, what should be done here, through my knowledge, and what I can do for the company as well. What are the main things besides the things that were decided? Sustainability is a very forward view, and even if I am educated in sustainability, it is difficult to grasp the new company and the strategy and decide where do we begin and where do we end, and what are the goals? It's growing on you, some things are important now and some things come in from the side, and you don't know how to tackle things.

3. **What lead your company to hire you in this position?**

In the beginning, there was a need for it, due to the MRV reporting for example, and the focussing around sustainability; new fuels, analyzing for environmental indexes, and a progressive attitude. There was a position emerging which was not super technical and not super economical. They needed someone out there to 'get the temperature' of what can benefit the company environmentally and economically. Someone who can do the calculations and know how to get the benefit from it. Terntank as a company has been very progressive and very forward in the area of safety and environment, in that line, it was very suitable for them to have a position like me as well.

4. **Does Terntank have any big targets in place, for example, some things they want to have achieved by 2030?**

In 2015 we got our first LNG vessel and in our calculations, they are up 40% more efficient in CO2 emissions. They have a goal but no set objectives. In the future, I am going to take all the visions into proper goals and how we are going to achieve them. We have 3 vessels on the spot market and 10 with longer contracts. 70% of our fleet is rented out to the big oil majors. We can't take their logistics into our account, but we can do as much as we can, but how do we measure it? We can only measure the hard facts and anything that has logistics in them we can't reach. How do we as a company that builds mainly high-end ships, collaborate and how do we set ourselves some targets and what would those targets be? It isn't super clear but pretty straightforward.

5. **When you are looking at goals, do you take the GHG emissions as a reference or take the UNSDGs and see how you can contribute to those goals the best?**

The simplest answer is Greenhouse Gasses because the industry benchmarks are based on that. Most guidelines and the MRV and the EU Taxonomy, are about achieving higher efficiency and thus CO2 reduction of our fleet. However, we need to take a more active and broader approach as the SDGs. Everything that is happening now, such as the EO Taxonomy. The EU is defining what a green investment is. Today a green investment is not as green as we think it is. As we do the restart of the economy in the EU after the pandemic, the criteria for receiving funding are very narrow. If you want to receive money, you have to be very green, and not only according to GHG.

6. **What is your role in contributing to this challenge?**

My role is divided. First of all, I have the controller position, which is data-driven. This includes all the reporting, bringing the material when we are doing some investments, and everything that is data-driven regarding the environment and investments. And then we have the coordinating role which comes from marketing:'what is our appearance towards our customers, and to ourselves, what do we want to communicate and how do we communicate it. How do we assure there are not bad working conditions on the ships and even on the building sites down in China, so it's very broad. I don't do all the work by myself, but I coordinate it and keep track of the progress.

7. **Do you get out in the field to track the developments?**

I try, however since Corona has put some major stops to it. It's more like writing a manual for site managers. I try to present any findings that could result in bad PR and even lose some money since often the money we lend has sustainability criteria. The goal I am working for is securing the sustainability work, that is going on. Are we doing the right thing at the right time?

8. **What makes you a suitable candidate to take on this job?**

Since it is a new position, it is very broad in who are suitable for this. Of course, you need an environmental background. You need to see how the environment works, why we are working with it, what are the major topics, and how does the EO work and how does the IMO work through the environmental side as well. However, it is not necessary to have the economic background as I have, because I can see that in our Office we have so much competence regarding the economy. You do not need to be an expert on it, but you need to be an expert in putting it together, in project work or a case. If you are very good at making like projects, you are on the very right way. You need to have an environmental background as a sustainability controller.

9. **How do you identify where the company is lacking or doing harm?**

We have all the guidelines from the IMO and the EU. They are leading and setting where we are going. However, until today they are still very vague, they are just guidelines. They are giving you the direction of where the shipping company is going to be in the future. How do we work close to the university, where everything is happening, how do we use the institutes to get ourselves the knowledge? So everything that is in the future we are already testing to see how we are going forward.

10. **Would this offer more positions for Maritime Students?**

The same thing you are doing now is going to be perfect as the background for one of these positions. You must know, how does shipping works and what are the challenges ahead. How do we work from those challenges and apply the knowledge to your company? Can every Marine Institute have a basic or specific course like analyze all the environmental challenges that the shipping industry is facing, is going to give you enough knowledge to start a career in this area.

11. **Do you have any research internship projects that maritime students could take on?**

There is not for now, but I would love to do it in the future. There is a super lot to do in this area, and I think it is a perfect opportunity to introduce our company and how we work, and showing a way of working with sustainability and introducing you to it, and get the know-how of working with sustainability. I will think about it, and let you know as soon as I have time to take one of you on. We are working with a Ph.D. student called Hannah, who is taking on how our approach works with the 'just in time principle'. Now shipping is locked up in old contracts. For example, if we slow steam because we know the harbor is occupied, we lose money with the current contracts, because we get paid as soon as we drop the anchor and send the notice. So, if we have to wait 6 to 12 hours at anchor, we make money. So, it is financially worse to slow steam. With the Oil Major Preem, we made a clause that we are giving away the saving of the fuels, but we are starting the voyage, even if we aren't ready to load. When we tender notice, it must state that we are ready to take the load or discharge the load, but we aren't in respect of the contract. Right now, we are only having this active 'just in time' approach with our spot vessels, but we want to do this with all the oil majors that we are working with together. If we are going to do this business, we want to do it sustainably and lift the sustainability work. We could save several tons of CO_2 per voyage, but we don't do it because of the contracts we are locked up in.

12. Is there an incentive for these oil companies to work together to find a solution?

Since I came, we started to put more pressure on it and show them that we are trying to work sustainably, why aren't you joining us? However, different oil mayors have different contracts and it's very hard to get it forward because it's all about money. So, if they see that they are losing money, it is very hard to go on with it. They will likely say let's wait a couple of years until BIMCO has taken it up in their way of working for example. The attitude against the initiative is very positive until they say: 'oh, we are losing some money, and then they back off slightly. However, we have the work ongoing now, and we expect more companies to start joining us. Maybe it is going to be for our sake to take the loss of income to get it going and see how much we can lose for us to start the initiative. But we are one of the very few that is making it commercial.

13. Do you see other companies in your industry introducing these same positions?

The bigger companies have these positions or are getting them. However, in the tanker sector that we are in in the range of 10 vessels, it does not look so good. But it all depends on how you use your resources. A marine engineer can use 70% of his skills for one objective/position and 30% of his skills in something new that you will need in the future. Companies must work with it, but I am not sure if they are going to put sole new positions on it. They are going to work on it, so it is a big plus to have all the know-how and the knowledge. It is looking bright for the future. It is also the reason I came to Chalmers because they have the environmental impact from the shipping course.

14. Do you have anything else that you want to tell me about your position?

I think we covered a lot; it is broad and if you put it in a perspective I could talk very long about for example social dilemma's, how do we attract woman to it, and what is happening when we are all working on the global market and doing the global recruiting. So, there is a lot we did not cover in this super interesting interview.

15. Do you think the social/managing aspect is the most interesting part of your job?

Everything is equally interesting. I like the controlling part because it is very hands-on. Because this is literally what we are doing, and this is us in numbers. The other thing is the appearance of the company, is equally fun to work with that.

9.2 Annex - 2. Interview with Roger Strevens, Vice President and Global Sustainability, Wallenius Wilhelmsen

1. **What is the sustainability challenges Wallenius Wilhelmsen (WW) is facing?**

At WW our environmental, social and governance aspects are of equal importance, however, that is not to say that we face equal challenges across those three areas. The biggest challenge we face is emissions reduction and, specifically, decarbonization.

We are humble before the challenge because we understand what it entails – it is already deeply affecting every aspect of our business. We welcome it because we believe it is very necessary, and that it will be the biggest driver of opportunity for this generation in shipping.

2. **How does WW tackle these challenges?**

The approach is based on four pillars:

- Take the initiative, waiting is not a good option since time is not on our side, risk being at a commercial and strategic disadvantage
- Partner up, the challenge is far greater than one shipping company alone can achieve. Not enough resources or capacity.
- Attract innovators, shipping is a hidden industry, but its challenges are not unique to it. These challenges are faced by other heavy industry sectors.
- We look for progressive but pragmatic outcomes. We only want to spend the money once. We want as much change with the minimum of inefficiency and critically, unattended consequences. We strive to be the engaged and willing industry dialogue partner.
- We take a broad-spectrum approach. We do not try ourselves to one thing and know we have to try multiple things.

2.1 What is the spectrum?

We mainly focus here on environmental issues and more specifically emission reduction. First, we have to look at what the problem is we are trying to address. We can divide this into three major categories:

- What do we do with our existing fleet? We have 83 vessels and some brand new ones that we would prefer to operate their full intended lifetime. We have a legacy of 50000 large existing vessels, what can we do with them? The solutions viable for them are not necessarily the same as for new builds.
- We also think about new vessels. Our very clear preference is to have zero emissions; however, this is the biggest challenge for operating deep-sea vessels. This is different than a ferry which is crossing a fjord. That is possible to do emissions-free already. However, it will be very hard to scale that up to deep-sea vessels because the challenges are so different. We have one example: we looked at an electric cargo vessel in Norway, and their energy demand is 16000 times less as we need for our vessels.

3. How can maritime students contribute to the challenges?

Already the fact some students take an interest is a very positive and necessary thing by itself. You can say one thing: 'This is a smoke stacked industry in the 21st century, I don't want to be part of that, however: 'Besides all the uncertainties and all the unknowns in the path of decarbonization, when this process is over, there will still be shipped. The carbon will go, the shipping will stay.

3.1 What makes you so certain that shipping is here to stay?

It is the engine of world commerce. Some people say; we will have near sharing and not shipping, but I don't believe that. People forget that the closer you produce to the location of sales the more you lose the benefit of the economy of scale and production. There is a very fine balance between your inbound and outbound logistics. You will always need your raw materials, components, and parts. The closer you move to your market you have more and more to bring. Every projection that's out there appears to be pointing in the opposite direction: there will be more shipping, not less.

4. How many people work on the sustainability challenges?

When you're looking at Emission reduction that is an entire company challenge, it doesn't come down to one person or one department. The reason I say that is: Sustainability is impacting every single corporate function, and profoundly impacting it.

It used to be: if there was any engagement at all it would be something that is given as half an hour on a Friday afternoon, one day per year. That is not what it is like now: for many functional groups, it's dictating what's going to happen.

Take for example Finance and Investor relations: Investors are looking at shipping and they realize, there will be shipping, not necessarily the group of stakeholders as we got today, and they want to know what your plan is. We have passed the point that we just give them our last year's result, they want to know how Is this playing out for you, what are you going to do, what is your approach. On the Finance side, if you want to raise money, borrow money, or raise a fund, the range of financial services that are available to you and the price of them, will be affected by what you are trying to do is sustainably linked or green bond linked. It has come to a point that it is more expensive to raise a bond that isn't green than a bond that is. That's the pressure from the Finance and IR side.

Trying to achieve employee engagement, attracting talent, retention of talent without a strong approach to sustainability is not a good idea. So that part contributes as well.

When you look at operations: we as a company, compete in this segment based on operational efficiency. That is the underpinning of how we compete. The biggest single cost we have is fuel, which means that we already have a permanent and central focus on operational efficiency.

You cannot separate sustainability from the other cardinal objectives of the business, and this is true for most, if not all energy-intensive businesses. There is a Paradigm shift. It used to be something that a company is hesitantly engaging with if they had to. Some of them tried to take a leadership position because they could leverage it for a brand or other quite specific interests. Now we have reached the point where good business is good business.

5. **What made it possible for Wallenius Wilhelmsen to develop the first concept for a wind-powered ocean-going transport vessel?**

The Oceanbird vessel is a concept developed by Wallenius Marine, which is a different company from Wallenius Wilhelmsen. Wallenius Wilhelmsen has the interest to build a RORO vessel based on the concept of the ocean bird named Orcelle Wind. We are taking the concept forward and we have two major activity areas: we are doing the detailed design and conducting an extremely comprehensive evaluation of the concept.

The concept needs to make sense from 5 perspectives for us to go ahead:

- It needs to make technical sense: will it stay upright? There are many more questions of course.
- Will it make operational sense: can it go under bridges?
- Does it make regulatory sense: on the emission side you can imagine that it would be good. It is zero emissions when it's operating on the wind but it will need an auxiliary energy source, and what is the emissions profile of that? Plus of course; the class rules and regulations. The classification societies must be satisfied.
- It needs to make financial sense: This is a deceptively complex question because it not just: does it make financial sense now but will it do so in 5,10 and 15 years from now, because the frame of reference for shipping is changing quite rapidly because primarily regulations at the moment, but it is not to be assumed that that will be the dominant driver in the decades ahead. There are changes in innovation; once a new way of propulsion is established, there is nothing to say that new propulsion technology will be more expensive than it is today. The transition cost you can expect to be high. The third consideration in the frame of reference is demand. Not just customer demand but also the financial stakeholders' demand. This is a wild card at the moment. The signals are weak, we are in an early stage, but it does seem to be pointing increasingly in the direction: that customers and financial stakeholders expect demand/prefer zero-emission services.
- Does it make commercial sense: It is essential for wind. What is the fastest way to become a millionaire in shipping? Start as a billionaire! You can waste an immense amount of money in a very short space of time by making the wrong decisions. The wind is not going to blow in the direction and speed you always want it to. So, will this vessel be able to travel at the speed required to offer competitive sailing, relative to vessels using zero-emission fuels?

What you do for the long term must be consistent with surviving for the short term. You can do some glorious and spectacular things but be out of business by the end of the month. It just leaves the initiative with less willing companies.

9.3 Annex - 3. Interview Ronald Vergouwen, CEO Iskes, 4-11-2020

1. **What are the trends and challenges related to sustainable development in the Offshore Market?**

There is a difference between the Offshore and the Harbor company. The Offshore Industry mainly takes place behind the horizon and therefore seems to focus less on sustainability. The port service takes place close to life on land, which makes limiting environmental pollution more important. Customers within the port consider sustainability more important and there is often additional local legislation.

Within the tenders that customers issue, sustainability and/or fuel savings are increasingly and higher up the list. A sustainable shipping company is often more expensive, and the ecological profit must outweigh the extra costs.

It is difficult to compete in an international market with companies that are less concerned with the impact on the environment. It is difficult to make boats pay for sustainable solutions without it being necessary, especially in an international market this is not possible.

In the offshore industry, there are currently fewer tenders (fewer offers), and sustainability is usually not included in the criteria. What is often part of the criteria nowadays is fuel consumption, which has a secondary effect on the environment, but where it is mainly important for the cost picture.

2. **Which initiatives have ISKES tugs taken to become more sustainable?**

In the past, ISKES has tried to innovate sustainably more often. In a tender for TATA steel, the CO2 emissions of the tug were very important, which is why ISKES decided to develop a Hybrid tug together with DAMEN. It has batteries that allow the tug to sail continuously for an hour. When they ran out, an auxiliary diesel would switch on. The batteries are charged onshore and are only used for single boat sailing, which is 95% of the time. The auxiliary engines must only be running during towing.

10 years ago ISKES also devised a hydrogen solution for a tugboat with the help of a subsidy of 500,000 euros and 500,000 euros in equity, but at the time this solution was not economically viable for a tug.

3. **What is driving ISKES to take these initiatives?**

ISKES invests independently in sustainable solutions because as a family business they can easily decide this themselves, and they like innovation. Also, because it is starting to become important with the current tenders. It is more expensive, and they can hardly do real innovation without government subsidies. In some cases, it also becomes difficult to compete with non-sustainable companies if no legislation is in force.

4. **Is there a position within ISKES tugs that is responsible for sustainable development or will you see such a position in the future?**

In general, large companies that play a greater social role are more likely to decide to continue sustainable innovations. They take the so-called pioneering role because they have the means and are put under more pressure. The smaller companies, the followers, will also slowly develop. At the small companies, there are also no positions that are specifically responsible for sustainability and the control thereof. This role lies mainly with the board and the main technical service. At large companies, there will certainly be a sustainability strategist and team to work on making the company more sustainable.

9.4 Annex - 4. Interview with Senior Lecturer Kent Salo, about the future skills for Mariners, 28-4-2021.

1. **What was the purpose of the project?**

The project: 'Future skills for mariners' wants to find out what challenges are coming up for shipping companies towards reaching the UNSDGs and if education can speed up sustainable development. We will be doing interviews with companies about where they find the knowledge they need for sustainable development.

2. **Which people were interviewed for the project?**

Swedish shipping companies, the Swedish Transport Administration (Trafik market), the Swedish Maritime Administration, the Port of Gothenburg, and the Swedish Coast Guard. The people interviewed were mostly people working in environmental positions within the company such as the sustainability manager, the environmental controller, head of sustainability. However, also people working in the technical department and onboard ships were interviewed.

3. **What knowledge gap could you demonstrate?**

The most apparent gap is a lack of knowledge about technical solutions for GHG reduction measures, to support **decision making.** Most companies want to know which technologies they should invest in. Although most sustainability managers are active on the technical knowledge front, there is still a lack and insecurity about applicable technical solutions. In addition, basic **environmental awareness** is often lacking throughout all layers of the company.

4. **How do organizations and companies fill those knowledge gaps?**

Some organizations send their employees to external workshops and training or have internal training courses. This is mostly for the crew on board. The managers mostly further educate themselves during networking, seminars, and conferences to stay up to date. During conferences, most people within shipping talk only to other people within shipping, and rarely an example is taken from a different industry, which can cause sustainable development to be rather slow compared to other sectors.

5. **What are the requirements for environmental positions within shipping companies?**

Approximately 50% of the people in environmental positions within shipping companies do not have an environmental education background. They have a background from within shipping but have a strong interest in environmental questions. The other persons do have an environmental course in their education. The sustainability controller of Terntank has an economic/environmental background at the University of Gothenburg and no experience within the shipping industry at all.

Within Stena Line, two positions are working with environmental questions. At the Port of Gothenburg, 4 positions are working on environmental questions, throughout multiple departments.

Maritime education is not preparing for research. However, from the maritime master program, two students pursued a career as a researcher and became a Ph.D. student.

An interesting result from the research was that: the marine engineering course is crowded with STCW content. The shipping companies ask for more flexibility and think the universities are too slow. They want new content. Their new marine engineers and master mariners should come out with new knowledge about environmental questions and technology. There is so much content already in the educational programs that is mandatory. An important question that came up was how can we make educations more flexible, what STCW content is obsolete and can be removed? There is a struggle for all the content that must be added to the courses.

9.5 Annex - 5. Interview with Åsa Burman, Director Lighthouse Swedish Maritime Competence Centre, 12-11-2020

1. **What are the sustainability trends within the Swedish shipping sector?**

The European Community Shipowners Association (ECSA) is driving the momentum to invest in solutions. The main topic playing a role currently is looking for an alternative fuel to bridge the gap. This requires research but mainly money. That is one of the biggest barriers to bridging the gap at the moment: there is a lack of money.

2. **How can shipping overcome the challenges?**

It is important to not bet everything on one horse. It is difficult to say what is going to be the fuel of the future, and therefore it is smart to not bet on one horse.

An initiative to overcome the challenges is Waterborne, Partnership Proposal For Zero-Emission Waterborne Transport. It is part of Horizon Europe, a research and innovation funding program with a budget of 95,5 Billion euros. The partnership aims to transform waterborne transport into a net zero-emission mode of transport, through the demonstration of zero-emission solutions suitable for all main ship types and services before 2030.

The legislation also plays an important part. Such as the MRV requires companies to report emissions. When shipping would be included in the Emission Trading System or a similar system of the IMO, this could generate a fund to finance the required innovation without putting the competitiveness of shipping in danger.

The UN declared 2020 till 2030 the Decade of Ocean Science. The decade of ocean science aims to establish a framework for ocean science to help governments sustainably manage the oceans and more particularly to achieve the 2030 Agenda for Sustainable Development.

3. **Can you increase the transition with human resources within shipping companies?**

When employees know about the issues, this generates a good mentality and follow up of the environmental protection procedures within the company and onboard. Especially for the behavior onboard this environmental awareness is important

4. **Have you heard about the environmental officer and if there is a new demand for it?**

The family-owned business wants to do good because they think it is important. They are keen on innovation. An example of a new environmental position is the sustainability controller of Tern Tank. This is a new position that is related to sustainable development, and I recommend you to talk with him.

5. **Is it possible to distribute my questionnaire through your contacts at the European Community Shipowners Association?**

I will ask if it is possible to distribute the questionnaire through the shipowners association. However, it must be updated and the questions reviewed. There are too many questions right now and the wording is not correct.

9.6 Annex - 6. Interview Ronald de Bloeme, Environmental Instructor CSMART, 19-01-2021

1. The Environmental Training Package will only focus on the EO job responsibilities and compliance, what environmental tasks should be included and why?

The environmental training package should be about the awareness required for the EO not so much about the tasks. When the cadet comes on board, he has no experience yet and must learn everything about environmental compliance and shipboard practices from scratch. That's a difference when comparing to the beginning EO. This is ideally and normally a person with relevant experience.

The Environmental Training Package (the E-package) will only be for Deck and Engine Cadet and the approach must be different than for a new EO. The E-package should focus on the awareness required to carry out the EO Job. Awareness combining all the elements of the environmental compliance of the vessel. This awareness includes; where and when are you allowed to do what (discharge), how much storage space and quantities are available, what are my direct surroundings and which regulations are in force where I am sailing. Where can I find them? The planning and situational awareness, including where, am I, how long can I stay here, and what am I allowed to do, are essential to the competence of the EO. In addition, the EO must be aware of the technical limits and working order, of the systems that must work in compliance with the ECP. Therefore, the EO must combine the nautical and technical situational awareness to ensure the vessel's operation is in full compliance. The compliance duty is an additional pair of eyes to oversee the full vessel's operation and helps to close the loop for full situational awareness.

The first EO position onboard a cruise ship started somewhere before 2000. The first Captain did not know what the EO was expected to do. On land sustainability and environmental protection have long been important for industries and societies. However, there is almost no supervision on the sea and it always seemed to be immeasurably large and deep. Therefore, environmental protection lagged within the shipping industry. However, nowadays, it is increasingly gaining importance worldwide as the effects of climate change are becoming more apparent. After approximately 25 years of the EO being on board, the function and purpose of the position are clear to everyone, and environmental compliance is deemed important.

Since the first EO was introduced, the position would be claimed by someone that already had experience onboard or in a senior position. However, due to the large increase in cruise vessel tonnage within the corporation, there are fewer candidates from within the business to transition to EO. Therefore, the new EO's often don't have any relevant shipboard experience, which can be negative for the mutual understanding and respect between positions on board, such as the EO and a Senior Watchkeeping Officer.

2. Which GLADIS courses should be completed by the cadet as part of his environmental training?

During the Environmental Training period for the cadet, the cadet should do as much online training as possible, about specific environmental subjects such as the Oil Record Book, Garbage Handling, the EGCS, etc… Which training and how many are done are will be decided on board together with the EO, and discussed with the Staff Captain, and Staff Engineer.

3. What is the most valuable competence of the EO, and why?

To be interested and understand what you are looking for. There must be intrinsic motivation and interest for the job. It is expected that you understand the ship's processes and how everything works together. This requires an active and pursuing mentality. In addition, persistence is very important. It is not a 9 to 5 job. You must be ready to take action at all times and be resourceful.

4. What is the most valuable knowledge of the EO, and why?

Knowing the ship's technical systems. Technical understanding is more important than Nautical competence. The nautical competence is additional; however technical knowledge is vital. Therefore, the EO ideally grows from an Engineering rank to become EO.

5. What is the most valuable skill of the EO, and why?

Communication skills are essential. The EO must know how to communicate Internally (with other officers and crewmembers), as well as externally (company and authorities). He/she will talk with all crew members, from the wiper to the Captain, and must communicate the relevant information in a way that is useful for the receiver. When giving information this must be done with confidence. As training is also part of the EO duties, an educative way of explaining is important.

In addition, the EO must use his eyes and ears to know when you must be somewhere and where not. You are permitted to be everywhere, but don’t need to be everywhere. Being in the right place at the right time is key.

Because the EO communicates with everyone on board it is important to build relationships with everyone and be involved with many things. This fosters easy working conditions and will get many things done more efficiently. The EO needs to be prepared. Have a list of phone numbers ready when entering the US, know where the offices are of other key officers. Do not lose valuable time trying to chase persons or information if you are required elsewhere. Remember: On many ships, the EO is a department of one

6. How can we best divide between practice and theory, and why?

In general, people cannot concentrate longer than 1 hour at a time. So, during the training do not talk longer than 1 hour. After explaining, go do something. The division between practical and theoretical should be 50/50. Through practice, you learn more because you remember better. Ask the cadet to report back. Interesting to see and hear how he/she experienced a practical task.

7. What are the suggested methods to teach the Cadet about the EO tasks & responsibilities and Compliance and why?

Follow the existing EO, but also follow a whole watch in the Engine room, and on the Bridge to understand how everything goes. Same for the Electricians, the Chef in the Galley, the men in the recycling center, and the men dealing with stores. Do not forget bunker operations and offloads. Take a watch where there is a discharge or a busy traffic situation. As EO you don’t have operational duties, but you should go around the ship, build relationships with everyone. Know where everyone is and what they do, and where they are.

8. How much time is required and possible for the cadet to invest in the environmental training package, and why?

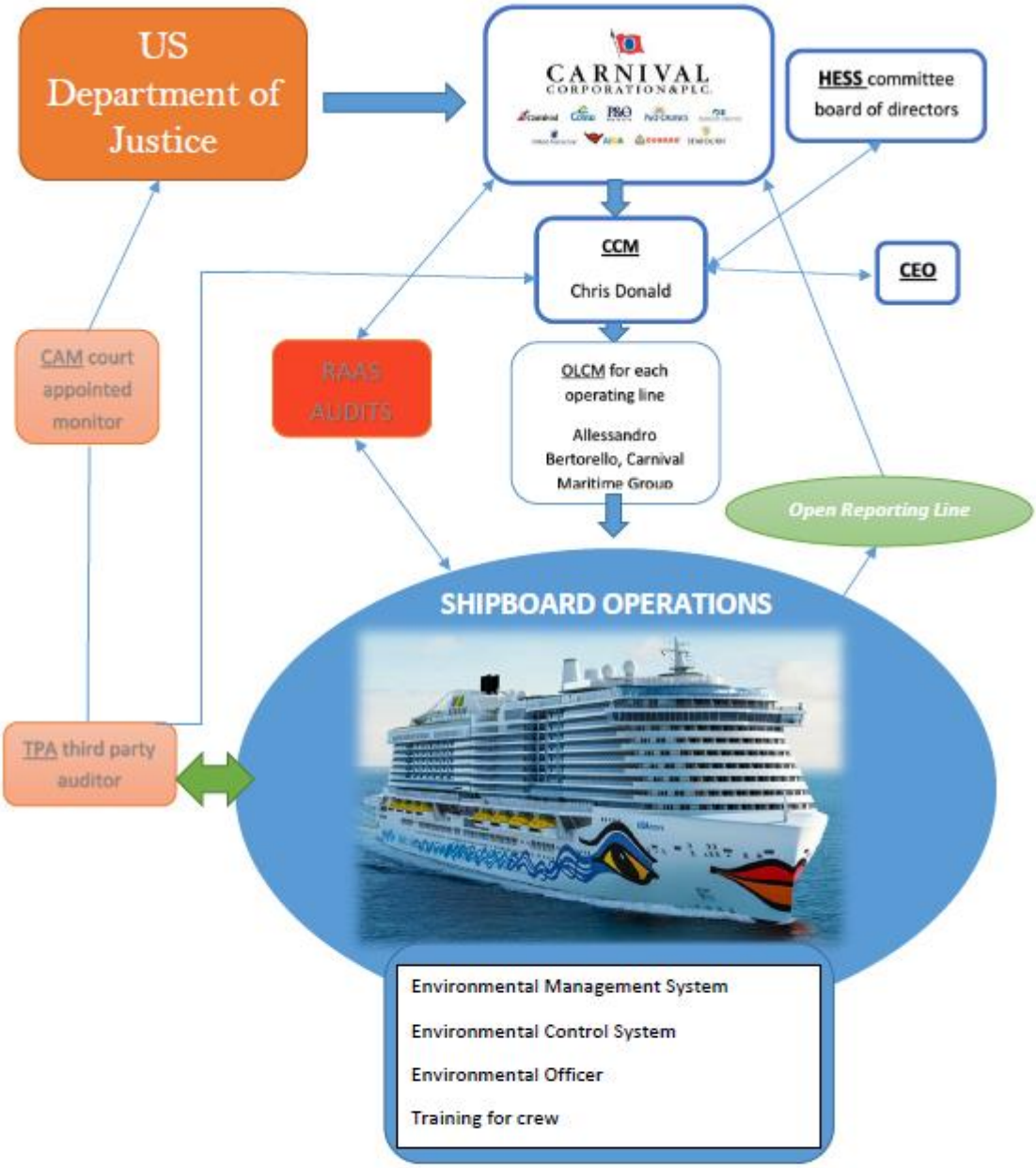
Not in the position to answer this question.

9. What must be the learning outcome of the Environmental Training for Cadet?

That the Cadet understands the EO job and its aspects, so he or she knows what the job is like. When the cadet becomes Officer, they know this important aspect of cruising themselves. In addition, they might be inspired to take on this job as a later career step.

It requires healthy interest and intrinsic motivation. The EO must have basic knowledge and skill. Onboard there is no one to teach you, so it is important to know on hand.

9.7 Annex - 7. Illustration of the ECP compliance structure, made by Brendan Bollweg on board AIDA Nova



Compliance with all Marine Environmental Protection Requirements

9.8 Annex - 8. Job Description Environmental Officer AIDA

xJob Profile	**Job Title**	Environmental Officer
	Rank	Officer
	Department	Deck
	Superior	Master
	Subordinates	-
	Aim	The Environmental Officer is assigned a compliance role only and oversees the ship's environmental compliance activities with relevant maritime environmental legislation and Company procedure; he/she has no operational responsibilities and is a non-watch standing officer.
	Educational Requirements	Engine Officer license and/or an environmental/science-based bachelor's degree or higher. Successful completion of the annual Corporate Environmental Officer training.
	Professional Experience	First proven experience in the area of technical, organizational, or environmental protection preferably in the marine or shipping industry.
	Professional Skills	Competency/ Knowledge in Environmental Management (waste streams and processes, basics of sustainability, etc.) High result orientation and decision making Ability to work under pressure and emotional stability Ability to cooperate & willingness to change Good quality of work results Good administrative skills and ability to prioritize Good computer knowledge (MS-Office, Internet and Lotus Notes)
	Certification	Pls see attachment as extract of "D Mandatory Certification Matrix"

Competencies	**1**	**2**	**3**	**4**

Leadership	Goal-oriented leadership		x		
	Employee development		x		
Corporate	Economical thinking & acting				x
	Result orientation and decision making				x
Personal	Ability to cooperate & willingness to change			x	
	Ability to work under pressure and emotional stability				x
Health, Environmental, Safety & Security	Safety/Security awareness & sustainability				x
Professional	Orientation to guest and placing of the AIDA smile		x		
	Behavior of reclamation and feedback		x		
	Nautical / Technical skills				x
	Ship Safety Management		x		
	Quality of work results			x	
	Computer skills			x	

1 = not relevant, 2 = less relevant, 3 = relevant, 4 = strongly relevant

		0	1	2	3	4	5
		n/a	(A1 - A2)	B1	B2	C1	C2
Language Skills	**English**					**x**	
	German					x*	
	Italian					x*	

*preferable

According to Common European Framework of References for Languages

5	C2	Can understand with ease everything heard or read. Can express very fluently and precisely differentiating shades of meanings.
4	C1	Can understand a wide range of demanding, longer texts and recognize implicit meaning. Can express fluently and spontaneously.
3	B2	Can understand the main ideas of complex text. Can interact with a degree of fluency and spontaneity with native speakers.
2	B1	Can understand the main points of clear standard input on familiar matters regularly encountered in work, leisure, etc.
1	A1 A2	Can understand and use familiar everyday expressions and very basic phrases aimed at the satisfaction of needs of a concrete type. Can communicate in a simple and direct exchange of information.

Main Tasks & Responsibilities	Duties include (but are not limited to): 1. Reports directly to the Master 2. Oversees the Environmental Compliance of the ship 3. Uses a direct line of communication with the Director Environmental (OLCM) 4. Periodically checks that the ship fully complies with the procedures of Carnival Global HESS-MS 5. Has unrestricted access to all areas onboard, unless otherwise precised in ENV1008 6. Carries out his activities according to the ENV1008, among this, on a constant basis: 7. Reports about environmental management and performance on board 8. Gives his assistance to internal and external auditor during environmental audits 9. Gives his support to all crewmembers in finding a solution to environmental related problems 10. Verifies that all types of waste, may they be liquid or solid, are properly segregated, managed and labelled until their landing, according to applicable laws and Carnival procedures 11. Conducts regular rounds, including Engine Spaces, Garbage Handling and food preparation areas 12. Is responsible to periodically check environmentally relevant Log Books to guarantee their compliance, in accordance to ENV1008 13. Is responsible to carry out Environmental trainings to all personnel on board, according to Company procedures. 14. Is responsible for completing and keeping the records of all the environmental training 15. Takes part to periodic meetings at the presence of the Captain and the other Heads of Department to discuss environmental issues

	16. Guarantees the correct sampling of waste waters and other types of waste according to the agreed sampling protocols or as required. He is also responsible to archive and distribute onboard the sampling results received from the shore side offices 17. Checks that the Captain is promptly and properly informed about environmental incidents and that all incidents are notified to Shore side offices and relevant Authorities (local, state, federal, international) as applicable and as instructed 18. Submits reports on Environmental incidents and checks the correct follow-up and update of environmental incident reports created with the IT systems on board 19. Is the appointed liaison between the ship and shore side offices for all environmental related issues 20. Is responsible to send to the relevant shore side office the monthly environmental data according to the agreed procedure and timing 21. Assists the Captain and the Environmental Director to answer questions or complaints from guests or crewmembers about alleged environmental misbehaviours 22. Is responsible to spot check on external contractors working on board, in context of relevant environmental issues and checks records of instructions given to them 23. Is responsible to monitor the follow up of environmental findings 24. Is responsible to keep ship specific Environmental documents up to date Safety Duties: 25. Facilitate a work environment that supports a successful safety culture. Is responsible for ensuring that his/her team implements and maintains an effective Hess management system. 26. Enforce and promote Safety procedures in the team/Department under responsibility 27. See procedure ENV 1008 and POL 1010 (ECP) for detailed list of tasks and responsibilities and further guideline

9.9 Annex - 9. Environmental Training Tasks for Cadet's on Cruise ships, Environmental Cadet Project with AIDA, Brendan Bollweg

At the beginning of this training, the Cadet and the EO should set goals and make a plan to achieve them. They should know from each other what to expect from the training. The following table should be used as a guideline to plan the training.

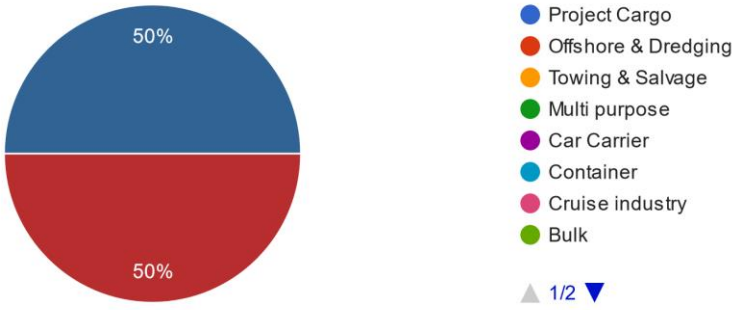
ENVIRONMENTAL TRAINING TASKS FOR CADET	
DURATION	2 to 4 weeks
DEPARTMENT	Environmental Officer
TRAINING TASKS	Prepare theoretically, execute together with the EO, and debrief the following EO duties: • Fuel Bunker Operations • Waste Segregation and landing • Wastewater sampling • Bilge Control Discharge Box inspection • Investigate and monitor the Oily Bilge system units and particulars • Daily soundings • Environmental/Sustainability reporting • Environmental record inspection
PROJECTS	• Make a discharge & disposal plan for a roundtrip to gain situational awareness. • Present the history, design, and purpose of the ECP to demonstrate a thorough understanding.
COMPUTER-BASED TRAINING	• EO Learning program in GLADIS
REFERENCE MATERIAL	• Env 1008 – Environmental Officer Roles and Responsibilities • EO Induction Portfolio

Furthermore, the Cadet must follow the EO around during their rounds, to understand the cross-department relationships, points of concern, and routine duties. The Cadet should start to oversee what it takes to ensure the full compliance of the vessel and learn the ways of the EO's most important skill, communication. When working together with the EO, the cadet should pay close attention to the relationship's the EO fosters and the way of communicating. The Cadet and EO should plan which days the Cadet follows the EO, and which days are spent on Self-study.

9.10 Annex - 10. Results from the questionnaire.

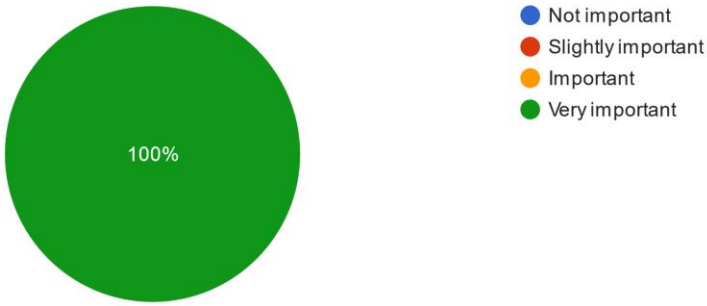
1. What sector does your company operate in?

2 responses



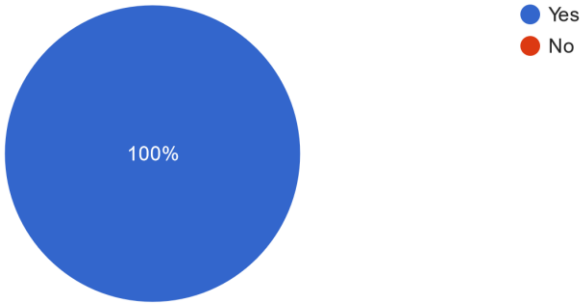
2. How important is the sustainability transition for the Shipping Industry?

2 responses



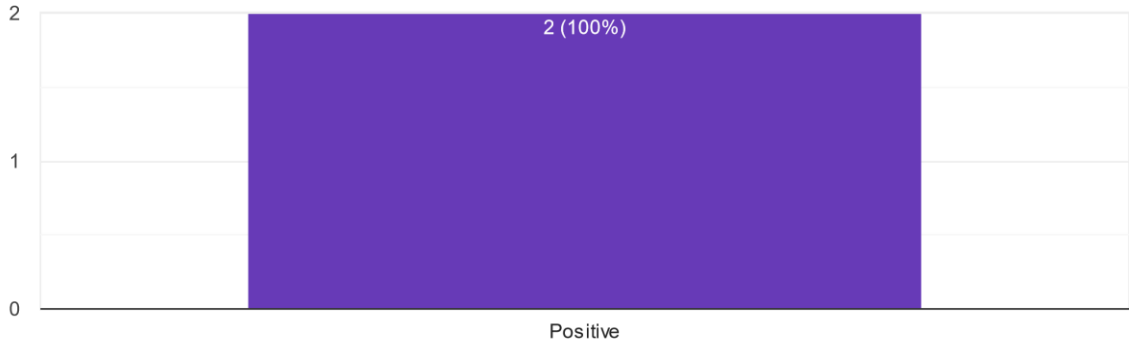
3. Does your company have a plan to contribute to the United Nations Sustainable Development Goals (UNSDG's)?

2 responses



4. How many environmental positions are there within your company?

2 responses



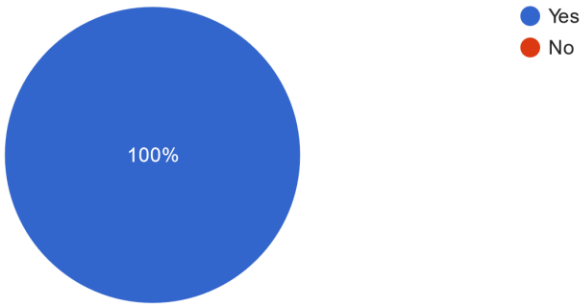
5. What are the main sustainability challenges for your company? (name 3)

1 response

Emissions to air, equality & diversity, ship recycling.

6. Is there a gap between the sustainability challenges your company races and the required resource?

1 response



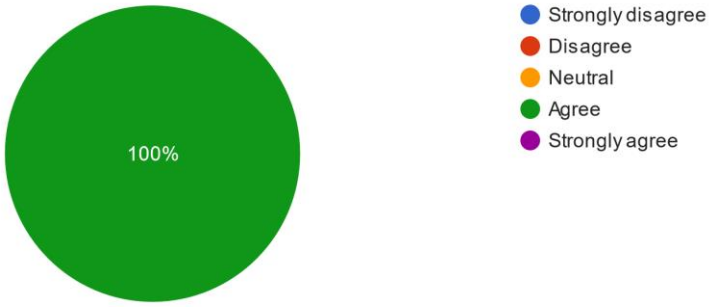
7. If yes, how does your company want to bridge this gap?

1 response

Our company may invest in sustainable solutions but ultimately this is a gap that needs to be bridged by cheaper green solutions or a polluters pay tax.

8. Is there a demand for Maritime graduates with at least basic Environmental knowledge

1 response

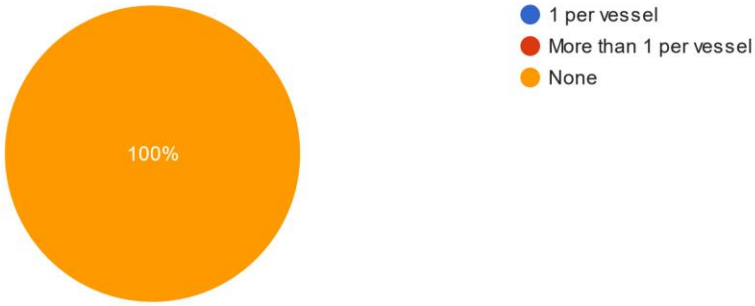


9. Do you currently have Environmental Officers (EO's) employed on board or on shore?

2 responses

10. If yes, how many are working on board?

2 responses



11. Are there any EO's working shore side?

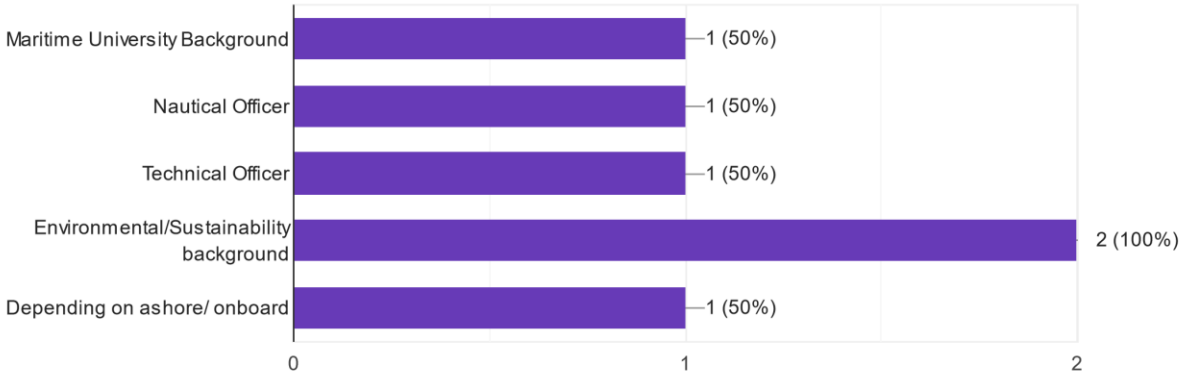
2 responses

12. Does the company want to employ more EO's to face Environmental Challenges?

2 responses

13. What background does the EO have?

2 responses

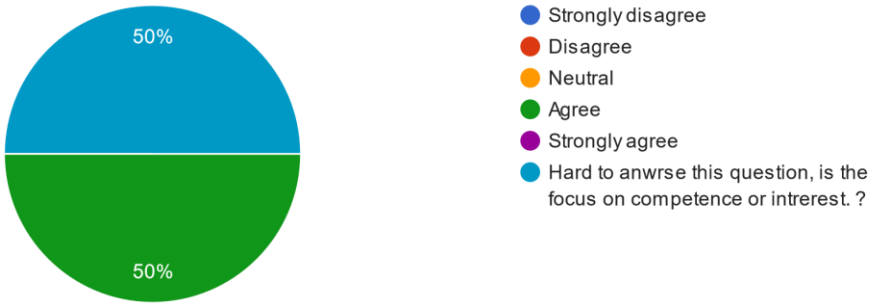


14. The sustainability transition of this company will offer new positions for nautical and technical graduates.

2 responses

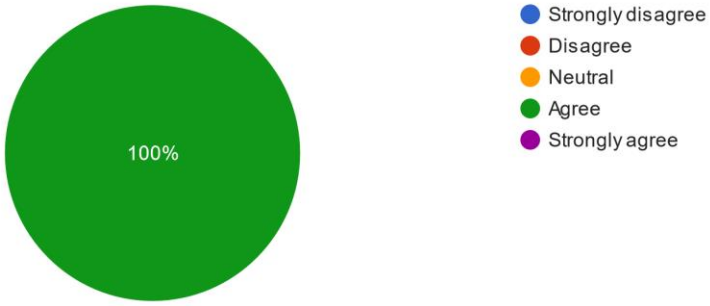
15. To achieve sustainable development goals, the company requires personnel with environmental competence and interest to tackle the challenges of the future.

2 responses



16. The questions in this questionnaire are currently relevant and of interest to the company.

1 response



17. Do you have any thoughts about the questionnaire you want to share with me?

1 response

Its very easy to regard sustainability only as carbon emissions but its wider than that.

DEPARTMENT OF MECHANICS AND MARITIME SCIENCES
CHALMERS UNIVERSITY OF TECHNOLOGY
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