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Boon or Curse: A Detailed Reaction on Autonomous System Being Implemented in Shipping Sectors

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Abstract
With shipping being one of the primary transportation systems for both people and goods, technological updates to it have become a necessity for humans to lead a better and more convenient day-to-day life. Due to this, integration automation in shipping is being highly introduced by tech enthusiasts. However, the existing studies regarding this integration often focus on the technical side, rather than its impact on human life. The primary purpose of this study is to analyse how different professionals from the shipping sector are reacting to the automated ships. A customised demographic questionnaire had been used to collect data from maritime professionals. While the analysis part was mainly focused on figuring out connections between different questions answered and deriving hypotheses. The key findings were mostly about the certain parts of the population who are said to be affected or being benefited according to the participants and what type of review they are providing in terms of this transformation. While not discussing technical parts, this study mainly focuses on evaluating human acceptance and the reason behind it. It can help to uncover some issues that remained unnoticed and enhance the smoothness and speed of the transformation.

Keywords: Maritime Autonomous Surface Ships (MASS), Maritime education and training (MET), Chi-square test of independence, Spearman's rank correlation.

1. Introduction

1.1 Background of the Study

With the passage of time, the global shipping industry, which is directly involved in more than 90% of international trade, is undergoing significant reconstruction due to digitalisation,

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automation, and the aim of enhancing operational capability (Alamoush et al., 2024). Several factors fueled the speed of this transformation, which includes improving the efficiency of operational activities, decreasing average voyage costs, increasing safety for both ships, the seafarers and the goods, lowering both the human initiated error in operations and the consumption of fuel to meet the environmental regulation, last but not the least to expand the range of qualified seafarers who are the main driving force for maritime industry (Alamoush et al., 2024; Kim et al., 2022; Muslu, 2020). However, all these factors are working as the prime indication of focusing on Maritime Autonomous Surface Ships (MASS).

Maritime Autonomous Surface Ships, in short MASS, are basically watercrafts being operated independently without the intervention of humans to a certain level. The definition of MASS, being ships that can operate on their own with different levels of automation and autonomy, has been provided by the International Maritime Organization (IMO) (Belabyad et al., 2025). Having the similar concept with the Society of Automotive Engineers (SAE), the maritime sector has defined and created level concept to articulate the level of automation being implemented on the ships, such as Level 0 with zero automation and fully manual operating system, Level 1 where ships have the decision support with different automated process, Level 2 means ships where the control is being controlled remotely, however with seafarers onboard, Level 3 are those ships with the capacity of remotely controlled mechanism and no seafarer onboard, But the Level 4 ships are fully automated (Bélabyad et al., 2025; Deling et al., 2020; Tang et al., 2022). This categorization is mainly based on the three main functional abilities, which are understanding and sensing the environment, automation implementation in the task for decision making, and the execution of an automated system for control (Deling et al., 2020; Tang et al., 2022). All these tasks can be allocated to both humans and machines in different configurations and scenarios.

Various countries, especially Norway and other European nations, have already been working on different projects to evaluate the feasibility, obtaining positive feedback from the trial pilot voyages and demonstrator projects in specific routes with different operational scenarios (Johns, 2019; Muslu, 2020). Here, projects like Yara Birkeland, which are developed with the intention of being operated shore-based Remote Operating Centres (ROCs), along with hybrid crewing models, indicate the fact that the MASS technology is successfully being transformed from theory to practicality (Haralambides, 2023; Johns, 2019).

1.2 Problem Statement

Even though various levels of technological revolution are being achieved through automation, a significant amount of knowledge gap can be observed in understanding the human element of this reconstruction. While research and projects are mostly focused on the regulatory, operational, and feasibility-related framework (Belabyad et al., 2025; Johns, 2019; Kim et al., 2022), there is a huge absence of studies related to people's reactions, acceptance level, and point of view on this transformation. These studies should be based on those individuals who are being

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directly affected by this change, such as seafarers, port personnel, and people from maritime professions (Belabyad et al., 2025; Chan et al., 2022; Haralambides, 2023).

All this may be due to the lack of situational awareness when the controllers interact with the automated system, also the absence of the capacity in operators, which is strictly required for the autonomous operations, along with the necessity of a redesigned education system and training (MET) for mariners, can also be the cause of those challenges (Chan et al., 2022; Deling et al., 2020; Haralambides, 2023). According to Chan et al. (2022), junior officials often lacked sufficient knowledge for understanding the system in the scenario of autopilot failure during the simulation studies and needed alarm initiative to identify faults, highlighting training and interface design limitations. On the otherhand, in various studies, a particular group of authors is focusing on the fact that automation might affect the economic sectors and have a negative impact as job posts can be replaced by autonomous systems, the other group is presenting counter argument with the evaluated fact that automation will create new high-skilled roles (Belabyad et al., 2025; Haralambides, 2023; Muslu, 2020). While gaining an understanding of these reactions is definitely not just an academic exercise, this is a crucial part of the transformation from manual to automation. As technology adoption strongly depends on the user's trust, acceptance, and work adaptation (Deling et al., 2020; Haralambides, 2023), it will assist the transition to be smoother and more proportionate.

1.3 Research Objectives

This particular research work has been conducted to address the specified knowledge gap through methodically defining the attitudes, concerns, and points of view of different maritime professionals regarding the implementation of automation in the shipping sector.

The objectives that have worked as the driving force of this research are below:

1. To evaluate the primary factors for different maritime professionals being influenced to accept or reject the Maritime Autonomous Surface Ships (MASS).
2. To verify how different demographic variables like age, year of experience, and job roles shape the perception of the autonomous shipping system and its impact among professionals.
3. To evaluate the interpreted boons, which are regarded as benefits and curses, which basically define the drawbacks of autonomous shipping systems from the viewpoint of different maritime professionals, like seafarers, shore-based personnel, and stakeholders.
4. To assess the connection between the awareness of various ongoing real-life projects like Yara Birkeland, Waymo, Tesla FSD, and standpoints regarding economic efficiency, safety, and feasibility of MASS.
5. To prove the estimation of different professionals regarding impacts on employment and age groups, and to get a better idea of the reasons behind these predictions.

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1.4 Key Research Questions

To obtain these objectives, this study has been constructed revolving around the following research questions:

RQ1: How do variables like job roles, year of experience, and sector of employment impact differently on the perception of an autonomous system being regarded as a threat to employment, as well as the overall acceptance of MASS?

RQ2: To what extent can the viewpoint of an autonomous system being a curse or boon be estimated from the belief about outlooks on economic efficiency and safety, knowledge about autonomous projects, and feasibility?

RQ3: Which industry professionals are most likely to be adversely affected or benefited from automation according to the veterans and other individuals related to the marine sectors, and what are the key factors of those predictions?

1.5 Significance of the Study

The conducted research study was initiated to get a better understanding of the mindset of human faction in this whole autonomous system, how they are accepting it, how they are adopting these changes, as well as the uncertainty of their life and career, which might be the result of this change they are facing. While evaluating various relationships between different variables that serve as the key factor for perceptions of different individuals, this research present an unique dataset based on a fully customized questionnaire.

The findings of this study provides indication of why and which way people involving the maritime sector should take steps to create a better atmosphere for executing tasks to achieve goals. For the stakeholders and owners, they are indicated to some key factors that suggest they navigate the transition to autonomy. While the developers and builders should focus on supplementing information regarding specific topics to minimize the knowledge gaps that create misunderstandings and misconceptions. On the other hand, policymakers and educators should re-evaluate their safety and social integration policy, along with providing various well-structured training facilities to the new generations. Last but not least, this study directly indicates how people should be brave enough to embrace new technology and not put conclusion before understanding a particular technology, as this will ultimately lead to that invention not being utilized fully and efficiently. As the study provides significant insights and the main concerning factor is human, if the findings of this particular study are fully utilized, the involved people, along with society, will greatly benefit.

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2. Literature Review

2.1 The Evolution of Maritime Autonomous Surface Ships (MASS)

The concept of MASS, or Maritime Autonomous Surface Ship, has been developing rapidly, from being just a theory to operational pilots with the help of technological revolution and regulatory advancement, especially the post 2018 period, which is marked as the peak of this shift from theory to practical testing (Munim & Haralambides, 2022). This transformation is being thoroughly accelerated by various real-world projects as well as through substantial R&D investment and increasing academic scrutiny (Kim & Schröder-Hinrichs, 2021).

2.1.1 Development Trajectory & Key Projects

With projects like AUTOSHIP and AEGIS, Norway has been in the lead position in the sector of automation (Rødseth et al., 2023). Also, the matter of safety improvements and regulatory readiness has been specifically mentioned in early projects like AAWA (Li & Fung, 2019). On the other hand, by using the Technology Adoption (TechAdo) model, a holistic assessment revealed a strong and logical argument that, due to various socio-economic and human factors being overlooked in favour of technical discussions, MASS technology development is still in its infancy (Fonseca et al., 2020).

Key commercial projects which are hailed as revolutionary:
Yara Birkeland: With the intention of eradicating truck journeys and limiting emissions, Norway built the world's first fully electric automated cargo ship, specifically for short routes (Molica Colella, 2022; Rødseth et al., 2023).

ASKO Maritime & Rolls-Royce Falcon: These are the projects that have already been tested and illustrated the feasibility of autonomous systems for relatively short repetitive routes (Powell, 2019; Rødseth et al., 2023).

Other Global Initiatives: Projects like Mayflower Autonomous Ship, Japan's MEGURI2040, and China's Zhi Fei trials revealed the global efforts in various long-range sailing and automated berthing (Munim & Haralambides, 2022; Wang, 2024).

Most importantly, this transformation to an automated system is not just limited to large projects like ocean-going cargo, but also smaller vessels like service craft, tugboats, ferries, and vehicles used for offshore management and maintenance are included in the range of this transformation (Li & Fung, 2019; Wright, 2020).

2.1.2 Technological Foundations

With the integration of AI, data platforms and different enhanced-level sensors, which are implemented to avoid collision and data-driven maintenance, MASS technology has been designed (Munim & Haralambides, 2022; Riyadh, 2024; Wang, 2024). In one study, it has been

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specifically indicated that while MASS offers various potential, if there is no integration enforced into the design and operation, the initial prediction of benefits may not be fully utilized, but rather can impact negatively due to various "failed promises" (Tsvetkova et al., 2024). However, the probable increase in safety, efficiency, as well as the reduction in emissions have always been regarded as the main driving force for considerable R&D interest (Kim & Schröder-Hinrichs, 2021; Riyadh, 2024).

2.2 Factors Influencing MASS Adoption and Acceptance

The level of acceptance according to the holistic adoption model is basically operating in more than one level, while integrating different areas like technical knowledge, individual preference, as well as the environmental situation of a specific area (Fonseca et al., 2020).

2.2.1 Individual & Attitudinal Factors:

Professional Role & Experience: As seafarers are the ones who have to deal with the changes firsthand, as there will be changes in employment criteria, duty formation, demand for required skills and different levels of human risks, they expressed greater concern regarding the job security and consistency compared with the individuals involved in shore-based positions (Li & Kum Fai Yuen, 2024; Rødseth et al., 2023; S. Li & Fung, 2019). However, it needs to be mentioned that this switch from manual to automation is definitely not removing human beings mindlessly from jobs, rather this is creating new job opportunities which require advanced transformation in skills and adopting new capabilities along with the MASS technological revolution (Emad et al., 2020; Li & Kum Fai Yuen, 2024).

Trust & Safety: As MASS technology is advancing at a fast pace, people's trust depends mainly on its performance in a specific situation. From various past studies, it can be specifically mentioned that even though automation can provide possible error reduction, expats are still not that confident regarding its ability to handle emergencies (Hammad et al., 2022; Mallam et al., 2018; S. Li & Fung, 2019). Also, there is a huge misconception that the main factor of safety is about preventing collisions of ships; however, data showed that the highest possibilities of human crews being removed from dangerous ships, which have a high probability to sink or fire, or even travelling in challenging routes, are the primary safety contribution of automation in the shipping industry (de Vos et al., 2021).

2.2.2 External & Environmental Factors:

Economic Viability: The business benefit or loss is not universal; rather, it is situation-dependent. While analysing benefits regarding the shipping sector, the amount saved from fuel and crew cost need to be compared with the building and remote maintenance of automated ships need to be evaluated specifically, which the industry surveys identified in a previous research survey (Burmeister et al., 2024; Munim & Haralambides, 2022; Rødseth et al., 2023). While the study of feasibility evaluation mostly explained that rather than being hailed as an alternative,

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automation should be regarded as the targeted solution that needs to be implemented selectively to utilise its values and gains (Alamoush et al., 2024; Field, 2023).

Infrastructure & Cybersecurity: For MASS adoption, it is required to have a robust communication network, along with strong cybersecurity and powerful shore control centres consisting of highly skilled professionals. However, the lack of these factors is one of the main reasons for stakeholders' concern regarding this transition from manual to automation (Alamoush et al., 2024; Munim & Haralambides, 2022; Riyadh, 2024). On top of that, being highly data-driven, ships are now mostly exposed to various cyber risks that need to be addressed in real time (Coito, 2021; Kim et al., 2020). Also, due to the ship being dependent on sensors and wireless communication, the hackers often can access the data, which not only destroys data integrity but can also eradicate physical safety (Giannaros et al., 2023).

Social Acceptance & Governance: If the MASS adoption needs to be successful, social acceptance, which requires public acknowledgement and a transparent management system implementation, is highly required (Fonseca et al., 2020). Like a few countries which implemented flexible national policies where practical learning and information exchange between companies and regulators, this type of ideology needs to be developed in every country for the successful adoption of automation.

2.3 Research Gaps

After going through several previous studies, a few parts or areas have surfaced which are somehow being neglected by the researchers. Among them, the absence of data regarding the operations through commercial implementations and the lack of interest in focusing research on human factors, such as the workload, the operators who are working from the shore and so on (Li & Fung, 2019; Munim & Haralambides, 2022; Powell, 2019). However, one thing should be mentioned that professionals with disabilities didn't participate in many notable survey studies regarding autonomous ships. However, individuals with disabilities were an important part of the study on the topic of road transport research (Miller et al., 2022).On the other hand, there is a huge level of knowledge gap due to various regulatory restrictions, along with the data confidentiality issue. As the complex trials which are conducted internationally, are often remain under-explored due to insufficient data regarding these operations. However, this behaviour of technical revolution being over-hyped and regarded as the main focus of research studies, significant gaps of understanding regarding the socio-economic factors, along with various policies which are essential for successful adoption and total transformation, can be observed (Fonseca et al., 2020). Therefore, it is necessary that different implementation hurdles,s as well as legislative barriers which exist regardless of multiple technological progress, should be indicated specifically in future research (Kim & Schröder-Hinrichs, 2021). Also, there is an extensive requirement for methodically structured documents and comprehensive study opportunities on various internationally organised practical experiments (Humphries et al., 2022). As the autonomous ship AI behaviour and its operation with human users onboard is still not fully studied, an extensive amount of research work needs to be done on this topic, along

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with the pattern of how human operators interpret and implement navigation rules while facing autonomous ships (Cascetta et al., 2021; Miyoshi et al., 2022). There is another thing that need to be in focus that, even though preference on autonomous ships are highlighted in various studies, not a significant number of studies related to the acceptance level for specifically different types of autonomous ships like cargo or passenger ferry had been conducted, unlike acceptance level of specific service type road transport, which have a considerable number of research analysis (Bala et al., 2023).

3. RESEARCH Methodology:

3.1: Research Design

The study employed a hypothesis-driven, quantitative analysis, taking into consideration the mindset of various professions in the sea sector. The concept of autonomous shipping and its implications have been discussed. How people from the shipping industry are reacting to ships being fully or partially autonomous, and what mindset they have regarding this issue. The particular approach was chosen to experimentally test ten specific hypotheses derived from sources such as past studies or other channels of thought regarding autonomous shipping, with a focus mainly on the core "boon or curse" dichotomy. A methodology that mainly focuses on deriving quantitative analysis based on a structured questionnaire was one of the most appropriate methods for the specific research work that is being conducted in this study. While narrowing it down, three were mainly focused. The first one is systematically measuring the perceptions of different individuals from the shipping sector regarding the autonomous system being strongly implemented. On the other hand, enabling statistical hypotheses to proceed with the validation for proposed relationships was also one of the main focuses, while facilitating generalisation of opinions to the extensive sector. The particular research design used in this elaborate study is directly linked to each survey component for testing specific aspects of the central research questions.

3.2. Data Collection Instrument and Procedure

3.2.1. Survey Instrument Development and Scaling

The primary data collection prop was a specifically structured 22-item online questionnaire (see Appendix A) which had been designed specifically to "boon or curse" dichotomy of autonomous shipping. The questionnaire had been constructed focusing on different matters, like how people are reacting to the new technology and how accurate the information they have regarding the various scenarios. Not just that, even if the people are welcoming about the new thought of automation as well as the evaluation of whether they have other real-life information of related news and inventions like the automated car by TESLA or the new automated cargo ship constructed by Norway, which is called Yara Birkeland. This study basically utilises different perspectives on what different professions of the same industry have different thoughts on one specific matter. With the initial intention of achieving the validation for different predicted hypotheses, the questionnaire was developed in four logical sections to ensure a logically well-

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organised flow of responses from general attitudes to specific individuals working in the maritime industry.

Section 1: Demographic and Professional Profile (Q1-Q4): Collected basic data on respondents, mainly focusing on their employment sector, current designation, and total years of experience. This segmentation helped to enable comparative analysis and derive hypothetical analysis.

Section 2: Fundamental Awareness and Attitudes Towards Technological Revolution (Q5-Q9, Q14, Q15): This section was developed with the intention of serving as a calibration and awareness check on the participants. It was to evaluate the general comfort with autonomous technology, like using driverless passenger cars as a relatable proxy (Q5), insights into their economic and employment impact (Q6, Q7), and familiarity with the ongoing (Waymo, Tesla - Q8) and maritime (Yara Birkeland - Q14, Q15) autonomous projects.

Section 3: Crucial Insights of Maritime Automation (Q10-Q13, Q16-Q21): This part of the questionnaire comprises the substantive core of the survey. It measured:
Technical Feasibility and Preference: Belief and thoughts in the possibility of ships being fully automated (Q10) and preferred mode of future ship operations according to the professionalsn / (Q11).

Employment and Socio-economic Impact: Perceived threat to seafaring jobs (Q12) using a 5-point Likert scale (Strongly Agree to Strongly Disagree), expected certain effects (Q13 - multiple select), and specification of the most vulnerable groups (Q18, Q20).

Multi-dimensional Outlook: A 5-point scale was used in Q17 to capture individuals' ratings for Safety, Economic Efficiency (Cost-effectiveness), and Environmental Impact, ranging from "Very Positive" to "Very Negative."

Investment Outlook: Thoughts or insights on the value of the significant investment required (Q16).

Section 4: Integrative Synthesis (Q22): The survey questionnaire concluded with an open-ended, forced-choice question requiring respondents to present their views on a verdict: "Finally, based on your experience, do you ultimately see the adoption of autonomous systems in shipping as more of a 'Boon' or a 'Curse'?" This provided one of the principal dependent variables or clues for several key hypotheses.

However, while conducting various analysis, the perception of using single item indicator has not been used as different correlation needs to be established for deriving hypothetical analysis. But with the mindset of providing some specifically indicated factors like safety, economic perception, job concern and many more, the questionnaire has been constructed in such way that each question can be correlated with others for providing evidence-driven results.

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3.2.2. Validity and Reliability Assessment

To ensure the tool's and design's robustness, the following steps were taken:
Content Validity: The questionnaire was developed based on a systematic review of literature on various previous research studies on the topic of autonomous vehicles and maritime technology. The design and primary construction of the implementation plan were established through review by a panel of experts who are actively involved in academia. Also, two industry professionals with wide practical experience were invited for a short period of time, who are working as sailors for a long period of time. Their insightful feedback was strongly combined to improve question comprehensibility, relevance, and coverage of the "boon or curse" construct.

Pilot Study and Refinement: A pilot study, which is not part of the final sample, was conducted with 15 maritime professionals. The outcome of the feedback was mainly focused on question interpretation, along with the appropriate approach, survey length, and technical jargon. Various minor adjustments were made to the wording for a better grip of understanding based on this feedback.

Ensuring Measurement Integrity: Due to the survey's design, which utilizes single-item indicators for specific constructs, such as "threat to jobs" in Q12 and "economic outlook" in Q17, traditional multi-item reliability metrics like Cronbach's Alpha were not applicable. The validation of these direct indicators is provided through the clarity and specific relevance of their contribution to the research objectives, as confirmed by the expert panel and pilot study. Here, the use of precisely framed items to capture specific insight is a well-recognised and appropriate process in probing and hypothesis-testing survey research when the established items are precise and clearly defined.

3.2.3. Survey Distribution and Sampling Frame

The survey questionnaire was created using Google Forms. After that, the distribution was through a multi-platform strategy to ensure broad reach across the global maritime community. The survey link was circulated through the following media to fully utilize the industry engagement:

Professional Social Networks: The professionals were reached out by using various platform like dedicated maritime groups on LinkedIn, Facebook, and WhatsApp, such as Mariners Group. Google form link had been provided with detailed description about the motive of the work for enhancing the participants' interest in the whole process.

Industry & Academic Networks: With the help of alumni networks of various maritime universities, various industry professionals and academicians contact information had been collected. Then they were reached out through direct emails to contacts within the researchers' professional network. Even though many of them didn't participate due to issues like shortage of time and familiarity.

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Direct Messaging Platforms: WhatsApp and WeChat groups frequented by maritime professionals, enabling direct peer-to-peer sharing within trusted communities.

A total of 120 data was collected over a period of 8 weeks. Participation was entirely voluntary and anonymous. However, verbal consent was taken before any use of the information provided by the respondents. Also, to ensure data integrity, any type of manipulation or post-editing directly to the responses that may concern the initial meaning was strictly prohibited. On top of that, to utilized each opinion and response, not even a single collected data has been scrutinized which might have ultimately resulted in unbalanced distribution regarding different parts of this sector.

3.3. Data Analysis Techniques

3.3.1. Analytical Software and Environment

The final dataset used for analysis was processed and analysed using Python 3.9 within the Google Colaboratory (Colab) cloud-based computational environment. Due to its accessibility, reproducibility, and workspace, which is integrated with various scientific libraries, Google Collaboratory has been used as the primary working platform. For data manipulation and cleaning, pandas was used, while Numpy was utilized for various numerical operations. Alongside, SciPy for statistical testing was mainly employed. On the other hand, Matplotlib and Seaborn were leveraged to generate clear, publication-worthy charts and graphs, which can be the medium for data visualisation for the final report.

3.3.2. Data Preparation and Variable Transformation

For hypothetical and statistical analysis and deriving various evaluations, several questions of the survey and responses filled out by the participants were procedurally encoded with the motive of assigning different variables. So that specific hypotheses and overviews can be derived from it to be represented in the final discussion part. However, to preserve the initial raw dataset from any type of alteration, the encoding was done only during data processing. All original survey responses remained unchanged in the dataset. The encoded derived variables were created in cloud memory during the execution of the Python code inside the Google Collaboratory to implement the assemblies that were defined in various research hypotheses. This particular approach validates the assurance of authenticity that data integrity was maintained.

3.3.3. Inferential Statistical Testing

A few hypotheses were derived by testing the variables that had been created using recoding. These variables worked as a key factor for analytical findings. Using a combination of chi-square tests of independence, correlation analysis, and predictive accuracy assessment, the analysis was executed. However, the nature of the data was the primary concern while selecting the analysis method.

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Chi-square tests of independence were constructed for different hypotheses that comprise the correlation between two categorical entities of the dataset. In this study, this technique was executed in the first hypothesis to verify whether the employment sector impacted the point of view of autonomous systems as a threat to jobs. Also, in the third hypothesis, checking whether belief in direct job loss predicted a final 'Curse' verdict. If the people from management and operations have different opinions on the thought of investment value verified in hypothesis four. Alongside the belief in technical feasibility, the associated preferred automation mode was tested in hypothesis seven, and whether the primary sector of employment was a deciding factor of the final Boon/Curse perspective in hypothesis nine. For all chi-square tests that were done while evaluating the dataset, statistical significance was evaluated at the $\alpha = 0.05$ level, and the chi2_contingency function from SciPy was used. The formula of Chi-square tests of independence is here :

$$\chi^2 = \frac{(O - E)^2}{E}$$

Spearman's rank-order correlation is a non-parametric correlation measure that is relevant for assessing the monotonic connection between ranked data, which was employed to test the second hypothesis. This particular test asserted the connection between years of experience of the respondents and the degree of threat perception predicted by the participants in different questions of the survey. The formula of Spearman's rank-order correlation is below:

$$r_s = 1 - \frac{6\sum D^2}{n\left(n^2 - 1\right)}$$

For the fifth and sixth hypotheses, which evaluate the association among sequential outlook ratings and outcomes of different variables, the technique of percentage analysis and trend examination was the primary tool, supported by visual trend lines to illustrate correlations.
Hypothesis no 8 focused on the observation where participants presented their idea and point of view on how people from different age groups would benefit, face difficulties, or be unaffected if the autonomous system is fully implemented in the shipping sector. This analysis was done by a simple method of the percentage of respondents.

The tenth hypothesis, which is the last one in the study, suggested that a contemporaneously negative outlook on safety and economics was a strong predictor of a 'Curse' verdict in the last question of the survey, and was assessed using a predictive accuracy framework. This interpretation was evaluated by calculating the percentage of respondents with this 'double-negative' outlook who gave a 'Curse' verdict and compared this against a high-threshold benchmark to evaluate its predictive power.

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3.3.4. Visualisation and Interpretation

The outcome of the whole analysis and various derived hypotheses had been methodically presented through different visual interpretation media, where stacked bar charts illustrated percentage distributions across groups. On the other hand, heatmaps clarified patterns in complex contingency tables. Also, the comparative bar plots emphasised dissimilarities between key categories, and trend lines illustrated correlational relationships. Each visual and tabular representation of the outcome has been presented, primarily focusing on specific research questions.

4. Result and Discussion

The respondents of this particular study are from multiple domains within the maritime and shipping industry. Additionally, they are actively involved in the sector in which they are engaged. Here, a total of 120 professionals participated in the survey by dedicating their precious time to fill out the questionnaire, representing a broad range of professional sectors and roles corresponding to shipping operations and maritime systems.

4.1. Sectoral Distribution

Respondents were distributed across seven major maritime sectors, with one respondent opting not to disclose their sector affiliation.

Sector of Employment	Frequency	In Percentage
Commercial Shipping	27	22.5%
Fishing & Aquaculture	23	19.2%
Passenger Shipping	20	16.7%
Naval / Defence	14	11.7%
Academia	14	11.7%
Logistic Company	13	10.8%
Shipbuilding & Repair	8	6.7%
Prefer not to say	1	0.8%
Total	120	100%

Table 1: Sectoral Distribution

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In Table 1, which represents the sectoral distribution of the participants, present that commercial shipping personalities have participated in the largest group, which was 27 persons among 120 respondents, about 22.5% of the whole group of participants, followed by fishing and aquaculture, numbering second with 23, representing 19.2% of the participants. While professionals from the passenger shipping service were 20 in number, and 16.7% in the scale of 100. On the other hand, both naval/defence and academia participated equally in quantities, with each having 14 people out of 120 respondents and 11.7 on a scale of 100. Also, the professionals from logistics companies were 10.8%, which was 13, and shipbuilding and repair was 6.7%, numbering 8 out of 120 people. There was also one participant who was not comfortable revealing the sector specifically, and chose prefer not to say for the specific question. This distribution ensures the representation of mindset from both operational maritime sectors, combining 58.4% of the final sample dataset, and supporting shore-based industries about 29.2%, with naval/defence representing a specific category at 11.7%.

4.2. Professional Designation

The final dataset is consisted with diverse professional roles across the maritime industry. The table below indicates the active positions professionals are in now.

Role Catagory	Count	Percentage
Ship Officers & Crew	47	39.2%
Fishing Professionals	12	10.0%
Management & Logistics	15	12.5%
Engineering & Technical	10	8.3%
Naval & Defense	10	8.3%
Academic & Research	13	10.8%
Passenger Ship Staff	8	6.7%
Other Roles	5	4.2%
Total	120	100%

Table 2: Professional Designation Summary

If the common knowledge about the maritime industry is mentioned, operational roles indicate ship officers, who consist of captains, chief officers, navigating officers, and many more. While the ship crew is basically the seamen, deckhands, cadets, in general, the early stage of one

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seaman's work life position, this also includes the engineering personnel of the particular ship. Shore-based roles contained management-related posts like general managers and operations managers. However, technical specialists are basically the design engineers, supervisors, and academic-research positions, comprising professors and researchers. Additionally, the sample contained fishing professionals like fishermen, boatswains, and naval/defence personnel, such as commanders and medical officers. This elaborated description, which is illustrated in Table 2, ensures that opinions were captured from both frontline operational staff, key leaders, and visionaries.

4.3. Professional Experience

This passage of the study will indicate the quantitative analysis of how much experience each respondent had through a tabular format.

Experience Catagory	Years Range	Frequency (n)	Percentage (%)
Entry- Level	Less than 1 year	17	14.2%
Early Career	1-5 years	27	22.5%
Mid- Career	5-10 years	32	26.7%
Senior	10-15 years	30	25.0%
Veteran	More than 15 years	14	11.7%
Total	All categories	120	100%

Table 3: Professional Experience Distribution

The largest in size among the 120 professionals are the mid-career ones with 5-10 years of experience, numbering 32 and 26.7% of the total participants, followed closely by senior professionals with 10-15 years, 25.0% of the total, numbering 30 professionals among 120 people. Early-career respondents (1-5 years) consist of 22.5% or 27 in the actual count of people. While the entry-level professionals with less than 1 year of experience and highly experienced veterans with experience of more than 15 years represented 14.2% (n=17) and 11.7% (n=14) respectively.

Critically, 62.5% of the total participants possessed 5 or more years of experience, indicating expensive practical exposure to maritime operations. This experience depth establishes the assurance that responses are informed by hands-on industry knowledge, operational challenges, and historical context, thereby elevating the validity of opinions on technological transformation.

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The balanced variation across different experience levels alleviates the possible bias while maintaining strong representation from various professionals who have witnessed industry evolution firsthand.

4.4. Descriptive Statistics and Analysis

A total number of 120 people participated in the survey, various observation was made from their responses. Those observation was used as the key factors for deriving various hypothetical analyses to serve as the research outcome.

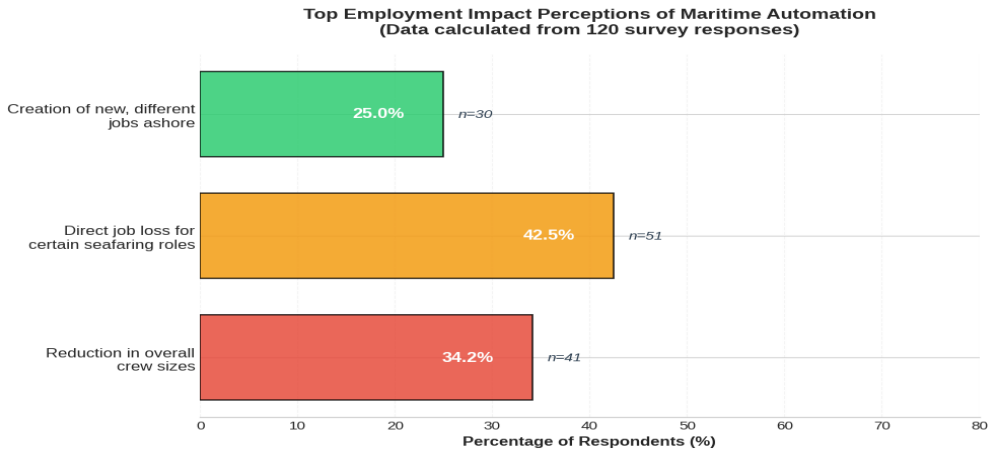

Figure 1: Employment impact perceptions

Here, the perception of affecting the employment sectors for certain roles in the shipping industry due to automation were broadly dominant. As about 42.5% of the total respondents indicated direct job loss for certain seafaring roles. While only 25.0% of the participants mentioned positively, with the mention of new job opportunity creation due to the automated system being implemented. On the other hand, a total of 34.2% actually tried to remain neutral and indicated a possible reduction in the overall crew size because of automation.

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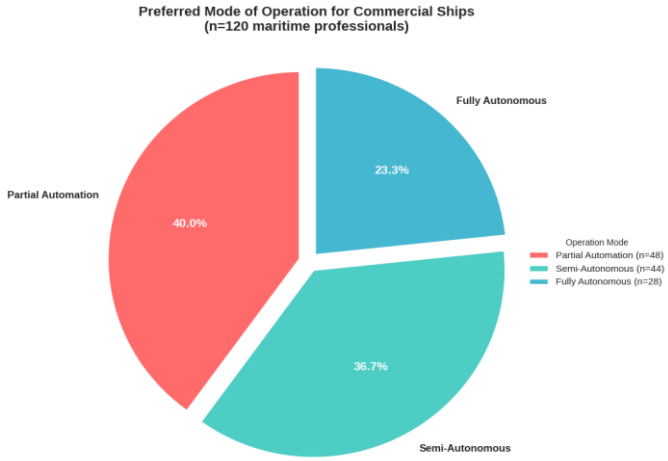

Figure 2: Operation mode preference distribution

While a large portion of the participants, about 62.5%, expressed discomfort with the idea of a fully driverless car regarding safety issues, pointing out a certain level of wariness toward fully automated transportation systems. This same concerning fact also got to be noticed in the maritime sector, where only 28.3% of the total participants believed in the fact that it is currently technically possible to fully automate a ship for safe, long-term use under all conditions. While about 40.0% favored the idea of Partial Automation, which is human-centred with AI assistance, and about 36.7% preferred Semi-Autonomous operation, implying an AI-led operation with reduced crew. However, only 23.3% supported a leap to Fully Autonomous vessels.

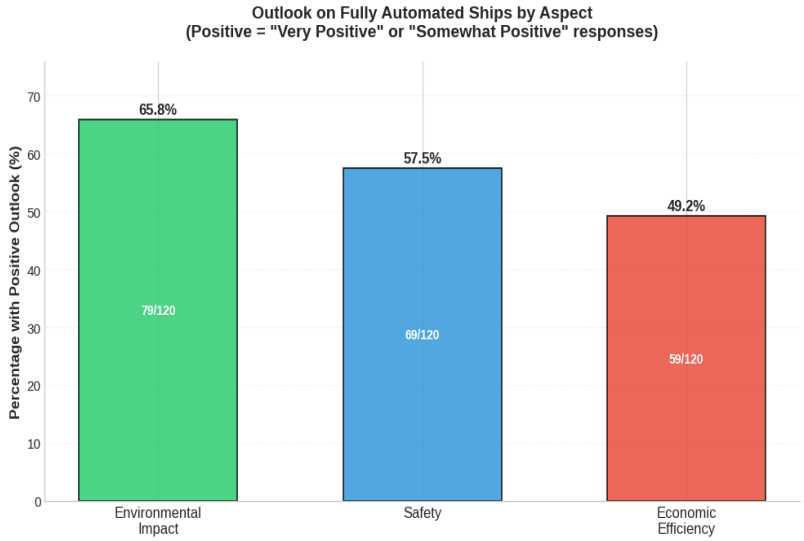

Figure 3: Percentage of positive overview on different factors

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While evaluating the impacts of fully automated ships on the environment, safety, and economic efficiency, the respondents had the least positive overview of the economic efficiency. About 49.2% of them only responded positively regarding their perspective on cost-effectiveness. However, the rest of the participants did not hold that much expectation or belief that it would be economically efficient. On the other hand, a large portion of the participants, reaching nearly 65.8%of them, agreed to the fact that the implementation of automation will have a great positive effect on nature and the environment. Consequently, the viewpoint of safety regarding this can be said to be neutral, as a little more than half of the population, which is 57.5%, had a very positive outlook, while others didn't.

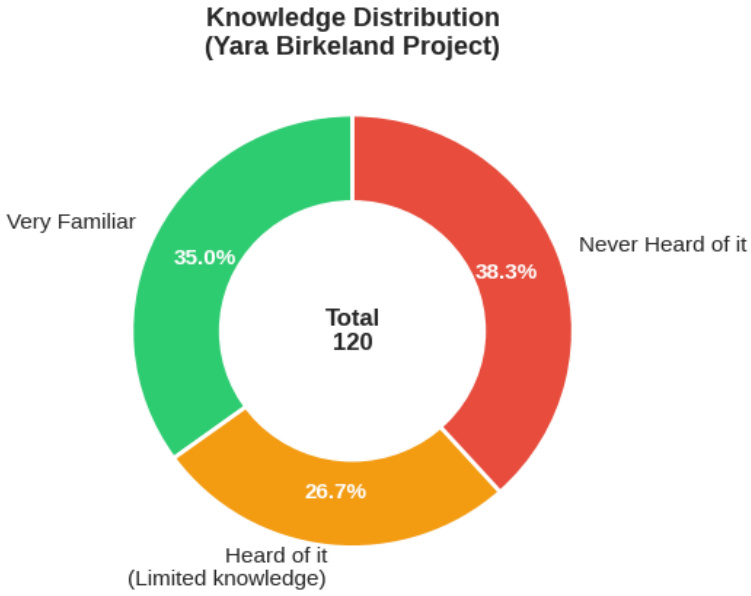

Figure 4: Knowledge about Yara Birkeland

During the observation, a very interesting thing was noticed. Even though participants were commenting on autonomous systems and other stuff, a very small portion of them know about the ongoing popular projects that can be revolutionary in the sector of automation. Only 35% of the total participants were very familiar with Yara Birkeland, the fully autonomous ship developed by Norway. However, 38.3% of them have not even heard of this invention before, while being from the shipping industry. On the other hand, 26.7% of the respondents actually heard of this revolutionary invention but were not very familiar with it.

4.5. Hypothesis Testing and Discussion

Hypothesis 1 (H1) answers the first research question of this study regarding who are viewing automation as threat. The data showed that professionals who are currently engaged in roles related to seafaring jobs would be thinking of the autonomous system implementation as more of

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a threat to their employment chances compared to those in shore-based roles. The statistical analysis also reveals the same direction through its outcome. Here, from Figure 5, it can be illustrated that 50.0% of seafaring professionals recognise autonomous systems as a threat to seafaring jobs, compared to 41.7% of shore-based professionals, which contains a difference of 8.3 percentage points.

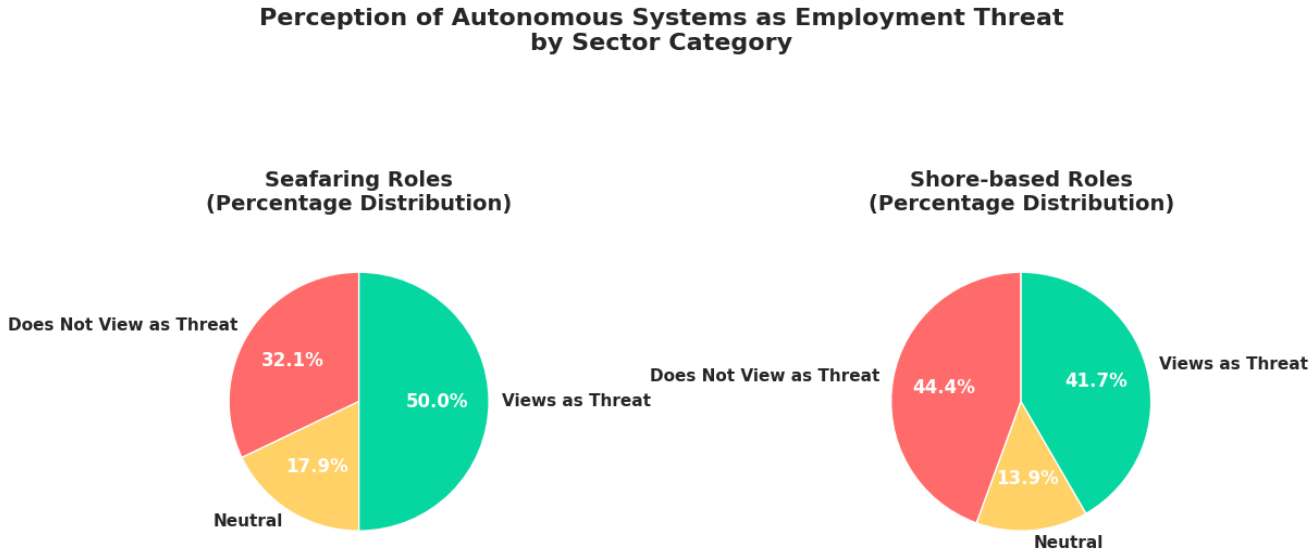

Figure 5: Threat Perception by Sector Category

However, if we try to compare the portion of participants who do not think of this new work mode as a threat, the shore-based one is at 44.4%, while the seafaring role is at 32.1%. However, a chi-square test indicated this difference was not statistically significant ($\chi^2 = 0.41$, $p = 0.523$). Interestingly, within seafaring roles, Naval/Defence with 57.1% and Fishing & Aquaculture with 52.2%, the participants involved with seafaring roles showed the highest threat penetration, while within shore-based roles, participants involved in academia, which is about 42.9%, presented familiar concern levels to seafaring groups.

Then, to evaluate any possible correlation existing between years of experience in the shipping sector and the penetration of autonomous systems as a major threat to seafaring jobs. However, this particular hypothesis had solid evidence as it is highly supported by the data, where strong and clear existing correlations can be observed between the level of professional experience and perception of job threat. As from figure 6, it can be observed that with the increasing year of experience, the perception of job threat increased significantly. Here, those professionals with only 0-1 year of experience, only 17.6% of the total population thought of an autonomous system

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being a threat to their job opportunities, compared with those who have 15+ years of experience, about 64.3% of them viewed automation as a threat. This particular information exhibits the fact thatthere is about a fourfold increase in threat perception from the least to the most experienced groups.

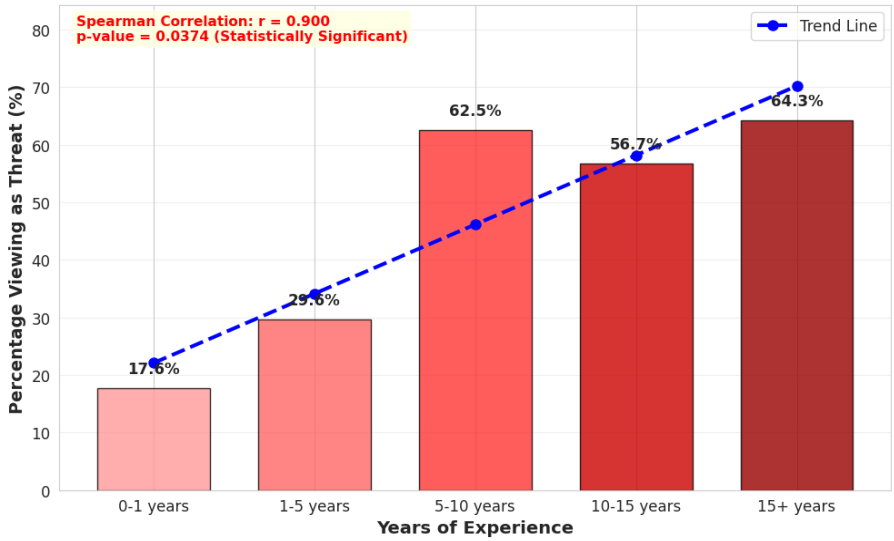

Figure 6: "Threat Perception by Years of Experience in Shipping"

With the value of r being 0.900 and the value of p being 0.037, the Spearman's rank correlation analysis displays a strong positive relationship between experience level and threat perception. The monotonic increase is especially noticeable in the mid-career ranges, where the perception of job threat and level of experience is about 29.6% for 1-5 years, 62.5% for 5-10 years, and 56.7% for 10-15 years. If we try to evaluate the raw counts, it reveals that among professionals with 15+ years of experience, 9 out of 14 (64.3%) viewed automation as a threat, while only 3 out of 17 (17.6%) with 0-1 years shared this concern. This hypothetical analysis points out the fact that the years of effort and investment of time, as well as the energy of professionals with a high level of experience for developing their traditional seafaring skills, will go to waste, according to them, if the autonomous system is fully implemented. So, in Figure 5, a very positive correlation has been illustrated between the percentage of threat perception and the constant rise of experience level.

This particular analysis was to evaluate whether those of the respondents who strongly believe that automation will direct cause of job loss for various roles related to the maritime industry had selected automation as a curse as their final verdict or not. In general, those who had thought of an autonomous system as a threat to their job should select and declare it as a curse; however, the calculation of chi square method, as well as the simple statistical value, is unable to illustrate any significant relationship between them. As shown in Figure 7, only 38.0% of total participants

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who believed in direct job loss viewed automation as a Curse, compared to 55.1% of those who did not believe in direct job loss. This illustrates an arbitrary difference of -17.1 percentage points, which suggests that belief in job displacement does not necessarily correlate with negative overall sentiment toward automation.

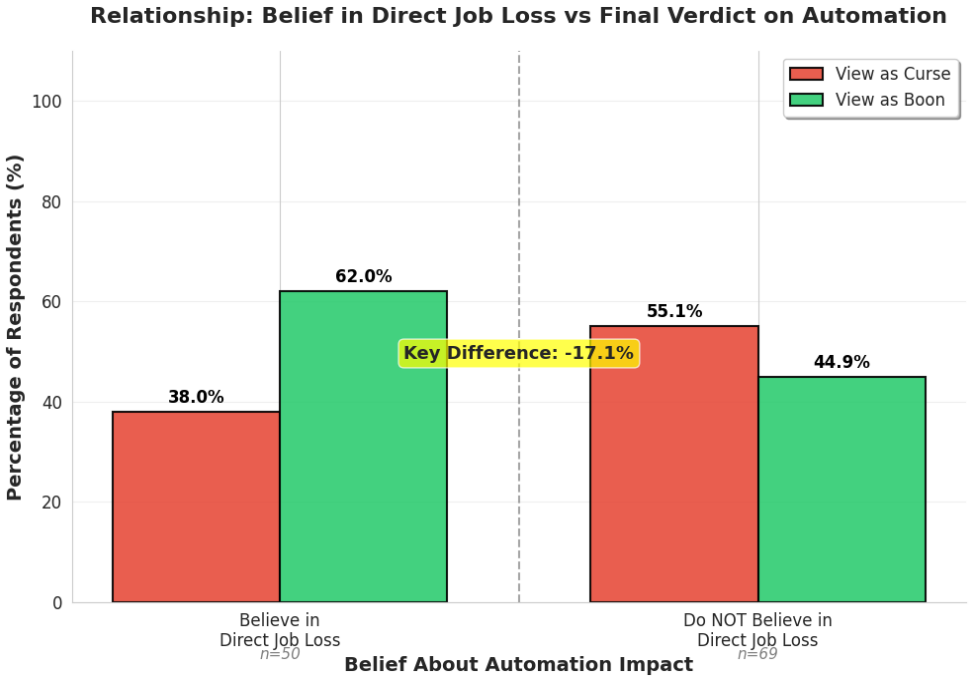

Figure 7: "Belief in Direct Job Loss vs. Final Verdict"

A chi-square test where the value of χ^2 and p is 2.74 and 0.098, respectively, shows a lack of statistical significance. Whereas the raw counts represent that among 50 participants who believed in direct job loss, only 19 of them viewed automation as a Curse, while 62.0% or 38 people viewed it as a Boon. On the other hand, 69 respondents of the whole participants who did not believe in direct job loss, 38 viewed it as a curse, and 31 as a boon. This particular pattern indicates that awareness of a possible job threat may have been accompanied by identification of other benefits. Alternatively, the respondents who have acknowledged job loss risks are more likely to see automation as an unignorable thing that requires adaptation rather than direct rejection. The given stacked bar chart presented in Figure 7 visually illustrates this counter relationship, with the "Believe in Direct Job Loss" group showing a higher proportion of Boon perspectives.

Here, this visual representation of data analysis states that respondents involved in management roles would be more likely to view investment in autonomous ships as positive compared to operational seafaring staff. However, the analysis from the final data sample revealed a result that is opposite to the prediction. But the cause of this result may be due to a notable sample size disparity.

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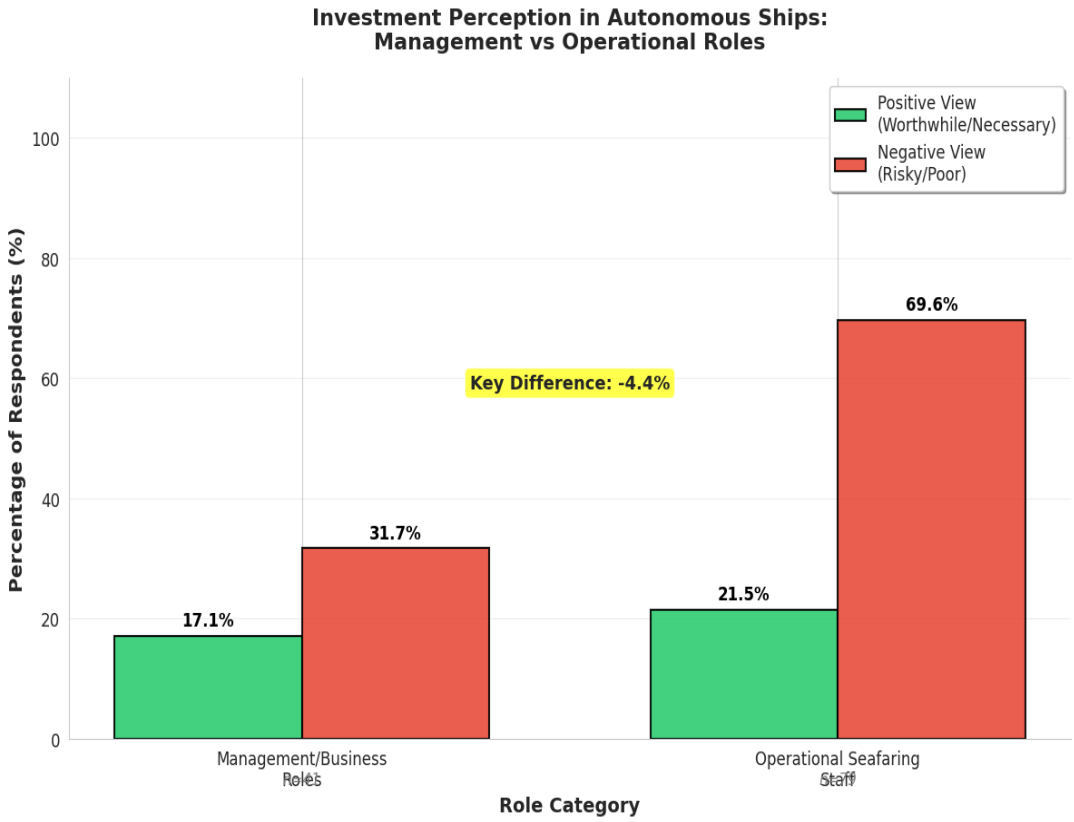

Figure 8: "Investment Perception in Autonomous Ships: Management vs Operational Roles"

As the final sample consists of 41 Management roles, while there were 79 respondents from Operational Seafaring Staff, this caused a large uneven distribution for analysis, which reduced the statistical power of the analysis. Consequently, while about 21.5% of the total Operational staff held an overall positive view of the investment, just about 17.1% of the management staff thought of automation as a profitable investment. The chi-square test found no significant association due to the insignificant values of the parameters from the analysis. The absence of a proper notable finding needs to be interpreted with caution, as the size of management staffs in the final dataset may have limited the ability to detect a true underlying difference in perspectives between these key industry groups.

To evaluate if the participants with a positive outlook on the Economic Efficiency of automated ships think of autonomous technology as a 'Boon', another detailed calculation had been conducted. Analysis of the complete dataset with 120 sample data fully supports the prediction of this hypothesis by revealing a meaningful descriptive relationship consistent with the predicted effect.

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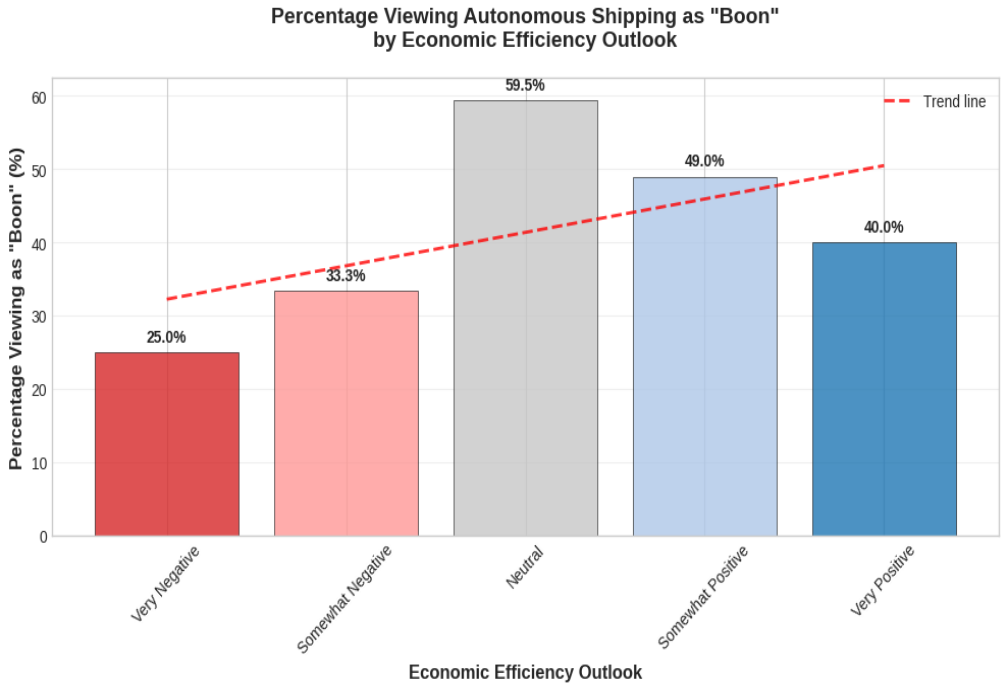

Figure 9: "Percentage Viewing Autonomous Shipping as 'Boon' by Economic Efficiency Outlook"

From the figure given above, it can be mentioned that those with a very negative outlook on the economic prospects of the autonomous system predicted the implementation of it as a boon for only about 25%, whereas among those with a very positive outlook, 40% of them selected the automation as a boon. However, those who had mostly neutral opinions regarding economic efficiency, 59.5% of them declared the technology to be a boon to humanity. On the other hand, the percentage of those with somewhat negative and somewhat positive was about 33.3% and 49.0%, respectively. So, it can be declared that even if the economic outlook is not affecting the verdict of curse or boon, results can be correlated as those with a negative mindset regarding this system implementation will most likely think of automation implementation not as a boon.

To provide evidenced hypothetical analysis, in this part of the study, correlation between familiarity of existing projects and safety verdict had been established. The graph represented the analysis of those respondents who were familiar with real-world autonomous projects, such as Yara Birkeland, Waymo, Tesla FSD, and might have a more positive outlook on the safety of autonomous vehicles. The analysis of the sample data strongly supports this predicted hypothesis. Figure 10 directly illustrates the information, where it is clearly described that those with higher awareness regarding projects related to automation have an overall more positive outlook about the safety of autonomous vehicles.

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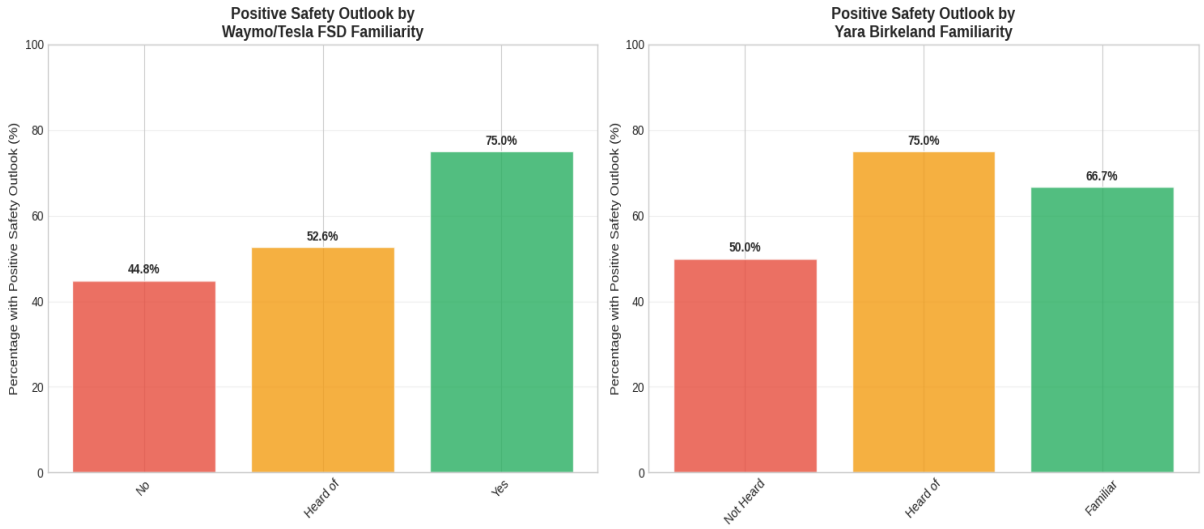

Figure 10: "Percentage with Positive Safety Outlook by Familiarity with Autonomous Projects"

The graph shows that among those who are very familiar with the projects of Wamyo or Tesla FSD, 75.0% among them think of autonomous vehicles as completely safe to use. But only 44.8% of those who do not know anything about these projects think of this system as safe. The same goes for Yara Birkeland, as those who have heard of it and are very familiar with it, about 75.0% and 66.7% of them think of this system as completely safe, while those who have not heard of this project, about half of them think of the autonomous ship as unsafe to use. This illustrative evidence strongly agrees with the core premise of the predicted hypothesis, which mentions that knowledge and exposure to autonomous technology can result in a higher level of trust in its safe application within the shipping sector.

The next hypothesis shows the fact that those whose belief in the technical possibility of ship automation is notably strong are more likely to have a higher preference for advanced operational modes of vehicles like Semi or Fully Autonomous mode. The analysis derived from the final sample data strongly supports this predicted hypothesis. Only 45.8% of the respondents who think full automation is never possible prefer advanced automated technology, whereas about 83.3% of the people among those who think of the absolute possibility of automation prefer to have an advanced automation system. This basically illustrates that technical belief is a powerful differentiator in operational vision.

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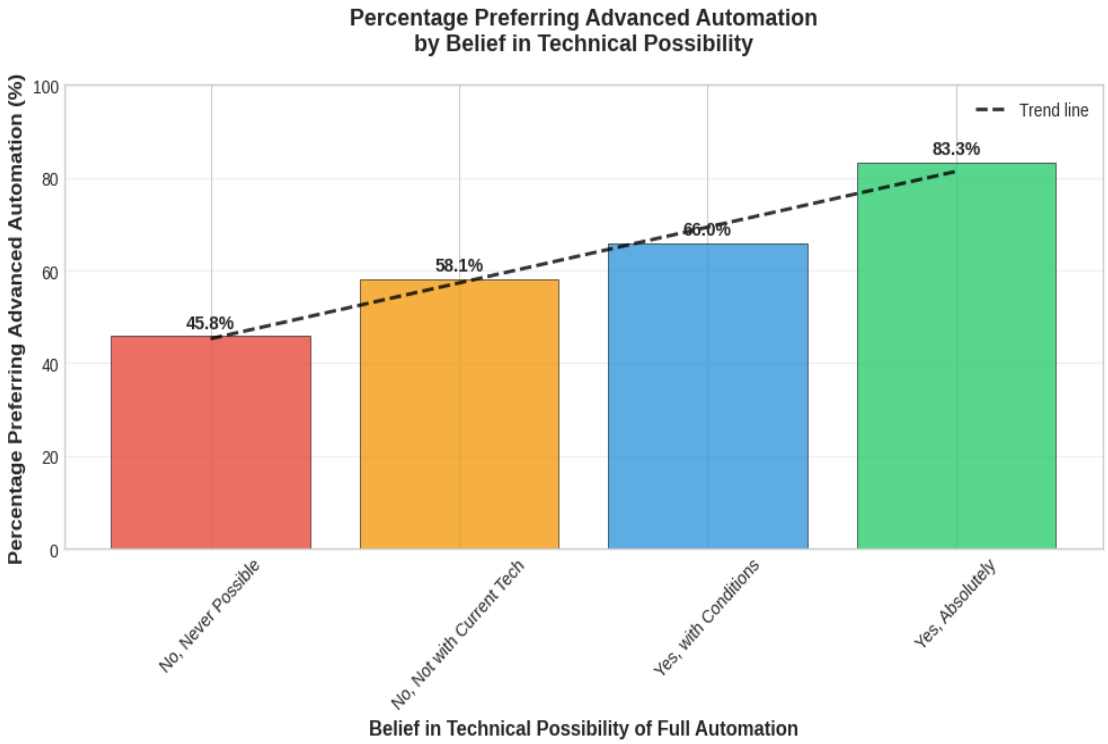

Figure 11: "Percentage Preferring Advanced Automation by Belief in Technical Possibility"

In the figure, the visual trend line clearly highlights this positive association. The analysis displays that the level of belief in the certainty of the feasibility of an autonomous system being implemented in the shipping sector directly connects one individual's preference for advanced technology, providing clear conceptual support for the hypothesis. With this, the answer of research question 02 has been provided which is strongly supported by the detailed evidenced analysis of the collected data.

The remaining hypotheses are mostly to answer the last research question of this research study. Figure 12 is represented to evaluate the thoughts of the participants regarding difficulties or benefits that will be faced by people from different age groups. The predicted hypothesis was that young professionals will most likely have benefits from automation, whereas mid-career professionals will face various difficulties. Also, the result from the analysis greatly supports this prediction, with the result where 56.7% of the participants believe that young professionals will benefit, and 69.2% believe mid-career professionals will face difficulties.

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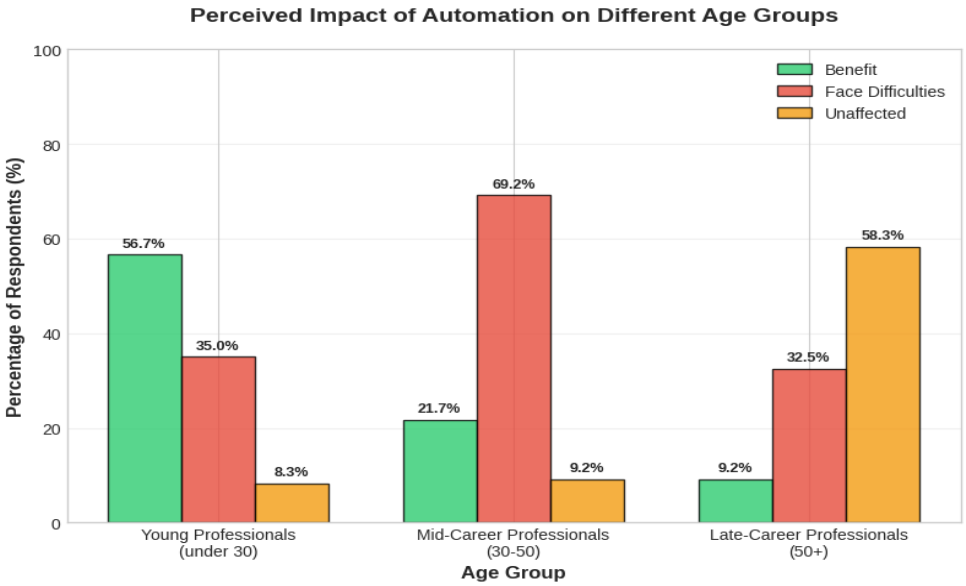

Figure 12: Perceived Impact of Automation by Age Group

Here, the bar chart precisely displays that the late-career professionals are more likely to be the least affected by this transformation, as the rate of being unaffected is 58.3%, but for young and late-career professionals, it is 8.3% and 9.2%, respectively. Thus, the hypothesis is supported by the analysis.

The figure 13 represents the fact that one's view of an autonomous system as a boon or a curse was strongly impacted by the primary sector of employment. The analysis of the final sample dataset supports the hypothesis statistically. The data analysis reveals the calculated values, which provide strong evidence of the predicted perception completely. According to the outcome, Logistics (92.3%), Shipbuilding & Repair (87.5%), and Academia (76.9%) showed overwhelmingly positive 'Boon' perspectives. However, the professionals from operational sectors such as Commercial Shipping (75.0%), Passenger Shipping (75.0%), and Fishing & Aquaculture (69.6%) decisively selected their verdict as ‘Curse’ regarding the autonomous system being fully implemented.

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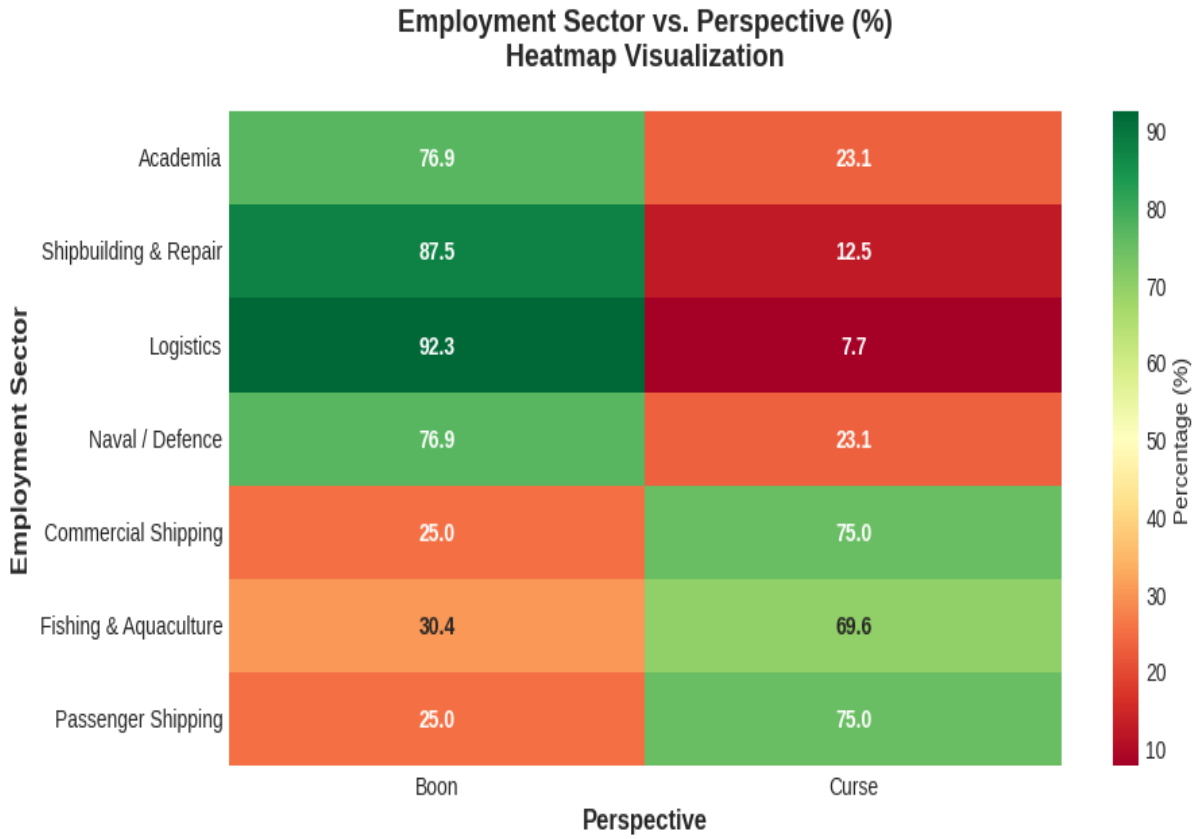

Figure 13: Percentage Viewing Autonomous Systems as 'Boon' by Employment Sector

The provided heatmap and graphclearly illustrate the percentage of people from different employment sectors declaring their verdict as a curse or boon regarding autonomous ships. A chi-square test confirmed the association is highly statistically significant ($p<0.001$). This output supports the predicted hypothesis completely.

This last hypothetical analysis presented that a group of participants with a negative outlook on both Safety and Economic Efficiency serves as a near-perfect predictor of a final 'Curse' verdict. The data analysis result from the final sample dataset provides highly strong statistical evidence that significantly supports this hypothesis. The output of research analysis unveils that 87.5% of the total respondents with this double-negative outlook, which is 7 out of 8 in number, gave a 'Curse' verdict, achieving the highest rate among all outlook combinations and approximately higher than 49.1% overall average.

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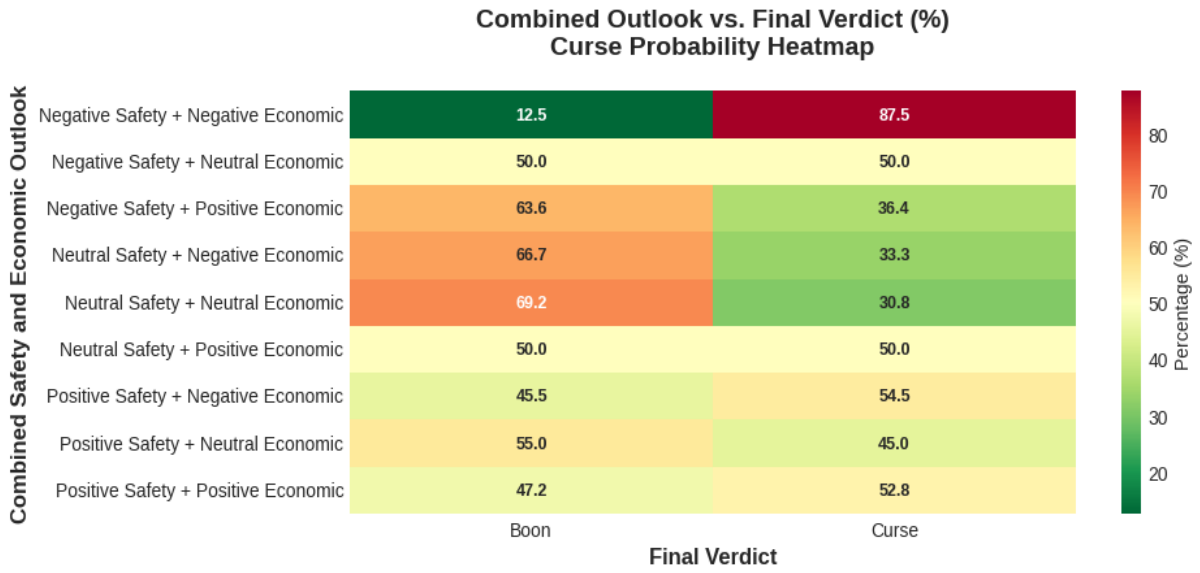

Figure 14: Double Negative Outlook vs Final Verdict

The given heatmap in Figure 14 efficiently represents the highly noticeable contrast between the double-negative group with a percentage of 87.5%. On the other hand, in the presented bar chart, which is the given Figure 14, it is clearly illustrated that the 90% threshold line provides a clear reference for assessing the hypothesis.

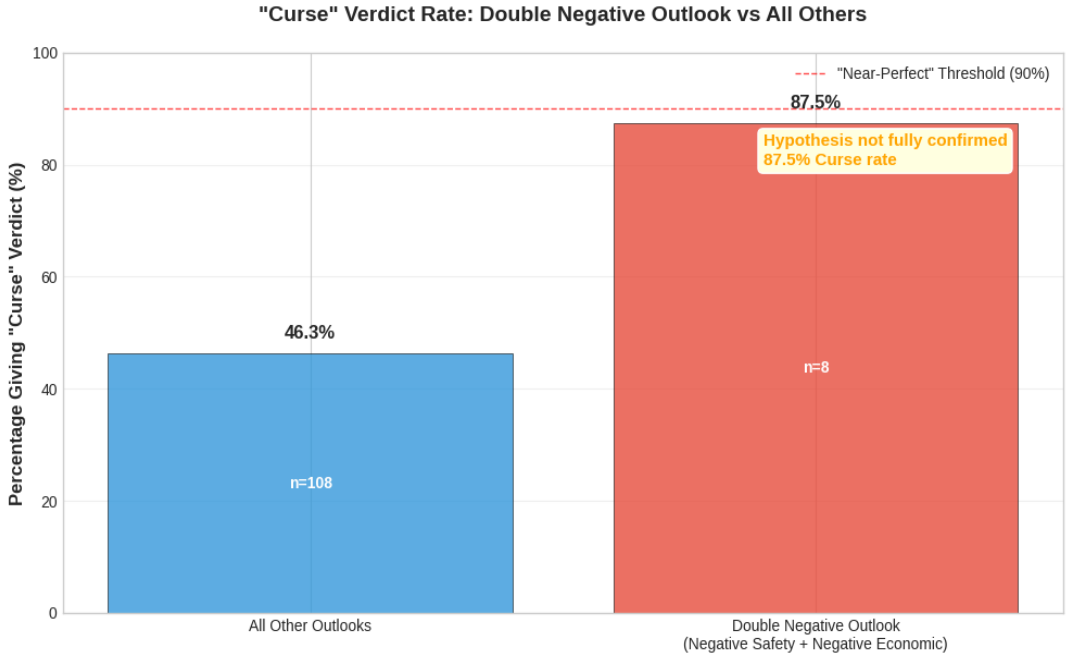

Figure 15: Double Negative Outlook vS All Other Outlook

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Even though the "near-perfect" benchmark of 90% was not met as the predicted hypothesis, the 87.5% exhibits accuracy in this outlook pattern as a highly reliable indicator of opposition. So, the overall outcome directly supports the predicted hypothesis with proper evidence.

5. Conclusion

From the very beginning, shipping has been used as the most convenient transportation system, which people used for long route travelling as well as to carry a large amount of goods (Kosowska-Stamirowska et al., 2016). Various studies were conducted to make it more convenient. In 1970, a book named Ships and Shipping of Tomorrow by Rolf Schonknecht was published, where the concept of ships being navigated by seamen from the shore was mentioned for the first time (Timeline of Autonomous Ships, 2018). After that, many countries were trying to work on transforming this theoretical concept to practical reality. However, during all this, human somehow gets neglected or their opinion becomes the silent part in different scenarios. It is also mentioned in various previous research studies that humans are the main driving force behind the scenes of the ship; their physical and psychological well-being should be ensured in a way that will not cause redundant burdens and hinder the use of the operation (Javed, 2023; Şenbursa et al., 2024). The changes in operational are evaluated to be mostly welcomed by all, with some concern regarding issues like decreasing job opportunities for different professional roles. The evaluation reveals a crucial prediction on how the initial challenge of maritime autonomy might be less technical and more socio-economic, which centres on workforce transition and impartial benefit distribution. Accordingly, the most preferred mode of operation is not full manual or automated, but the semi-automation where decision-making tasks in various situations remains the duty of humans, but with AI-assistance.

The study here presents that a significant amount of people are still in disbelief regarding automation with has been facilitated by various factors like knowledge gap, job insecurity and many more. The direct declaration of which particular group are not accepting the changes and who didn’t can not be provided due to the limitation of this research study. As the sampling method of the collected data can not be said to be completely unbiased with the determination of evaluating each response, there were imbalancement between different groups such as industry professionals, acadicians, stakeholder, builders and many more. So, providing straight-forward statement will not be logical enough and this is what can be regarded as the primary limitation of this study. The future aim of this research is to enhancing the sampling method to create balance among sectors and providing specific analysis outcome.

In conclusion, for autonomous shipping being well accepted and regarded as a boon in the overall scenario, the stakeholders and industry owners must take some initiative to ensure that the transition from human to technology is well structured while taking consideration of both human wellbeing which includes their economic stability, along with the owner's business profits. Practical implications need to be concerned along with technological advancement. Not just investing in upgrading the technology, but also by investing money and resources for retraining professionals, which will create different job opportunities for them in related roles

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and providing detailed proof of safety and cost advantages of automation with real-world data to people, will make the acceptance level higher and make the transition smoother. While this study contributes by providing primary views on the current opinion of different maritime professionals regarding autonomous ships, it can change over time. While designing training methods along with workforce transition, peoples acceptance and durability of the designed method need to be considered distinctly for successful enforcement. However, whether this change in attitude and opinion will be for the better solely depends on how the transition is being designed and implemented. If greater acceptance is anticipated, future work should be focused on these changes and the reason for it, as well as designing well-structured AI systems where humans are not presented as a replaceable factor, but rather a crucial part of the team to execute operations on different scales.

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