ALAM JOURNAL OF MARITIME STUDIES (AJMS)

ALAM'S RATINGS' PERCEPTIONS OF AUTONOMOUS SHIPS

Amir Syawal Bin Kamis
amirsyawal@alam.edu.my

Rating Programs, Akademi Laut Malaysia, BT 30 Kg Tg Dahan, 78200 Kuala Sungai Baru Melaka, Malaysia

ABSTRACT

The development of autonomous ships has been a popular topic in the maritime industry, particularly after the recent maritime autonomous surface ships exercise conducted by International Maritime Organisation. It has huge potential to revolutionise ship navigation at sea. This study seeks to investigate the views of undergraduate rating students from Akademi Laut Malaysia regarding autonomous ships. The research involved interviewing the rating students and analysing the data with Atlas-ti software. Results indicate that rating students are typically in agreement that autonomous ships' concept can improve safety aboard manned vessels. They recognise that technology has the potential to enhance operational efficacy and reduce human error. However, the students were concerned about the potential impact of autonomous ships on industry-wide job security. They are concerned that the implementation of autonomous ships will reduce the number of seafarers required on ships. This document offers valuable insights into the perspectives of seafarers regarding autonomous ships, which can inform the development and implementation of this technology within the maritime industry. By resolving the concerns of seafarers, industry stakeholders can facilitate the adoption of autonomous ships in a more harmonious manner.

ARTICLE INFO

Keywords: Autonomous ship, Perception, Qualitative, Seafarer, Thematic analysis

1.0 INTRODUCTION

The implementation of autonomous ships is anticipated to bring about a significant transformation in the maritime sector. Advancements in autonomous navigation systems and machine learning algorithms have increased the probability of achieving fully autonomous ships, as per recent research (Ayob et al., 2020). Autonomous shipping has garnered considerable attention in recent years as a growing number of scholars have directed their research towards the advancement of sophisticated technologies that can enable the functioning of unmanned vessels, including mathematical models and algorithms (Ayob et al., 2020; Fan et al., 2020; Jeong et al., 2019; Kamis & Fuad, 2022). Consequently, a plethora of research

studies have surfaced, demonstrating an increasing inclination towards investigating this domain. The prospective advantages of self-governing shipping are noteworthy, encompassing diminished operational expenses, enhanced safety, and heightened efficacy. The feasibility and practicality of autonomous ships are increasing due to the advancements in machine learning, artificial intelligence, and robotics. Consequently, it is probable that the research in this domain will persist in expanding as scientists and engineers endeavour to tackle the technical and regulatory obstacles that are yet to be overcome.

The International Maritime Organisation (IMO) carried out an assessment of the feasibility of autonomous vessels in practical settings through a maritime autonomous surface ships (MASS) exercise in 2018, which was deemed successful (IMO, 2021). The aforementioned activity has generated significant discernments regarding the prospective advantages and hindrances of utilising autonomous surface ships in business endeavours. Various corporations, such as Rolls-Royce and IBM, have initiated research and development activities in the domain of autonomous shipping and have achieved significant advancements in the development of autonomous ship technology (IBM, 2022; Rolls-Royce, 2016). The Norwegian container ship, MV Yara Birkeland, is expected to initiate its operations soon and is currently the vessel that is closest to achieving complete autonomy. The advent of this novel zero-emission vessel will inaugurate a fresh epoch for worldwide marine transportation and facilitate the attainment of the sustainability objectives established by the United Nations (Skredderberget, 2023). Autonomous ships have the capability to enhance safety, efficiency, and environmental sustainability, thereby presenting a potential revolution in the maritime sector in the coming years (Lazarowska, 2019).

2.0 OBJECTIVE OF THE STUDY

The introduction of autonomous ships has been hailed as a significant step forward for the shipping industry since it has the potential to improve the safety of vessels, save operating expenses and reduce carbon emissions. This reach intends to investigate ALAM's ratings' perception of the autonomous ship.

3.0 METHODOLOGY

The first stage of the study is to briefly introduce to the students the concept of autonomous ships through a lecture session, as shown in Figure 1. A group of 75 students were given an explanation of the concept of an autonomous ship during this phase. This session is expected to stimulate the interest of students and prompt them to generate inquiries that will shape their perceptions of autonomous ships (Alvarado et al., 2011).

During the second stage, a sample of ten students was selected randomly and subsequently interviewed to evaluate their comprehension of the autonomous ship's concept and their attitudes towards autonomous vessels (Boyce & Neale, 2006). The interview inquiries will evaluate the student's comprehension, their viewpoints on the advantages and disadvantages of autonomous ships, their insights on the challenges and limitations of autonomous ships, and their perceptions regarding the factors that contribute to the development of autonomous ships.

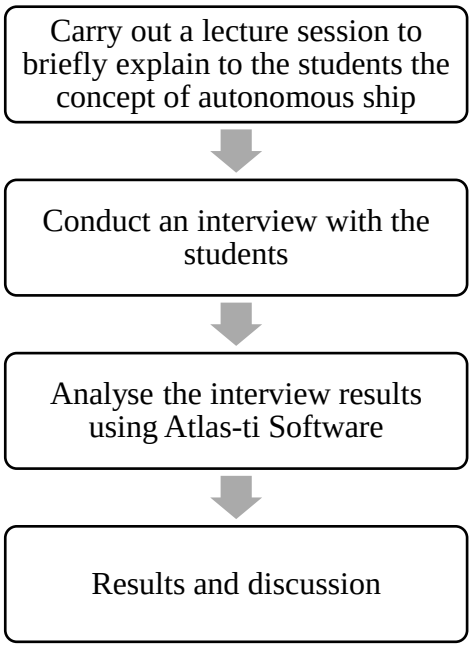

Figure 1. The research flow

Afterwards, using the Atlas-ti programme, the interview data were analysed thematically. The software will be used to categorise the data and identify the themes that emerged most prominently from the interviews. The themes will be analysed and interpreted so as to draw conclusions (Nowell et al., 2017). The study's findings will be presented as a summary of the main themes that emerged from the interviews, as well as an analysis and interpretation of the data. In addition to discussing the implications of the findings, the report should presumably reveal opportunities for future research.

4.0 FINDINGS AND DISCUSSION

The participants in this study are male students enrolled in the pre-sea rating programme at Akademi Laut Malaysia, all of whom are between the ages of 20 and 25. Furthermore, it is noteworthy to mention that those mentioned above lack any antecedent familiarity with sailing on a vessel. The relevance of this information is contingent upon the contextual parameters of the survey or study being undertaken. It can be deduced that the participants are presently undergoing seafarer training based on the fact that they are enrolled in a pre-sea rating programme. The data pertaining to the user's gender, age, and level of experience can be utilised to understand their viewpoints, beliefs, and attitude concerning the maritime industry and the obstacles encountered by novices in this domain. The followings are the interview questions that were asked during the interview:

1. How familiar are you with the concept of autonomous vessels?
2. What are the potential benefits of autonomous ship operation, in your perspective?
3. What are the drawbacks of autonomous ship operation, according to your perspective?
4. What is your perspective on the potential effects of autonomous vessels on the workforce within the maritime industry?
5. What are the challenges and limitations associated with autonomous ship operation, according to your perspective?
6. What factors do you believe are responsible for the implementation of autonomous ships?

KNOWLEDGE OF AUTONOMOUS SHIP

As a result of the interview, it was revealed that two of the students claimed to possess a firm understanding of the concept of autonomous vessels. They were able to provide insightful elucidations regarding the functioning of autonomous vessels, the benefits and drawbacks of the technology, and the potential uses for the vessels. Despite possessing a fundamental understanding of the operational mechanisms and significance of autonomous vessels, the remaining eighth of students expressed a need for supplementary resources to attain a comprehensive grasp of the concept.

The results suggest that certain students may possess a firm grasp of the concept of autonomous vessels; however, there is a necessity for enhanced education and awareness regarding this developing technology to ensure that all students comprehensively comprehend the subject matter.

THE BENEFITS OF HAVING AUTONOMOUS SHIP

Safety

The study revealed that a significant proportion of the student population held the belief that the foremost objective of autonomous ships was to enhance safety. The proponents of autonomous ships posit that such vessels have the potential to mitigate the hazards linked to human fallibility in navigation, consequently diminishing the probability of maritime mishaps and fatalities. Apart from safety, a number of students opined that the reduction of workforce and manpower on ships was a noteworthy advantage of autonomous vessels. It was perceived that a reduction in the quantity of crew members present on ships would result in economic benefits for shipping enterprises. According to some fellow students, the preservation of uniformity in vessel navigation and motion was deemed a crucial benefit of self-governing ships.

Reduce human error

The students opined that the implementation of autonomous vessels could guarantee adherence to pre-established routes and consistent velocity, thereby mitigating the variability in the ship's motion. In addition, a number of them held the belief that the implementation of autonomous vessels could potentially mitigate instances of human error in navigation, thereby diminishing the likelihood of accidents stemming from such errors. The implementation of sophisticated technology in ship navigation could potentially reduce the occurrence of errors attributable to human operators.

In general, the students expressed diverse perspectives regarding the principal advantages of autonomous vessels, with safety and cost minimisation emerging as the prevailing topics. It is noteworthy that the benefits exhibit interdependence, given that mitigating the likelihood of mishaps can result in decreased expenses for entities engaged in maritime transportation. The viewpoints of the students regarding the advantages of autonomous vessels underscore the potential benefits of this nascent technology and the necessity for additional instruction and comprehension of the subject matter.

PRIMARY DOWNSIDE OF AUTONOMOUS SHIP

System Malfunctions

The participants were requested to offer their perspectives regarding the limitations of autonomous vessels. Several students have conveyed apprehension regarding the potential for system malfunction in self-governing vessels, which may result in catastrophic consequences. In addition, the students conjectured that in the event of an autonomous vessel operating amidst manned vessels, the possibility of accidents could not be ruled out due to the potential lack of complete understanding of collision regulations by the autonomous vessel, as well as the likelihood of non-compliance by certain navigators. Furthermore, certain students have highlighted that while operating a semi-autonomous vessel, wherein humans retain partial control, there exists a potential hazard of navigators excessively depending on the system, thereby elevating the probability of an incident. The possibility of system failure is considered to be a potential disadvantage of autonomous ships.

Despite the utilisation of sophisticated technology in these vessels, the possibility of malfunctions or technical complications that may result in catastrophic outcomes remains a concern. In the event of a system malfunction, an autonomous vessel may encounter a loss of navigational control, thereby jeopardising the safety of both the crew and the ship. The potential occurrence of accidents during the co-navigation of autonomous and manned vessels has been identified as a concern by the students. Although autonomous vessels may comply with collision regulations, they may not possess a complete comprehension of the manoeuvres executed by human navigators, who may not conform to identical regulations. Insufficient understanding could result in unforeseen collisions or perilous circumstances, despite the autonomous vessel's adherence to protocol.

Over-reliance on technology

Additionally, the excessive dependence on the system within a semi-autonomous vessel represents a possible disadvantage of this technological innovation. Over-reliance on a vessel's autonomous functionalities by navigators could potentially result in the disregard of crucial data or inadequate response to unanticipated circumstances. The excessive dependence on navigation systems may lead to incidents that could have been prevented had the navigators exercised greater attentiveness. In summary, it is crucial to consider and mitigate the limitations of self-governing vessels, as emphasised by scholars, in light of technological advancements. As the frequency of these vessels increases, it is crucial to address the potential hazards associated with their utilisation and establish adequate safety protocols to avert mishaps and guarantee the well-being of crew members and other vessels in the proximity.

THE IMPACT ON MARITIME EMPLOYMENT

Reduce job security onboard ship

The findings of the interview suggest that a considerable proportion of the students hold the view that the advent of autonomous vessels would have an adverse impact on the opportunities for maritime labour. The participants conveyed apprehension regarding the prospective instability of their employment, particularly in light of the uncertain trajectory of the future. The deployment of autonomous ships may lead to a potential decrease in the demand for seafarers to operate the vessels.

Increase jobs in other areas

Notwithstanding, certain students hold the viewpoint that the implementation of novel technologies such as artificial intelligence and software engineering, which are imperative for the operation of autonomous vessels, may give rise to novel job prospects. From their perspective, the issue at hand pertains to the willingness to engage in the exploration of novel prospects and undertaking measured risks. In general, the outcomes of the interview indicate a notable level of ambiguity and apprehension among students concerning the probable influence of autonomous vessels on maritime labour. While a portion of students express optimism regarding the potential for emerging technological fields to generate employment opportunities, a larger proportion harbour apprehensions regarding the possibility of job displacement.

The potential impact of autonomous ships on the maritime industry is yet to be determined. However, it is evident that these matters will require vigilant observation and resolution in the forthcoming years. The findings underscore the significance of furnishing seafarers with pertinent educational and training prospects, which can equip them for potential employment prospects that may surface with the advent of autonomous vessels. Providing seafarers with adequate knowledge and skills in emerging fields such as artificial intelligence and software development is imperative, as it has the potential to generate novel employment prospects. Through this approach, maritime professionals can enhance their competitiveness in the labour market and explore alternative career trajectories congruent with their aptitudes and passions. The provision of educational resources and training opportunities can aid in maintaining the preparedness of seafarers for the evolving employment landscape within the maritime sector.

CHALLENGE AND LIMITATION

Safety and Security

The students' prioritisation of implementing suitable measures to tackle potential safety and security concerns is indicative of their conscientious approach towards the integration of autonomous technology within the maritime sector. Although the idea of enhanced efficacy and decreased expenses linked with automation may appear alluring, the potential hazards associated with this novel technology must not be disregarded. An area of significant interest pertains to the upkeep of self-governing vessels, which may necessitate an alternative methodology compared to the conventional approach adopted for crewed ships.

Ship maintenance

The students express a keen interest in delving deeper into the operational procedures of these vessels, particularly with regard to conventional techniques for corrosion prevention, such as chipping and painting, as well as the replacement of lubricants and spare parts. Inadequate maintenance of autonomous vessels may lead to compromised operational safety, thereby posing a risk to the security of both the vessel and its cargo. The students also highlight the significance of addressing cyber security threats as a crucial matter. With the growing dependence of the maritime sector on technology, it is also exposed to heightened susceptibility to cyber threats. The possibility exists for hackers to gain unauthorised access to an autonomous vessel, thereby jeopardising the safety of the ship, cargo, and surrounding ecosystem. Hence, it is imperative to implement measures aimed at safeguarding these vessels from potential cyber threats. In summary, the student posits that prudence is necessary, although the potential for self-governing technology in the maritime sector appears encouraging.

Additional investigation and advancement are imperative to guarantee the safe and secure management of these systems. The maritime industry can optimise the benefits of autonomous technology while ensuring the safety of human lives and cargo by addressing maintenance and cyber security concerns. In the end, this will enable the industry to attain the advantages of automation while upholding a conscientious stance towards technological advancement.

THE FACTORS THAT TRIGGER THE DEVELOPMENT OF AUTONOMOUS SHIPS.

Influence by unmanned road vehicle

The students suggest that the autonomous vessel was potentially influenced by the development of autonomous automobiles and other self-driving modes of transportation, and their assertion holds some degree of validity. The principal objective of autonomous vehicles is to diminish the human labour force and enhance efficacy. Autonomous vehicles are engineered to function without human intervention, thereby diminishing the necessity of humans for navigation operations.

Influence by green shipping concept

Notwithstanding, certain students contend that the autonomous vessel was devised to address ecological concerns. The MV Yara Birkland is cited as an instance of an autonomous vessel specifically engineered to mitigate carbon emissions. The implementation of carbon reduction strategies, including but not limited to optimisation, electrification, and decarbonisation, is imperative in order to effectively alleviate the consequences of climate change. The implementation of batteries in the MV Yara Birkland aligns with a key objective of the decarbonisation strategy, namely the transition towards electric power as a primary energy source. Electricity can be produced using renewable sources such as solar, wind turbines, and hydroelectric plants, which are considered more ecologically sustainable than diesel engines that release harmful emissions such as carbon dioxide.

Ship owners looking for methods to increase cargo capacity

An additional benefit of minimising the human presence on board is the expansion of the cargo transportation capability. The removal of the structure necessary for human habitation on a vessel can result in a decrease in displacement and an increase in the cargo capacity of said vessel. The decrease in human presence aboard the vessel leads to the elimination of necessary resources such as sustenance, hydration, and medical aid, resulting in an additional reduction in weight.

In summary, the perspectives of students regarding autonomous vessels are characterised by a dichotomy between the reduction of human labour and the resolution of environmental concerns. Autonomous vessels were originally conceived with the aim of minimising human labour; however, the technology is presently advancing to integrate eco-friendly characteristics. The MV Yara Birkland exemplifies an autonomous vessel that integrates both components. The adoption of electric energy sources and the minimisation of human presence aboard vessels are crucial determinants in mitigating carbon emissions and augmenting cargo transportation capability.

5.0 CONCLUSIONS

It is noteworthy to emphasise that the participants in this study were students of the rating programme who lacked any prior experience in working aboard a ship. Hence, it can be predicted that their perceptions are constrained by their comprehension of in-class learning. The study demonstrated while some students possessed a good comprehension of the notion of autonomous vessels, the remaining students conveyed a requirement for additional educational materials.

To them, autonomous ships offer several advantages, such as enhanced safety, decreased reliance on human force, and maintenance of consistency in vessel navigation and movement. Advocates of autonomous ships argue that these types of vessels possess the capability to alleviate risks associated with human error in navigation. The advantages of autonomous vessels, including safety and cost minimisation, were observed to elicit diverse perspectives among the students. Notwithstanding, the individuals also conveyed concerns with respect to the possibility of a system malfunction in autonomous vessels, as well as the potential dangers of navigators excessively relying on the system.

The possibility of system failure is regarded as a potential drawback of autonomous vessels. The possibility of malfunctions or technical complications in autonomous vessels continues to be a matter of concern. Furthermore, an overreliance on the semi-autonomous vessel's system may result in preventable incidents if the navigators had exercised more attentiveness. In view of technological advancements, it is imperative to address and alleviate the constraints of autonomous vessels while implementing sufficient safety measures to prevent accidents and ensure the safety of crew members and nearby vessels. The results of the interview revealed that there exists a certain degree of uncertainty and unease among students with regard to the potential impact of autonomous vessels on the maritime workforce.

While a certain segment of the population holds a positive outlook, a greater proportion maintains concerns regarding the potential for job displacement. The results emphasise the significance of providing relevant educational and training opportunities to seafarers in order to prepare them for potential employment opportunities. The conscientious approach of students towards the integration of autonomous technology within the maritime sector is reflected in their prioritisation of implementing appropriate measures to address potential safety and security concerns. The student posits that the advancement of autonomous automobiles and other self-driving transportation modalities potentially impacted the emergence of autonomous ships. The primary aim of autonomous vehicles is to reduce the need for human labour and improve efficiency, as they are designed to operate without human intervention.

The implementation of this approach would allow the industry to leverage the benefits of automation while maintaining a responsible attitude towards technological progress. The MV Yara Birkland represents a paradigmatic instance of an autonomous watercraft that has been meticulously designed to address the issue of carbon emissions reduction. The effective mitigation of the impacts of climate change necessitates the adoption of carbon reduction strategies, including but not limited to optimisation, electrification, and decarbonisation. Furthermore, the reduction of human presence on board has the potential to enhance cargo transportation capacity and decrease overall weight. The original purpose of autonomous vessels was to reduce human labour; however, recent technological advancements have enabled the integration of environmentally sustainable features.

REFERENCES

Alvarado, S., Kanter-Braem, B., Manz, K., Masciopinto, P., McKenna, E., Nelson, D., Williams, C., & Korek, K. (2011). Sensation and perception: a unit lesson plan for high school psychology teachers. *National Standards for High School Psychology Curricula*, 1–46. https://www.apa.org/ed/precollege/topss/lessons/sensation.pdf

Ayob, A. F., Jalal, N. I., Hassri, M. H., Rahman, S. A., & Jamaludin, S. (2020). Neuroevolutionary autonomous surface vehicle simulation in restricted waters. *TransNav*, *14*(4), 865–873. https://doi.org/10.12716/1001.14.04.11

Boyce, C., & Neale, P. (2006). CONDUCTING IN-DEPTHINTERVIEWS: A Guide for Designing and Conducting Interviews for Evaluation Input. PATHFINDER International Tool Series, Monitoring and Evaluation-2, May 2006. *Attachment and Human Development*, *May* 2–12.

Fan, C., Wróbel, K., Montewka, J., Gil, M., Wan, C., & Zhang, D. (2020). A framework to identify factors influencing navigational risk for Maritime Autonomous Surface Ships. *Ocean Engineering*, *202*(February). https://doi.org/10.1016/j.oceaneng.2020.107188

IBM. (2022). *AI-Powered Automation - Mayflower Autonomous Ship*. https://www.ibm.com/cloud/automation/mayflower-autonomous-ship

IMO. (2021). *Outcome of the Regulatory Scoping Exercise for the Use of Maritime Autonomous Surface Ships (Mass)*. MSC.1/Circ.1638. https://wwwcdn.imo.org/localresources/en/MediaCentre/PressBriefings/Documents/MSC.1-Circ.1638 - Outcome Of The Regulatory Scoping ExerciseFor The Use Of Maritime Autonomous Surface Ships... (Secretariat).pdf

Jeong, M. G., Lee, E. B., Lee, M., & Jung, J. Y. (2019). Multi-criteria route planning with risk contour map for smart navigation. *Ocean Engineering*, *172*(August 2018), 72–85. https://doi.org/10.1016/j.oceaneng.2018.11.050

Kamis, A. S., & Fuad, A. F. A. (2022). *A Comparison Study between Advance Transfer Technique and Advance Transfer Mathematical Model Using Bulk Carrier Ship : Cross-track Distance Validation by Percentage Change and Mann Whitney U Test*. *16*(3), 541–551. https://doi.org/10.12716/1001.16.03.17

Lazarowska, A. (2019). Research on algorithms for autonomous navigation of ships. *WMU Journal of Maritime Affairs*, *18*(2), 341–358. https://doi.org/10.1007/s13437-019-00172-0

Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic Analysis: Striving to Meet the Trustworthiness Criteria. *International Journal of Qualitative Methods*, *16*(1), 1–13. https://doi.org/10.1177/1609406917733847

Rolls-Royce. (2016). *Autonomous Ships : The Next Step*. Marine Ship Intelligence. https://www.rolls-royce.com/~/media/Files/R/Rolls-Royce/documents/customers/marine/ship-intel/rr-ship-intel-aawa-8pg.pdf

Skredderberget, A. (2023). *Yara Birkeland: The first zero-emission, autonomous ship*. https://www.yara.com/knowledge-grows/game-changer-for-the-environment/