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WHITE BLACK LEGAL is an open access, peer-reviewed and refereed journal provided dedicated to express views on topical legal issues, thereby generating a cross current of ideas on emerging matters. This platform shall also ignite the initiative and desire of young law students to contribute in the field of law. The erudite response of legal luminaries shall be solicited to enable readers to explore challenges that lie before law makers, lawyers and the society at large, in the event of the ever changing social, economic and technological scenario.

With this thought, we hereby present to you

AUTONOMOUS SHIPPING: A REVOLUTION IN LOGISTICS AND SUPPLY CHAIN MANAGEMENT

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ABSTRACT

The introduction of autonomous ships and vessels marks a significant turning point in the maritime industry¹. While these innovative technologies offer numerous benefits such as increased efficiency, reduced human error, and lower operational costs, they also pose challenges and raise legal issues. This paper examines the legal framework surrounding autonomous ships and vessels, focusing on international maritime law and the various conventions, treaties, and regulations that govern their use. The paper analyzes the current state of the law and identifies areas that require further development to ensure the safe and effective use of autonomous ships and vessels.

The introduction of autonomous ships and vessels marks a very important development in the maritime industry, with the potential to revolutionize the sector. While these innovative technologies offer numerous benefits such as increased efficiency, reduced human error, and lower operational costs, they also raise legal issues and challenges. This paper provides an overview of the legal framework² surrounding autonomous ships and vessels, focusing on international maritime law. The paper mainly focuses on the history and origin of these autonomous ships and vessels in the maritime law, how it impacts on the economy more specifically (called as the Blue economy). The paper also intends to highlight the advantages, disadvantages, the necessity, hinderances and other aspects of the topic. The paper examines the

¹ unctad.org. (2022). Maritime Autonomous Surface Ships: A critical 'MASS' for legislative review | UNCTAD. [online] Available at: <https://unctad.org/news/transport-newsletter-article-no-97-fourth-quarter-2022#:~:text=According%20to%20the%20IMO%2C%20%22Maritime> [Accessed 19 Mar. 2023].

² ec.europa.eu. (n.d.). Documents download module. [online] Available at: <https://ec.europa.eu/research/participants/documents/downloadPublic?documentIds=080166e5cab1a5bc&appId=PGMS> [Accessed 19 Mar. 2023].

current state of the law and identifies areas that require further development to ensure the safe and effective use of autonomous ships and vessels. Legal issues such as liability, compliance with international maritime law, and insurance are also discussed. In this paper, the author also intends to present the future course of action for the smooth transition which will eventually bring about a change in the dynamics of international maritime law.

INTRODUCTION

Autonomous ships, also known as unmanned ships or crewless ships³, are vessels that operate without direct human intervention. The development of autonomous ships is expected to revolutionize the shipping industry, offering numerous benefits, such as increased safety, improved efficiency, and reduced costs. However, the emergence of autonomous ships also raises legal and regulatory issues, particularly in the context of maritime law both internationally and locally. This research paper explores the legal framework for autonomous ships in maritime law and the challenges associated with regulating these vessels.

Various methods and levels of autonomy can be achieved through monitoring and remote control from a nearby manned ship, an onshore control unit, or artificial intelligence and machine learning, enabling the vessel to decide the course of action.

LITERATURE REVIEW

The maritime industry has always been a sector where innovation and cutting-edge technology find application, and the need for increased efficiency and operational safety has led to the development of various levels of automation both on board vessels and ashore. Examples include, among others, situational awareness sensors, autonomous navigation systems, off-ship communication technologies, and robotics.

Various books like ‘Autonomous Ships and the Law (IMLI Studies in International Maritime Law)’ by ‘Henrik Ringbom’⁴ focusing on maritime law stress on the argument that elimination of the human element might significantly reduce the possibility of human error, but at the same time it also opens a Pandora’s box of other risks. From the simplest malfunction, such as power

³ Parikh, S. (2020). Autonomous Shipping - How do autonomous ships work? | Orderhive. [online] Cin7 Orderhive. Available at: <https://www.orderhive.com/blog/autonomous-shipping>.

⁴ Amazon.in. (2023). Autonomous Ships and the Law (IMLI Studies in International Maritime Law) : Ringbom, Henrik, Røsæg, Erik, Solvang, Trond: Amazon.in: Books. [online] Available at: <https://www.amazon.in/Autonomous-Ships-Studies-International-Maritime/dp/0367467100> [Accessed 19 Mar. 2023].

failures, to more menacing ones, such as cyber/radio frequency/satellite attacks, automated systems have their own weak spots. This being said the book doesn't talk about the impact of the emergence of artificial intelligence and how it can be incorporated in the maritime industry.

Articles like 'Problems Affecting Seafarers Today'⁵ by a noted writer by Mahendra Singh talk about how the economy from the maritime industry often called as 'Blue economy' is blooming and emerging. At the same time, they highlight the issues of human error, rising costs, operational inefficiencies, environmental issues but none of sources mention anything about how these issues can be tackled let alone the introduction of autonomous ships and vessels.

Various books, literary sources, articles, research papers and blogs are used as supplementary sources from which ideas, clues are taken into account talk about the problems and issues in general but none of them have given concrete solutions and answers to the questions raised.

STATEMENT OF PROBLEM

There are various challenges faced by the shipping industry, including safety concerns, operational inefficiencies, and rising costs which need immediate attention for safeguarding the maritime industry and maritime law.

Human error is a leading cause of accidents in the shipping industry and immediate measures are to be taken in order to mitigate the damages to both property and life. Secondly, improving efficiency and reducing costs are issues prevalent in this industry. These vessels cannot operate 24/7, the need for crew changes, breaks, or rest periods take up a lot of time. Need for faster delivery times, reduced downtime, and lower operating costs are areas of concern. Improving fuel efficiency, leading to lower emissions and reduced environmental impact is also a major area of focus in contemporary times.

OBJECTIVES

- i. The objectives of this research paper are to understand the need for autonomous ships in the maritime industry and also tends to look at the aftermath of the topic of discussion.

⁵ Mahendra Singh (2019). 10 Problems Affecting Seafarers Today. [online] Marine Insight. Available at: <https://www.marineinsight.com/life-at-sea/5-problems-affecting-seafarers-today/>.

- ii. The author shall address the problems in the maritime industry like human errors, mitigation of damages, improving safety, reducing costs, increasing efficiency, and addressing labor shortages and how the introduction of autonomous ships will address the issues mentioned above.
- iii. The use of these vessels also poses several challenges that must be addressed, including legal, ethical, and technical issues. The author intends to highlight these issues and come with possible solutions.

A comprehensive regulatory framework that addresses these issues to ensure that the use of autonomous ships is safe, sustainable, and beneficial to the shipping industry and society as a whole is also necessary.

SCOPE

Artificial intelligence (AI) has emerged as one of the most significant technological developments in contemporary times. AI refers to the ability of machines and computer systems to perform tasks that typically require human intelligence, such as learning, problem-solving, and decision-making.

The emergence and scope of AI (artificial intelligence) in contemporary times has significant implications for a wide range of industries and applications. While it presents several challenges, the potential benefits of AI in terms of efficiency, productivity, and innovation make it an essential area of development for all nations in the world.

The scope of the research limits itself to emergence of autonomous ships is a relatively recent development in the shipping industry, and more importantly focuses on the practicality of the subject of discussion. It examines the subject with respect to legal implications with a limited exposure of international maritime law. It also limits itself to problems and issues which appear on the face of it, specially to a public citizen. There may be various ground level technical complications and implications which does not fall under the scope of the research paper.

Companies and organizations are developing autonomous ships for various applications, such as cargo transportation, research, and military operations. For example, the U.S. Navy is developing

autonomous vessels for mine-hunting and anti-submarine warfare operations⁶. However, the adoption of autonomous ships is still in its early stages, and there are several challenges that must be addressed before these vessels can become mainstream in the shipping industry. These challenges include regulatory and legal frameworks, cybersecurity, and ethical considerations, among others, high costs, low efficiency and lack of safety.

HYPOTHESIS

Maritime industry is one of the most important and one among the fastest developing and growing industries in the world. This industry provides us a plethora of opportunities. Blue economy is a concept which is of great importance nowadays, due to which many countries are willing to spend huge amounts of resources for the it.

The Blue Economy⁷ encompasses a wide range of economic activities and sectors, including fisheries and aquaculture, tourism, maritime transport, renewable energy, biotechnology, and seabed mining. These sectors offer significant opportunities for economic growth and job creation, particularly in developing countries with large coastal areas. This being said, there are numerous problems and issues that need to be resolved- human errors, mitigation of damages, improving safety, reducing costs, increasing efficiency, and addressing labor shortages.

The author feels that the introduction of autonomous ships will be beneficial in addressing the issues mentioned above. With the growing importance of artificial intelligence, it is high time to make use of these to our benefit. The author feels that these autonomous vessels can operate in a more streamlined and optimized manner, reducing the risk of collisions and other accidents and giving no room or very less room for human error. Potential to increase efficiency and reduce costs in the shipping industry, faster delivery times and lower operating costs are some other issues which could be solved by the introduction of these autonomous ships.

⁶ Uppal, R. (n.d.). Mine Countermeasures (MCM) capability on AUV and Unmanned Surface Vehicles (USV) for Anti-Submarine Warfare (ASW) , Surface Warfare (SUW) , and counter terrorism missions. [online] International Defense Security & Technology. Available at: <https://idstch.com/military/navy/mine-countermeasures-mcm-capability-on-auv-and-unmanned-surface-vehicles-usv-for-anti-submarine-warfare-asw-surface-warfare-suw-and-counter-terrorism-missions/> [Accessed 19 Mar. 2023].

⁷ World Bank (2017). What is the Blue Economy? [online] World Bank. Available at: <https://www.worldbank.org/en/news/infographic/2017/06/06/blue-economy>.

QUESTIONS

- What is the need for these autonomous ships and vessels?
- What are the advantages and disadvantages of these autonomous ships and vessels?
- What are the jurisdictional and legal implications?
- What are the problems with the introduction of these autonomous ships and vessels?

INTRODUCTION

Autonomous ships and vessels in the maritime industry are vessels that are capable of operating without human intervention and human control. They are equipped with advanced sensors, navigation systems, and communication technologies that allow them to navigate, maneuver, and perform other tasks without the need for human intervention.

Autonomous ships and vessels are designed to improve safety, efficiency, and cost-effectiveness in the maritime industry. They can operate in a wide range of conditions and environments, including remote or hazardous areas where it may be difficult or dangerous for humans to work.

Overall, the development of autonomous ships and vessels in the maritime industry represents a significant opportunity for innovation and growth⁸, but it must be managed in a responsible and sustainable manner to ensure safety, efficiency, and environmental protection.

HISTORY AND ORIGIN

The concept of autonomous vessels and ships in the maritime industry has been around for several decades, but it has only recently become a reality with advancements in technology.

The first remotely controlled ship was developed in the 1950s by the United States Navy. It was called the "Controlled Drone Ship" and was used for target practice by naval gunners. However, this was not a fully autonomous vessel, as it required a human operator to control it remotely.

The first fully autonomous vessel, the "Mayflower Autonomous Ship"⁹, was developed by the Plymouth-based marine research organization ProMare and its technology partner IBM in 2020. It set sail from Plymouth, England, and crossed the Atlantic Ocean to Plymouth, Massachusetts,

⁸ Thetius. (2021). How will AI impact Maritime Law? [online] Available at: <https://thetius.com/how-will-ai-impact-maritime-law/>.

⁹ IBM Newsroom. (n.d.). IBM Newsroom - The Mayflower Autonomous Ship Project. [online] Available at: <https://newsroom.ibm.com/then-and-now> [Accessed 19 Mar. 2023].

in the United States, without any human intervention.

Today, autonomous vessels are being developed and tested by several companies and organizations worldwide, including Rolls-Royce¹⁰, Kongsberg Maritime, and Sea Machines Robotics. These autonomous ships are equipped with sensors, cameras, and other technologies that allow them to navigate and operate without human intervention.

NEED AND ADVANTAGES

There are several needs and advantages of autonomous ships and vessels in the maritime industry. Some of the most important ones are:

- 1) **Safety:** Autonomous ships can reduce the risk of accidents and human error. They can be equipped with advanced sensors and algorithms to detect and avoid obstacles, other ships, and hazardous weather conditions, making maritime transportation safer for crew members and cargo.
- 2) **Efficiency:** Autonomous ships can operate continuously and with greater precision than human-operated vessels. They can optimize routes, speed, and fuel consumption, leading to cost savings and reducing greenhouse gas emissions.
- 3) **Cost savings:** Autonomous ships can reduce labor costs¹¹, as they do not require crew members to operate them. They can also reduce maintenance costs, as they can detect and diagnose problems before they become significant issues, reducing time and repair costs.
- 4) **Capacity:** Autonomous ships can operate 24/7, increasing the capacity of the maritime industry and reducing the time required for cargo transportation.
- 5) **Innovation:** Autonomous ships provide opportunities for innovation and technological advancement in the maritime industry¹². They can be equipped with advanced

¹⁰ Autonomous shipping is the way forward in the maritime industry with Rolls-Royce leading the way in its development Autonomous ships The next step. (n.d.). Available at: <https://www.rolls-royce.com/~media/Files/R/Rolls-Royce/documents/%20customers/marine/ship-intel/rr-ship-intel-aawa-8pg.pdf>.

¹¹ Team, M. and Team, M. (2021). Key Advantages of Autonomous Shipping. [online] mfame.guru. Available at: <https://mfame.guru/how-autonomous-shipping-can-change-the-maritime-industry/>.

¹² Tsvetkova, A. and Hellström, M. (2022). Creating value through autonomous shipping: an ecosystem perspective. Maritime Economics & Logistics.

technologies such as artificial intelligence, machine learning, and big data analytics, leading to improved decision-making, safety, and efficiency.

- 6) Remote operation: Autonomous ships can be remotely operated from onshore control centers, reducing the need for crew members to be on board, and enabling greater flexibility and scalability in the maritime industry.

Overall, the introduction of autonomous ships and vessels has the potential to revolutionize the maritime industry, making it safer, more efficient, and cost-effective. However, there are also challenges that need to be addressed, such as regulatory and technical issues, before the technology can be fully integrated into the industry.

DRAWBACKS AND DISADVANTAGES

While there are several advantages to autonomous ships and vessels in the maritime industry, there are also some potential disadvantages that need to be considered. Some of the most significant ones are:

- 1) Security risks: Autonomous ships and vessels can be vulnerable to cyber-attacks, which can compromise their safety and operation. This risk can increase as more systems become connected and automated, and there is a need for robust cybersecurity measures.
- 2) Reduced employment: The introduction of autonomous ships and vessels can lead to a reduction in employment opportunities¹³ for crew members, particularly for low-skilled positions. This could have social and economic implications for maritime communities that rely on the industry for employment.
- 3) Technological limitations: The technology required for autonomous ships and vessels is still in its early stages of development. There may be limitations in terms of reliability, safety, and performance, which could lead to unexpected issues or downtime.

¹³ Marine, U. (2022). Autonomous Ships! Is It the End Game for Seafarers? [online] UNITEAM MARINE. Available at: <https://www.uniteammarine.com/autonomous-ships-is-it-the-end-game-for-seafarers/> [Accessed 19 Mar. 2023].

- 4) Regulatory challenges: There are several legal and regulatory challenges associated with the introduction of autonomous ships and vessels, including the need for new safety standards and regulations that address issues such as liability and responsibility in the event of an accident.

Overall, while the benefits of autonomous ships and vessels are significant, there are also potential challenges and risks that need to be addressed. The industry will need to work collaboratively with governments, technology providers, and other stakeholders to ensure that the technology is safe, reliable, and sustainable.

TYPES

There are several types of autonomous ships and vessels in the maritime industry. Here are some of the most common types:

- 1) Remotely Operated Vehicles (ROVs)¹⁴: ROVs are tethered unmanned underwater vehicles that are operated remotely by human operators on a surface vessel or onshore. They are commonly used in offshore oil and gas exploration, scientific research, and underwater inspections and repairs.
- 2) Unmanned Surface Vessels (USVs): USVs¹⁵ are unmanned surface vehicles that operate on the surface of the water. They are commonly used for oceanographic research, marine surveillance and monitoring, and military applications such as mine countermeasures.
- 3) Autonomous Underwater Vehicles¹⁶ (AUVs): AUVs are unmanned underwater vehicles that are capable of operating autonomously without human intervention. They are used for a wide range of applications, such as underwater surveys, oceanographic research, and environmental monitoring.

¹⁴ Menon, A. (2022). What is Remotely Operated Underwater Vehicle (ROV)? [online] Marine Insight. Available at: <https://www.marineinsight.com/tech/what-is-remotely-operated-underwater-vehicle-rov/#:~:text=1,-> [Accessed 19 Mar. 2023].

¹⁵ oceanexplorer.noaa.gov. (n.d.). Uncrewed Surface Vessels. [online] Available at: <https://oceanexplorer.noaa.gov/technology/usv/usv.html>.

¹⁶ <https://www.whoi.edu/>. (n.d.). AUVs - Woods Hole Oceanographic Institution. [online] Available at: <https://www.whoi.edu/what-we-do/explore/underwater-vehicles/auvs/>.

- 4) **Autonomous Cargo Ships:** Autonomous cargo ships are unmanned vessels that are capable of transporting goods without human intervention. They are being developed to improve efficiency and reduce the cost of maritime transportation.
- 5) **Autonomous Passenger Ferries:** Autonomous passenger ferries are unmanned vessels that are capable of transporting passengers without human intervention. They are being developed to improve safety and reduce operating costs in the passenger transportation industry.

Each type of autonomous ship and vessel has specific capabilities and applications, and they are being developed to address specific challenges and opportunities in the maritime industry.

PROBLEMS AND HINDERENCES

- 1) **Safety concerns:** Autonomous ships and vessels must be able to operate safely, especially in busy shipping lanes and congested ports. There are concerns that the technology may not be reliable enough to handle all the situations that may arise in the unpredictable ocean environment.
- 2) **Cybersecurity risks:** As autonomous ships and vessels become more connected and reliant on technology, they may become more vulnerable to cyber threats. This could potentially lead to the loss of control of the ship, causing accidents or putting cargo and crew members at risk.
- 3) **Ethical considerations:** The use of autonomous ships and vessels raises ethical questions about the role of humans in the industry and the potential impacts on local communities and economies. For example, the introduction of autonomous ships may lead to job losses and displacement of workers.
- 4) **High upfront costs:** The development and implementation of autonomous ships and vessels can be expensive, particularly for smaller shipping companies that may not have the resources to invest in the technology.

LEGAL FRAMEWORK, ENFORCEMENT AND JURISDICTION

The rise of autonomous ships and vessels presents significant challenges in terms of jurisdiction and legal responsibility. With no human operators on board, determining who is responsible for the actions of the vessel becomes a complex and multi-faceted issue.

Jurisdictional issues arise when an incident occurs involving an autonomous ship or vessel. Who has jurisdiction over the incident, and which laws should be applied? Should the laws of the flag state, the port state, or the state of the accident apply? These are some of the questions that need to be answered to determine the legal responsibility in the event of an incident.

One of the main challenges with jurisdictional issues is that there is no international legal framework that specifically addresses autonomous ships and vessels. The current legal framework for shipping is based on the United Nations Convention on the Law of the Sea (UNCLOS)¹⁷, which was adopted in 1982. However, UNCLOS does not explicitly address autonomous ships and vessels, leaving a gap in the legal framework.

The International Maritime Organization (IMO), the United Nations agency responsible for maritime safety and security, has recognized the need to address the legal issues surrounding autonomous ships and vessels. In 2017, the IMO adopted guidelines on the trials of autonomous ships¹⁸, which set out the requirements for the testing and development of autonomous ships. The guidelines encourage member states to ensure that their domestic legal frameworks are adequate to address the issues arising from autonomous ships and vessels.

However, the guidelines are not legally binding, and there is no international agreement on the legal framework for autonomous ships and vessels. This leaves shipping companies and other stakeholders in a legal limbo, uncertain about their legal responsibilities and liabilities in the event of an incident involving an autonomous ship or vessel. The lack of a clear legal framework also creates challenges for insurers and the insurance industry. Insurers need to assess the risk associated with autonomous ships and vessels and determine the level of coverage required. However, without a clear legal framework, insurers may find it difficult to determine the legal

¹⁷ Jus.uio.no. (2019). United Nations Convention on the Law of the Sea (UNCLOS) - The Faculty of Law. [online] Available at: <https://www.jus.uio.no/english/services/library/treaties/08/8-01/unclos.xml>.

¹⁸ <https://www.rivieramm.com/news-content-hub/news-content-hub/imo-outlines-autonomous-ship-trial-guidelines-55664>

liability in the event of an incident, making it challenging to calculate premiums and provide coverage.

The issue of jurisdictional issues is further complicated by the fact that different countries have different laws and regulations regarding autonomous ships and vessels. Some countries, such as Norway and Finland, have already granted permission for autonomous ships to operate¹⁹ in their waters, while others have not.

To address this challenge, there is a need for a coordinated effort to establish a clear and comprehensive legal framework that addresses the unique challenges associated with autonomous ships and vessels. This framework should include guidelines and standards for the design, construction, and operation of autonomous ships and vessels, as well as clear rules and regulations for their safe and efficient operation.

CONCLUSION

The implementation of an autonomous vessel will provide the opportunity to increase the efficiency of ship operation as well as enhance the sustainability, which is the greatest driver in any industry (United Nations, 2008). The construction of autonomous ships and vessels would change this situation, creating a better, more profitable and, hopefully, safer shipping market. Development of autonomous ships and vessels project will offer a wide-ranging solution to meet the main challenges of the maritime transport industry by decreasing the operational costs, giving less room for human error, protect us from damage of property and life, making it possible to navigate through harsh climatic factors, making it extremely environmental friendly and therefore being eco- friendly.

The implementation of the autonomous ship concept on a mass scale will have a huge impact on the efficiency of the industry, human resource management, and accident prevention. The benefits of environmental protection are also important. This being said there are numerous challenges in this path, some of them being huge first hand investment, safety concerns, cyber-security concerns and among others, but it is indeed high time to change our maritime procedures and

¹⁹ HPP Asianajotoimisto. (2019). Autonomous Shipping and Liability from a Finnish Perspective. [online] Available at: <https://www.hpp.fi/en/blog/autonomous-shipping-and-liability-from-a-finnish-perspective/> [Accessed 19 Mar. 2023].

standards with our ever changing environment, exponential growth of artificial intelligence, data analytics and machine learning.

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