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The Impact of Inadequate Maritime Conventions on Implementing Autonomous Ship Technology

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المستخلص
توضح هذه الورقة كيف تمثل الاتفاقيات البحرية الدولية الحالية عقبة في طريق تنفيذ تكنولوجيا الحديثة المتمثلة في السفن المسيرة ذاتيا . الاتفاقيات واللوائح التي تم التأكيد عليها في هذه الورقة هي MLC SOLAS , STCW, وكيف يمكن أن تخلق عوائق أمام قرار الاستثمار الإيجابي. بالإضافة إلى اعاقه أصحاب السفن عن تكييف هذه التكنولوجيا الجديدة. مع وضع هذه النتائج في الاعتبار تمت مناقشة الاقتراحات بدقة التي من شأنها قد تساعد في التغلب على المشاكل المحددة.
الهدف الرئيسي من هذه الورقة هو التحقيق فيما إذا كانت التكنولوجيا المطبقة حديثًا سيكون لها تأثير إيجابي على تطور النقل البحري وكذلك تحسين سلامة السفن ، ومدى فعالية المعاهدات والاتفاقيات البحرية الدولية بشأن التعامل مع مثل هذه التكنولوجيا و مقترحات لتعديل هذه الاتفاقيات لعمل هذه السفن ضمن نطاق آمن.
اعتمد البحث على منهجيات وصفية ،تحليلية وتناقضيه.

الكلمات الدالة: سفن بدون طاقم ، السفن المسيرة ذاتيا ،SOLAS, STCW

Abstract
This paper illustrates how the current international maritime conventions presents an obstacle in the path of implementing the new autonomous ship technology. The conventions and regulations that has been emphasized in this paper are SOLAS, STCW, and MLC and how they would create impediments to a positive investment decision. In addition to discouraging ship-owners from adapting this new technology. Putting these findings into consideration, suggestions has been discussed thoroughly that would help overcoming the problems identified.

The main aim of this paper is to investigate whether the newly implemented technology will have a positive impact on evolving the sea transportation as well as improving the ship safety, and the extent of the effectiveness of international maritime treaties and conventions on dealing with such technology and proposals to amend these conventions for the work of these ships within a safe scope. The research depends on descriptive, analytical, and contradictive methodologies.

Keywords: Unmanned ship، Autonomous ship, SOLAS, STCW.

1. Introduction

In recent years, the idea of an autonomous ship has had a significant impact. The EU's funding of the Maritime Unmanned Navigation through Intelligence in Networks (MUNIN) initiative has impressively raised awareness about the potential for a new era in global trade. The main idea behind this project is to provide autonomous ships the ability to make decisions while still being under the direction of a shore-based operator (LR, 2017).

The Finnish Funding Agency for Technology and Innovation supported a partnership led by Rolls-Royce to study the economic, social, legal, regulatory, and technological aspects of autonomous ships in addition to MUNIN's focus on the unmanned ship idea. This initiative also centers on allowing ships to make navigational decisions under the guidance of experts ashore (Unmanned-ship, 2017).

The International Maritime Organization (IMO) has developed rules for assessing the risks to maritime safety posed by autonomous vessels in recent years. A thorough evaluation is necessary to arising the risks that are influenced by the operation when these unmanned ships emerge, since the implementation of the unmanned vessel design will undoubtedly be advantageous to the future growth of technology. An additional IMO E-Navigation concept proposal calls for the Automatic Identification System (AIS) to be expanded to include ships, as well as to display ships' intended paths to the Shore Command Center (SCC) or other reception facilities. The development of the Artificial Intelligence Components (AIC) of unmanned shipping will undoubtedly greatly benefit from this service in terms of vessel interaction. The IMO should carefully consider designating ocean routes for unmanned vessels while also considering the implementation of the procedures that are similar to the traffic separation system that has been implemented in water areas with heavy traffic.

Member States shall register important ocean routes in the Exclusive Economic Zones and on the High Seas. The updated Collision Regulations allow only unmanned vessels operating in the maritime zone to use the authorized ocean routes. In order to ensure the safe operation of autonomous vessels, specific rules and regulations will be implemented in both surface and underwater environments. It is anticipated that hull designs for autonomous vehicles in the future will support both surface and submerged navigation. Thanks to its battery-powered propulsion, the autonomous watercraft is anticipated to be emission-free and reduce environmental air pollution (Wan, 2019).

For hundreds of years, the shipping industry has relied on the knowledge and expertise of ship crews. Autonomous technology is poised to revolutionise the marine industry with unmanned vessels. While larger vessel technology is still being developed, small unmanned vehicles have already started operating. The marine industry needs to embrace autonomy, understand how it will affect the sector's future, and figure out how to use it most effectively. The Maritime Autonomous Surface Ship (MASS) will have an impact on port infrastructure, including services and interfaces, ship design, and shipbuilding. Automation will change onshore aspects of shipping, including port infrastructure, cargo handling, and stowage, as well as the logistics and transportation network on land. Fast service, which enables shippers and customers to alter

dispatches and accept deliveries from this self-contained logistics transport chain on the fly, is one of the goals of the logistics sector (Lloyds Register (LR), 2017). To successfully introduce the MASS to the marine industry, stakeholders must cooperate and communicate based on shared understanding. The primary stakeholders and their relationships are shown in Figure (1). Onboard and ashore seafarers, insurance firms, cargo and bunkering companies, research institutions, universities, and training facilities are some of the stakeholders in the maritime industry.

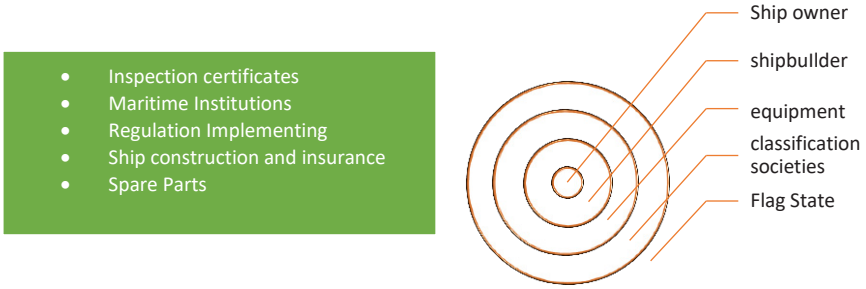

Figure 1: Marine Sector layout

This study's goal is to investigate how international treaties relate to the issue of unmanned ships, to examine the legal challenges to the development of autonomous ships and come up with solutions. The document should be consulted when revising national and international laws and regulations and when deciding whether to change current government policies in this area.

In addition, this paper presents some maritime treaties that must be changed in order to keep pace with the application of the work of automated ships, while clarifying the weaknesses in their current application to automated ships.

2. The Future of Seafarers and Manning Aspects

Globalization's impact on the maritime industry has started to be felt through the quickening pace of technological progress. The role of technology in shipping management operation is expanding however the STCW Manila 2010 safety rules have improved the sector to some extent. Maritime industry introduction of technologies like Internet of Things (IoT), Artificial Intelligence (AI), cloud computing, and blockchain will bring about some irreversible changes to the maritime sector. However, it is not yet obvious what kind of shifts the labor markets for workers will undergo. That indicates how many seafarers will be needed on board in the future, particularly in areas where unmanned ships will operate.

3. The Effect of The Unmanned Ships on The Maritime Labor Convention

There are some aspects of employing crew that are pertinent to the operation of unmanned ships. In the maritime industry, the term "seafarer" is frequently used to describe a ship's crew. The legal definition, however is more complicated than one may think. The term "seafarer" has only recently been used in international accords (ILO, 2017a, b). Most conventions use the term

"seaman." A working group identified 13 more definitions of "seafarer" in the marine labor treaties of the ILO. The definition of the crew is essential for applying the various standards to the "crew" of the Shore Command Center (SCC) because the unmanned ships are managed remotely. The MLC states that "Seafarer implies any individual who is employed or engaged or works in any capacity on board a ship to which the Convention applies" (Lielbarde, 2017).

This explains that seafarers on board the ship will be subject to the MLC. On the other hand, staff at the SCC will be able to successfully command the unmanned ships. According to the United Nations Convention on the Law of the Sea (UNCLOS) 1982, this crew will need to be skilled at navigation and seamanship. As a result, the SCC crew will assist in navigating the ship without actually being on board. This raises the question of whether SCC employees, who will be certified seafarers by all accounts, will be covered by the MLC?

4. Training and Certifications Required for Seafarers on Board Unmanned Ships

The requirements for ship's registration are primarily the responsibility of the flag state. Therefore, in order to allow unmanned ships, each flag state must modify its registration regulations. This process might not be as easy as it seems, though, because of different ships owners related to ship registration.

The UNCLOS 82 puts a number of criteria on the flag state with regard to ship registration. It is unclear if the SCC's crew will be able to fulfil the criteria as Art. 3 (b) mentions ship personnel. The same article further states that the flag state must act in relation to crew training while considering the proper international instruments. The STCW convention, which specifies minimal standards for seafarer training, certification, and watch keeping, is the most fundamental of them all. According to the STCW, seafarer training and certification require a minimum of 12 to 36 months of seagoing service. How this requirement will be met? It is presented as an intriguing question (Imo, 2017b).

In many countries, finding work for marine cadets to do seagoing service has proven difficult. Due to the arrival of unmanned ships, which cannot supply seagoing positions for maritime training, this issue will worsen as the number of positions on board decreases.

From an operational aspect, it is challenging to overcome the training challenges for a ship owner of an unmanned ship. On the one hand, the SCC will need to be manned by experienced seamen. This stipulation is made for flag states under UNCLOS. The ship won't be able to engage in international trade if this condition isn't satisfied. On the other hand, the crew will need to provide seagoing service that an unmanned ship's owner cannot to be certified.

5. Requirements for Specify Minimum Standards for the Construction, Equipment and Operation of Ships, Compatible with their Safety.

According to international convention for safe life at sea (SOLAS 74), a ship must be effectively and sufficiently manned. The convention does not, however establish the minimum number of crew members that must meet these criteria. Similar to this, UNCLOS mandates that flag state adopts all necessary safety measures, such as staffing ships, to preserve maritime security. In

accordance with UK regulations, ships with dangerous cargo must keep a safe deck watch and a safe engineering watch while in port.

From an operational perspective, ship owners are confused by the flag states' latitude on safe staffing requirements. It is more difficult to conduct business and creates barriers to entry when different jurisdictions approach safe staffing regulations in different ways. If several jurisdictions establish various manning requirements for the SCC, this problem could become worse (Carey, 2017).

6. Work Program Concern the Shipboard and Shore-Based Management

Ship owners were required to install a safety management system once the International Safety Management (ISM) Code was incorporated into SOLAS in 1994. According to Section 4 of the ISM, each Company shall designate a person or persons ashore (DPA) with direct access to the highest level of management in order to ensure the safe operation of each ship and to establish a link between the company and personnel on board. In addition to overseeing each ship's operations for safety and pollution avoidance, the authorized person or people should also make sure that there are enough resources and shore-based support available when they are required.

In the case of unmanned ships, the corporation and the crew are both housed on the same property. This could potentially enhance communication and decision-making when a safety and/or pollution prevention measure is required. In this sense, an autonomous ship may more effectively achieve the fundamental objectives of the ISM code.

7. Autonomous Ships in Terms of Seaworthiness.

The seaworthiness of the ship has a direct bearing on the owner's obligations. For instance, if a ship is fully manned, however, the operation of autonomous ships in the near future may present a problem for the aforementioned concept. The operation of autonomous ships may be carried out by computers rather than people, and crew members are no longer required to be on board, but the aforementioned theory is insufficient to address potential legal obligations resulting from on-shore ship operation and AI. Although the seaworthiness of autonomous ships is still in doubt due to the lack of a crew, the ship-owner might find it difficult to secure insurance at a fair price because the risk cannot be calculated. The ship's crew is not the only aspect of seaworthiness.

8. Master’s Role on Board Ship

The master of a ship is in charge only of the ship and is fully responsible for all matters pertaining to the ship or as mandated by laws and regulations. According to maritime law, the Master of a ship is the one in charge of all matters pertaining to the health, security, safety, and environmental protection of the ship. According to the SOLAS, the ship's master is required to perform a different task. The Master of the ship is endowed with duties, powers, responsibilities, or discretions that he must carry out or exercise for the ship's safety under international treaties and domestic law.

The Collision Regulations (COLREG), which stipulate that the action necessary for collision avoidance must be positive, done in adequate time, and with appropriate regard for excellent seamanship, may not be possible for the unmanned ship to follow. The duties and liabilities of the ship's master are transferred to SCC operators when the traditional role becomes vacant. Another issue that might have an impact on how autonomous ships operate is mandated pilotage, as different ports may have different laws or standards.

The IMO has taken on a more assertive and leadership role on MASS as a result of the recent rapid improvements in technology. To ascertain whether, where, and how unmanned ships would fit into current maritime treaties and laws, the Maritime Safety Committee (MSC) and the Legal Committee (LEG) have agreed to regulatory scoping exercises and gap analyses. In order to avoid the use of unmanned ships for illegal maritime transportation, the UN and the IMO should also look at the effects of UN sanctions and embargoes on unmanned ships.

9. Development Autonomous Surface Vessel for Search and Rescue Operations

Search and rescue operation is compulsory for all merchant ships to launched any incident or human victims in water in addition to lowering the risk of injuries and prepare recovery plans and procedures should make it simpler to transfer people from the sea to the ship. the upcoming technology for ships such autonomous ships will face more costs from tools, intelligence, surveillance and sensors on surface and deep-water to complete the search operation, to cope with MSC approved the Guidelines for the development of plans and procedures for the recovery of persons from the water. The operator at the ground station was able to monitor the sensor data and control the vessel's maneuver according to the created path.

10. Autonomous Ships is Getting Ready to Safe and Secure Distressed vessel

Before discussing the Lloyd's Standard Form of Salvage Agreement, it is a good idea to create a working understanding of salvage and salvage services. The voluntary removal of property or boats from a dangerous situation at sea is known as salvage. Services performed to effect salvage are referred to as salvage services. Salvors receive praise for their accomplishments.

The service is typically referred to as pure salvage if a salvor salvages before coming to a comprehensive understanding with the Master of the salved vessel regarding the terms of his service and the specifics of his payment. This just indicates that an admiralty court will settle the issue if the parties are unable to agree on an appropriate salvage reward following the service (Glimore ,1958).

10.1 Contract Salvage Lloyd's Standard Form of Salvage Agreement (LOF)

At this point, it would be helpful to have a fundamental understanding of the LOF concepts. The owner, master, or agent of a distressed vessel signs a LOF on behalf of the ship owner, cargo, and freight. To salvage the ship and its cargo, the salvor is required to do his "best endeavors." The contract requires the salvor to deliver the salved vessel to a secure port or anchorage. Up until a secure harbor is located, the salvage operation will continue. Owners of the salved vessel are guaranteed an early release of their property without the hassles of detention and arrest according to the form's arbitration provision. At Lloyd's, disputes are arbitrated. The salvage

contractor's award is secured by a security deposit at Lloyd's. The provision for early release is impacted by this. Last but not least, LOF was well recognized for being a no-cure-no-pay contract prior to August 1980. No-cure-no-pay is the salvage contractor's equivalent of the contingency fee arrangement used by tort lawyers: if he fails, if he doesn't save anything, he won't be compensated.

11. Survey – Mapping of the Barriers

No.	Conventions	Recommendations
1	UNCLOS	In order to establish a set of universally regarded international norms that would result in flag state and national legislation, autonomous ships should be managed by the International Maritime Organization (IMO).
2	SOLAS-STCW	State control memoranda for unmanned ship ports will need to be changed. The master role's authority, accountability, and missions with regard to port state control are replaced by the ISM Code. The IMO mandated that the lookout and officers' duty to keep watch be removed from the bridge design.
3	COLREG regulations	In the areas of safety culture, risk assessment measurement, and the precision of applying machine learning, new regulations are required. You'll need the following credentials and certificates in order to use and operate the new remote technology; The use of three-dimensional systems in the application of the maneuver with more than one decision to be taken. The responsibilities of the automated ships with bower driven vessels that are flown to it will allow the code to be changed. Using algorithms to develop a program that allows the maneuvers to be implemented safely
4	UNCLOS-MLC for manning and Seafarers	UNCLOS should be given a new scope and role, such as areas of implementing, which types of vessels that be cope with a new technology and the capabilities for the ports the deal with autonomation cycles.
5	Salvage Convention-Insurance	The IMO ought to adopt language making it quite clear that autonomous ships capable of aiding in times of need must comply by the agreement. The proposed amendment would look for technology replacements for those working on ships and hauling cargo.

Table 1: Barriers and Recommendation

12. SWOT Analysis Summaries the Developing Unmanned Shipping

Table (2): SWOT Analysis

Strengths	Opportunities
• Environmentally hazardous emissions are eliminated. • A decrease in the risk of human error and the related accidents. • Reducing fuel prices, which will aid in making up for a possible shortage of sailors. • Improving future marine transport dependability and efficiency while reducing total operating costs	• The idea of autonomous ships has gained popularity recently, and these technologies can be used to the shipping industry. •Rely on pre-programmed or self-learning algorithms to guide your judgments.
Weaknesses	**Threats**
• Work on the technology is ongoing. • There is a chance that seafarers will lose their jobs. • Unknown safety risks brought on the reliance on occasionally dubious technology. • The potential for computer hackers to seize control.	• Because the technology is still being developed, it is too soon to make a conclusion. • In order to gain acceptance of future unmanned shipping, as well as to define routes and set laws to assure their safe operation, the IMO is required. • The adoption of unmanned ships is further hampered by the current regulatory frameworks.

From the aforementioned table we pointed out that the strength and opportunities will boom within a decade ahead, since that the main aspects for the autonomous ships discuss the deduction of seafarers cost which is considered a pro for owners and investors. Therefore, all maritime sectors compete to be one of the digitalized units that make the autonomous ships more applicable. Although there are visible weakness and threats mentioned in Table (2), they no longer pose a challenge, because the maritime institutes, maritime associations and researchers are able to reach and handle a cohesive frame work to implement the autonomous ships.

13. Results

IMO should review the "Principles of Safe Manning," as adopted by IMO resolution A.890(21) and amended by resolution A.955(23), to consider the operation of Shore Command Centers and Shore-based Operators and to allow for further reductions in the number of crew on board. This is due to the rapid development of AI systems and other control technologies. These international legal frameworks won't be taken into consideration unless they are useful and functioning for the maritime sector. The uncertainty around how various jurisdictions will interpret international norms will be one of the biggest obstacles for a ship owner choosing to operate autonomous ships

According to the international regulatory system and legal precedents, seaworthiness is correlated with an adequate and qualified crew. Whether an unmanned ship may be considered seaworthy in a strict legal sense is uncertain given the current state of international maritime law. Given the aforementioned information, there are two options to consider if autonomous ships are to become a reality soon:

- The first is the utilization of the autonomous ship concept rather than an entirely unmanned design, although with a significantly reduced crew. The ability to get beyond legal restrictions is offered by this technique. Additionally, it addresses the issue of a seafarer shortage while also boosting economic sustainability by cutting staffing costs.
- The second tactic focuses on deploying the idea of an unmanned ship in a specific area. Autonomous ships work well in the human or unmanned liner shipping industry. The schedule for the liner business is pretty much unchangeable. This makes it possible to comprehend the regulatory setting at the ports of call better. This technique also reduces the dangers involved in lengthy voyages away from shore side stations.

14. Conclusion

From now on, progress in the use of modern technology has become something that cannot be ignored. The general trend now for all researchers and funders from the industry is how to use this technology to serve the industry and preserve the environment and how to reduce expenses . The most important international conventions that affect the work and continuity of modern technology represented by automated ships have been clarified, so the following have been extracted.

- The International Maritime Organization will consider most international conventions due to the importance of modern technology and its positive impact on marine life and trade.
- It is necessary to amend international agreements to add and modify modern curricula and programs to deal with such ships, and also some treaties will change completely, as shown in table 1.
- The strength and opportunity shown in the analysis confirms the necessity of the maritime transport orientation to change the itinerary to use technology, given that it serves the maritime transport sector as a whole.
- The form and content of marine jobs will change positively in the use and guidance of automated ships, which will increase the qualification of marine workers in reducing marine accidents and optimal use to preserve the environment.

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