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EXPLORING THE ROLE OF FULL-MISSION SIMULATION-BASED TRAINING IN ACHIEVING MARITIME SAFETY AND EDUCATION

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Abstract

The shipping industry is characterized as being global, technologically advanced, highly multicultural, and driven by a strong desire for economic productivity and profitability. However, shipping corporations frequently underestimate the benefits of safety and training to maximize commercial gains. Navigators need to be well-versed in a variety of conditions and situations to carry out a safe travel. For assisting the acquisition of necessary knowledge and abilities, training and simulations are essential. The current research aims to identify the importance of applying training simulations to seafarers through focusing on full-mission simulator. SWOT analysis is used to be done to analyze the efficiency of using simulators, where data is collected through focus groups. These focus groups are done with 15 experts and seafarers that use to make simulation trainings to trainees at the Arab Academy for Science, Technology and Maritime Transport. After applying the analysis, the research succeeded in identifying the strengths, weaknesses, opportunities, and threats of applying simulations. Finally, some recommendations are provided including using other types of simulators in the Arab Academy, such as; virtual reality (VR) simulator.

1. Introduction

The maintenance and use of ship electrical and automation systems are simulated in a complex of simulators because, as the convention emphasizes, only actual ship equipment can be utilized to maintain and operate these systems successfully and efficiently. Therefore, in order to provide onboard electro-technical officers and marine engineers with the most up-to-date configurations of current ship machinery and automation systems, these systems should be used (Hontvedt, 2015). Since it has been approved by the major maritime classification societies, use aboard ships is acceptable. Additionally, because the ship's technological means and systems must function without interruption, onboard electro-technical officers and marine engineers devote most of their professional attention to these rather than their virtual counterparts (Zinchenko et al., 2019).
The simulator system provides an adequate replication of operating situations including the technical features of real ship automation equipment. Along with activities including parameterization, modifying, and visualization, it also provides instruction on electromechanical system monitoring, control, and management. Due to the complexity of the simulator, numerous monitoring, control, and management configurations can be used to simulate a range of real-world

fault scenarios. It concentrates on how the automatic control system operates in emergency scenarios and practices the proper watch-keeper activities for searching, problem localization, and equipment troubleshooting (Connolly, 2018).

As a result, the full mission simulator complex (PMS), which was created for training and proficiency testing of marine specialists (electro-technical officers and marine engineers), complies fully with Sections Electrical, Electronic, and Control Systems and the pertinent competence required for ship electro-technical officers and marine engineers as a result of training (Nosov et al., 2019).

The simulator completely complies with both the practical training goals and objectives and the engine crew competence assurance goals and objectives. The simulator is congruent with the training objectives and replicates real-world operating circumstances (PMS) for teaching maintenance and repair skills. It also makes it possible to demonstrate these abilities in order to evaluate competencies. In accordance with the objectives and tasks of training, the simulator offers controlled operational circumstances, including emergency situations, and it also enables modeling of diverse operational situations (Zinchenko et al., 2020).

A learner can operate a power plant and individual electromechanical objects in the simulator in non-automated or automated modes of operation in order to track the operational parameters of control objects. This can be done by using real manual operation controls or any computer workstation. The student can also use the simulator's teaching, learning, and reference materials (Rystedt et al., 2018).

Therefore, this paper investigates the importance of applying training simulations to seafarers through focusing on full mission simulator.

2. **Literature Review**

In this section, the previous literature discussing the importance of applying training simulations to seafarers through focusing on full mission simulator will be presented, with the aim of knowing the impact of applying training simulations on the performance of seafarers in different countries and over the years. This section will display previous literature from 2017 to 2022.

Sanfilippo (2017) aimed to provide an integrated multi-sensor fusion framework to the Offshore Simulator Centre AS. The proposed framework aims to enhance the design, implementation, and evaluation of challenging marine operations by leveraging newly developed risk-evaluation techniques. It is possible to collect data from the simulator scene and the real world, including audio, video, biometric data via eye-trackers, other sensor data, and annotations. Future investigations into cutting-edge Situational Awareness Assessment Methodologies will build on this integration as their basis. In this study, a training system built around the idea of briefing and debriefing is applied. This research's contribution was indicated by the way in which this approach was incorporated into the suggested framework.

Sellberg (2017) looked at 34 publications from a variety of scholarly journals to investigate the usage of simulators in maritime education and training. it was shown that there are three primary areas of study: education, human factors, and maritime professions. An important finding from the synthesis of the studies is that little is known about the instructional strategies that would guarantee accurate and reliable outcomes for simulator-based education. There is a need for empirical research that further investigate the use of simulator-based training and evaluation in order to lay the groundwork for an evidence-based educational practice.

Sellberg (2018) set out to look into the opportunities and difficulties that come with various stages of simulator-based training. The results show how using technology in a simulated setting enables teachers to continuously check, correct, and assess students' behavior in connection to learning objectives. The results also show that in navigational situations, the ability to connect the general to the specific is a continuous instructional achievement that is maintained across all training phases, from briefing to scenario and debriefing.

Sharma et al. (2018) described that the maritime business as one of the most dangerous, therefore simulator training is commonly used to prepare potential operators. Maritime educators must prepare pupils who will work as future sharp end operators in a high-risk workplace. Creating engaging learning activities for trainees that will enable them to not only comprehend the highly placed knowledge of work environments but also to work in teams while exhibiting skills like critical thinking and leadership is one of the objectives of maritime education. Thus, it is necessary to find educational frameworks that consider the unique characteristics of the maritime domain. In order to improve maritime education and training, this exploratory study proposed computer-supported collaborative learning as a solution. Its goal was to evaluate marine simulator training via a sociocultural lens.

Hjelmervik et al. (2018) found that individuals who were given activities with progressively higher levels of complexity fared better than those who were given complex problems too soon in the training. Moreover, it was concluded that the new features that make the activities more challenging should not be incorporated into training simulators too soon without enough research, even when technology and computer capacity have opened up new possibilities. Additionally, it was discovered that participants performed better on complex tasks when the functional accuracy of the simulation was increased during training as opposed to when it was at its highest level from the start."

Benedict et al. (2018) purposed discovering the using potential of fast time simulation in the maritime training environment. It was determined that the new fast time technology has a lot of promise for lecturing and simulator training during briefing and debriefing sessions of exercises, as well as for teaching and learning in maritime education. Additionally, experiments were conducted at the Maritime Simulation Centre of AIDA Cruises, the CSMART Center for Simulator Maritime Training of Carnival Corporation, and the Advanced Ship Handling Training course at the World Maritime University to demonstrate how this new technology can be used to enhance simulator training.

Sellberg and Lundin (2018) investigated how simulators are used in maritime education, with a focus on how simulated environments are used to deliver navigation training. The results show how instruction during simulations is a continuous interactional achievement based on the ability to determine whether the evaluation criteria are appropriate to the specifics of the situation and the activities that are being carried out as they advance. When deciding how to enhance the students' learning during simulations, as well as a stand-alone subject, the concept of temporality becomes a topic for education. The findings underscore the close ties that exist between tasks, instruction, and technology.

Pham (2019) clarified that simulation-based training as one of the most successful tools in the MET segment for boosting seafarers' competency. However, simulation-based training is not used to its full potential in the maritime industry due to poor implementation. As a replacement for actual flight instruction, that product is acknowledged as being indispensable in the aviation industry.

The marine education, training, and operations in the digital age were examined by (Mallam et al., 2019). In light of this, the ideas of applications for virtual reality (VR), augmented reality (AR), and mixed reality (MR) are examined. It was meant to convey that the development of immersive head-mounted display (HMD) systems has opened up a wide range of new possibilities and uses for MET and operations. These personal gadgets, as opposed to the traditional, industry-standard marine simulators, are strong, versatile, and affordably priced. Interesting additions to the current MET and operations techniques and technologies include VR, AR, and MR HMDs, which may eventually offer a disruptive substitute. This would create new business opportunities and practical uses for the entire sector.

The goal of (Nazir et al., 2019) was to examine the variations in maritime simulator training across Europe. To further understand the simulator training design used by each participating institution, semi-structured interviews were conducted. Identical characteristics, training time, general principal teaching, student needs, feedback, training needs analysis, assessment, and instructor credentials were among the pertinent performance indicators covered in the interviews. The results show differences and continuities found in European simulator training facilities in relation to the prescribed performance indicators. According to the study, even though some simulator training across Europe appears to be carried out uniformly because of similar practices and a shared understanding of the model course 6.10, actual implementations of these features based on interpretation and readily available infrastructure may produce discrepancies.

Markopoulos et al. (2019) discussed the creation of virtual training technologies for use in marine safety training, where it is referred that when an officer has time for training, it is simple and effective to increase situation awareness in navigation by using VR training tools. The results indicated that the first prototype of the MarSEVR virtual training system for maritime safety training was shown in this research. The idea of a portable training system that is practical and can be used in offices, training facilities, and even on-board environments was the first prototype of the MarSEVR virtual training system for maritime safety training was shown in the article. The idea of a portable training system that is practical and can be used in offices, training facilities, and even on-board environments was emphasized.

In this study, Yushan et al. (2020) investigated simulators utilized in three firms using a multiple case study method. Data were collected from autumn of 2016 to spring of 2018 through making interviews. It was established that the simulator served as a conduit between marine research institutions and business, connecting them to the same actor network. In addition, this report pointed out that there was a disconnect between simulator-based research and real-world application.

Four safety training episodes and a virtual training tool called Immersive Safe Oceans were described by (Markopoulos and Luimula, 2020) and can be used to promote professional education in realistic training settings. These pilot episodes were produced for maritime safety and are now being assessed. Immersive Safe Oceans Technology is a lightweight, reasonably priced instrument that may be used on board just-in-time ships or at maritime training centres. Command bridge, machine room, crane, and fire safety are four newly featured episodes that demonstrate how Immersive Safe Oceans technology may be used in a range of professional training scenarios. These episodes also demonstrate how crucial virtual reality training is to individuals in the shipping industry. As a result, cutting-edge virtual training facilities had been used onboard for next-generation learning.

Liu et al. (2020) used a VR simulator as a case study to examine the effectiveness of training simulation. With the use of head-mounted displays (HMD) and innovative human factors evaluation, a simulation system for VR-based LNG firefighting has been created that could teach and evaluate both technical and non-technical abilities in the firefighting situations. The suggested human factors evaluation was based on a competency model, and it might assess non-technical seafarers' skills like situation awareness, vigilance, and decision-making. Six trainees and two instructors participated in an experiment using the proven LNG firefighting simulation system. The findings implied that the maritime trainees found the VR setting to be realistic, that it caused them to feel the same negative feelings (such as fear and tension) during the stressful situations as they would in real life, and that it helped them stay focused during the entire session.

Wahl (2020) set out to better understand how learning happens in a simulator-based training context that heavily relies on cutting-edge computer technology and group projects. The study demonstrates how fidelity and training quality may be impacted by trainer-trainee interactions, task features, and simulator technology. Professional marine officers were questioned to get information about two separate simulator programs. It is not always required to mimic the actual physical entities of a bridge to fulfill training objectives, it is suggested after analyzing the data gathered. Computer technology should be seen as an essential but not exclusive tool for reaching the necessary level of fidelity in order to provide high-quality training and realistic training activities.

The need for well stated evaluation criteria for human assessors in order to provide more accurate performance assessments was made obvious by Ernstsen and Nazir (2020). The current research provides an analysis of the validity and reliability of a proposed computer-aided performance assessment (CAPA) instrument for marine pilotage assessment. The suggested evaluation method was created utilizing the Analytical Hierarchy Process and Bayesian Network in order to standardize the weighing and computation of the performance indicators. In particular for evaluating technical competencies, the experiment showed the possibility for better dependability in performance assessment of marine simulator training. Additionally, it demonstrated the unreliability of employing traditional evaluation techniques, which should encourage additional study and the creation of marine simulator assessment techniques.

Senčila et al. (2020) showed a Full Mission Bridge simulation has shown to be an invaluable tool in assessing the conditions for safe passage during seaport development. An overview of the activities at the Lithuanian Maritime Academy is given in the article. The experts at the Academy ran a number of training sessions and exams related to navigational safety assessment using the Full Mission Bridge simulator in cooperation with the pilots of Klaipeda State Seaport. The development of the harbor navigation channel, the introduction of two-way ship traffic, ships sailing with tugboats, LNG vessel emergency response in various scenarios, extremely large ship accessibility studies, coordination with vessel traffic service, the assessment of boundary weather conditions, etc. are just a few of the topics covered by the overseen works. Finally, it was determined that Full Mission Bridge simulation would become a vital instrument for ensuring navigating safety during seaport development.

Simulators are often used in the training of aircrew and seafarers, offering a safer and more affordable alternative to training in an operational environment, according to (Lee and Duffy, 2021). Although there was very little information on rail simulation, a comprehensive literature review was undertaken in this study to examine their use in air, sea, rail, and road transportation. According to studies, the equipment and instruction quality both had an influence on how effective training is. The equipment's fidelity—the capacity to faithfully represent the real world—determined the degree of training that could be provided, and its capacity to induce suspension of disbelief directly affected students' achievement. In order to facilitate effective training transfer, instructors must also pull the greatest performance out of the students and present them with scenarios that mimic real-world conditions. Effective crew training and sufficient human-computer interface design are crucial for accident mitigation since the increased system complexity could divert the crew's attention and overwhelm training needs. It was eventually realized that, despite its extensive use in air and marine transportation, simulator training for land transportation was remarkably ignored.

Pan et al. (2021) presented various case studies illustrating the cooperation between a training facility, three offshore businesses, and a coastline authority. We investigated the common perspective of simulator use in these businesses using the actor-network theory through a qualitative inquiry. In the study, it was argued that the simulator is an actor in and of itself, capable of forming actor networks by tying other actors together based on common interests. A network of actors like this expands the use of simulators beyond training. It promotes the simulator as a conduit between marine academics and industry and links it to the same actor-network in an effort to streamline the process of "meaning construction." Through this process of meaning construction, a helpful description of the learning objectives for simulator-based training is offered. It is beneficial to define who, when, and on what basis will profit from the usage of simulators in the future. The report explored the usage of a multiple case study in the marine domain along with its benefits and drawbacks.

Voloshynov et al. (2021) analyzed virtual reality simulators in terms of best practices for use in maritime education. This topic was opened to investigation in terms of studies on their performance efficacy due to the lack of national research experience and evidence foundation for new VR simulators operating efficiency. This article gave a broad overview of the benefits of implementing VR technology in order to develop and formulate the professional competencies of future marine professionals. Additionally, it looked into how immersive digital technologies, which can be interactive and representative, might be used in the instructional process at maritime institutions. It was discussed if virtual reality (VR) technology should be used in the education and training of future seafarers as well as whether future maritime specialists might take virtual courses. Finally, the predictive accuracy of VR simulators used to develop professional competencies was demonstrated.

According to Aronsson et al. (2021), simulator training is becoming more and more beneficial for training in time-sensitive and dynamic conditions. From an activity theoretical standpoint, eight decision-making training simulator facilities were examined. The research indicates various inconsistencies between the actual training and the planned training objectives. Although competent teachers frequently alleviate restrictions in technology and organization, it is determined that there is a need for an organized approach to training design in order to specify the abilities and skills that should be trained, as well as applicable measurable training goals. A pedagogical paradigm that considers the features of simulator training is also necessary.

Kim et al. (2021) analyzed the current maritime simulator-based training and educational methodologies that play a vital role in seafarer competency development and training in the post-COVID-19 period through a survey of the current simulators in use in MET. Two focus groups' worth of data are subjected to a SWOT analysis. Finally, the study outlined several actions that the MET stakeholders may do to get over existing challenges and plan their future strategies for improving simulator-based learning.

Belev et al. (2021) goal was to determine the potential for adding relevant subjects to training institution curricula to better reflect the realities of maritime shipping. 79 participants who held the positions of Officers on Watch, Chief Mates, and Masters participated in interviews. The study succeeded in its goal when it recommended that organizations employ a strategic strategy and adapt to changing instructional pedagogies. Lifelong learning as a technique of smoothly making the switch from working on a ship to working on land. New technologies have made it possible to simulate numerous options for ship management at all levels of autonomy. Simulators will also be created using a new methodology that focuses on both training and the needs and trends of the marine industry. A conceptual and detailed level of investigation, comprehension, and preparation of processes and procedures will be possible for marine specialists thanks to sophisticated simulation tools utilizing virtual reality and augmented reality.

Mansuy et al. (2021) was a useful information source for nautical studies' thorough design phase real-time ship maneuvering simulators. When determining if a ship maneuver is feasible, the feedback of the pilots, which is unavailable for fast time simulations performed by a computerized autopilot, is a valuable resource. Real-time simulations, on the other hand, are substantially more expensive because the pilot needs to be able to fully immerse himself in a sailing environment. Additionally, to taking a lot of time, these simulations. Real-time simulators, which merely provide a 2D bird's eye view for pilots to execute maneuvers, can occasionally be utilized as a less expensive and quicker substitute. The case study of two harbors' nautical access was examined in this research, along with some of the benefits and drawbacks of a real-time bird's eye view configuration.

Hjellvik and Mallam (2021) used a growing technical trend called maritime cloud-based simulation to mirror classic on-site simulator software in terms of content and capability, opening new possibilities for decentralized involvement. In this study, a quasi-experimental methodology is used to evaluate the training design that can be tailored to the trainee. According to the findings, student self-efficacy predicted training success, while knowledge level before to training had no bearing on the outcome.

In order to comprehend the deep learning components of a maritime simulation program, Jamil and Bhuiyan (2021) studied learning and teaching of maritime. Overall, the findings demonstrated the importance of deep learning activities in maritime simulation and provided suggestions for improving present procedures. Although the results were from a maritime education program, they can be used to inform other academic fields that use simulation into their teaching and learning processes.

By compiling a systematic literature study on the articles of maritime simulator-based training from 2005 to 2021, de Oliveira et al. (2022) studied the fidelity of a maritime simulator. The study of 36 references is done using content analysis. According to the results, there are two different kinds of simulator fidelity: physical and functional. The physical one includes the ergonomics of the bridge, the visual system, vessel mobility, and hydrographic modeling, while the latter deals with training program design, simulator session design, and the teaching profession. The findings showed a strong tradition in the literature, there are not many citations, and the references are scattered among a lot of different journals, authors, and organizations. Even though there are many studies using high-fidelity simulators, most of them are based on subjective judgement, which has a negative impact on training.

Chan et al. (2022) evaluated two different simulators. A bridge watch simulator was used in the study to simulate an autopilot failure and test the situational awareness of 14 junior navigational officers and 14 navigational officer trainees. The study's findings showed that most participants lacked understanding of the system in the event of a fault. Additionally, even those with a high level of situational awareness needed a heads-up before they could detect a potential issue.

Weissenberger (2022) aimed to determine whether a VR simulator can be utilized as a teaching tool for the pilot service of the Norwegian Coastal Administration. The results of this research also advance knowledge of VR-simulators in the field of MET. The results of the interviews are consistent with the information gleaned from the systematic literature review. The simulator provides marine pilots with high levels of immersion and repeated scenario-based training. Pilots can learn using the portable and user-friendly system at home, on a boat, at the pilot station, and in group settings. The study concludes that VR-simulators are efficient and advantageous in terms of training effectiveness and motivation. The pilots gave the technology favourable evaluations. According to the study's findings, the simulator can be used to instruct marine pilots of all levels about new operations, heavier loads, and new operational zones.

In the context of the unusual Corona virus pandemic, which was controlled by MET providers through the delivery of traditional practical simulation-based training, (Bhuiyan and Sohal, 2022) set out to assess the effectiveness of cloud-based simulation training. The focus group discussion made clear that lecturers first needed to go through their own training in order to deploy a new approach to technologically enhanced teaching and grow accustomed to the new software. The establishment of the virtual learning platform was another expense that the training providers had to make, which was especially challenging for smaller training providers. An additional challenge was the unreliable internet connectivity. Its inability to match the fidelity of conventional simulators, which is necessary for giving simulation training authenticity and making sure that a student is trained and assessed as closely as is practical in a real-world setting, was another important flaw of cloud simulation. Despite the challenges, there are certain benefits that have been recognized as several shipping businesses have adopted cloud simulation to maintain training despite the Corona virus.

In Indonesia during the Covid-19 pandemic, Rakka (2022) sought to determine the function of cloud-based simulators for marine instruction and training. Through interviews, questionnaires, and document checks, primary data were gathered. Analytical Hierarchy Process and theme analysis were used. The discussion and data analysis demonstrated the need for cloud-based simulators in Indonesian MET institutes. Additionally, among the training simulator alternatives, cloud-based simulators received the greatest attention.

According to Hwang and Youn (2022), human intervention in the remote operation of an autonomous ship required navigational expertise. A potential instructional method for remote operators is simulation training. However, the duration of the simulation training is insufficient for students to develop navigating abilities on par with those of navigators on traditional ships. The simulation training should also contain a variety of navigation scenarios to provide the trainee with a thorough education. Therefore, the methods to generate large-scale and relevant navigation scenarios are provided in this study by eliminating the distribution of navigation elements from actual ship trajectory data and applying them to the permutation of navigation elements. Results compared a sample navigation scenario with an example of an unrealistic navigation to show the benefits of the suggested solutions.

3. **Research Methodology**

The current study aims to apply SWOT analysis for the aim of evaluating the efficiency of training simulators applied in the Arab Academy for Science, Technology and Maritime Transport. SWOT analysis is a two-dimensional examination that looks at both internal and external pressures that are both good and negative for the company. SWOT is characterized as a thorough approach for examining a system's internal environment as well as its external environment (organization, territory, etc.). It is one of the most well-known and used methods for strategic planning. The existence of several mutations that function both in theory and in practice demonstrates its variety and diverse, dynamic nature (Nazarko et al., 2017). Finding the strengths, weaknesses, opportunities, and threats in respect to a specific topic that has to be developed is the goal of a SWOT analysis. Strengths and weaknesses are the internal factors related to the organization, while external factors are represented by the opportunities and threats. An effective foundation of the four categories of things from a SWOT analysis is not an easy undertaking, despite how straightforward a SWOT chart could appear to be. The development of SWOT analysis is the subject of some research. They take into account numerous strategies to improve inter-personnel exchange of ideas and structure the analytical process along clearly defined vectors (Brad and Brad, 2015).

In order to apply SWOT analysis, qualitative data is collected through focus groups. Five focus groups are done with 15 experts and seafarers that use to make simulation trainings to trainees at the Arab Academy for Science, Technology and Maritime Transport, where participants are asked about full-mission simulation (the adopted simulation inside the academy). The focus groups consist of six questions, which represent as the following:

1. What is your evaluation of the simulation training system applied in the Academy?
2. What are the points of strength of full-mission simulation?
3. What are the points of weakness of full-mission simulation?
4. What are the opportunities of full-mission simulation?
5. What are the threats of full-mission simulation?
6. What are your recommendations for developing the training simulation system in the Academy?

4. SWOT Analysis

This section analyzes the collected data from the five focus groups for the aim of identifying the points of strengths, weaknesses, opportunities and threats of full-mission simulator. Accordingly, this section is divided into four sub-sections.

4.1 Strengths

From the focus group, different strength points are being presented. The strength points talked about the necessity of this simulation as it represents an effect tool of trainings that teach seafarers how to deal with all necessary instruments inside the ship, have specialized training with new crafts, ship equipment, and navigational areas. It also provides physical and technical knowledge to the trainees as well as evaluates their level of excellence through the process of troubleshooting. The focus groups also referred to Engine Room Simulator and its importance in training the engine department. All these concluded points appeared in the focus groups, as following:

1. Simulation of a ship with exact copies of all necessary instruments and displays that exists in the real ship.

2. Developing interactive simulations for the aim of helping seafarers to gain experience and improve their teamwork skills.
3. Studying the accessibility of nearby ships and ways of identifying weather conditions.
4. Addresses most of the regulatory requirements and workplace learning demands due to good level of fidelity offered.
5. A useful tool for specialized training with new crafts, ship equipment, or navigational areas, for offering case studies that ensure the safety of navigation.
6. An effective instrument to evaluate the circumstances for secure sailing during seaport construction or development.
7. High level of physical and behavioral realism.
8. Offered a full-featured, real-time computer simulation capability capable of assisting advanced training in navigation.
9. Engine Room Simulator was created to educate, train, and evaluate the staff of the Engine Department.
10. Basic physical and technical knowledge.
11. Measuring and tracking the trainee progress with objective performance metrics and reports.
12. Guarantee operations advancement and troubleshooting.

4.2 Weaknesses

Weaknesses points of full-mission simulator are also discussed through the focus groups. Two main identified weaknesses are related to subjective resources, such as; the high costs, the time needed and the materials needed. The other two points are focusing on the operational process of the simulation. Weakness points are represented as follows:

1. Long time and the high cost required in adding new features.
2. Requires a great amount of resources to acquire and operate.
3. The proper division of individual experiences and perspectives in order to acquire an accurate assessment of the marine situation.
4. Overwhelming of trainees by external distractions, stress, and time constraints.

4.3 Opportunities

Different opportunities are identified also through the focus groups. The opportunities talks about the ability of this simulation to be integrated with other devices or simulations, such as; virtual reality, dynamic selection, artificial intelligence and other devices that helps in collecting data about the trainees. Opportunities also talked about the ability of adding new or sudden situation to see how the trainees will interact towards this situation. Finally, it is referred to eye-tracking methods. The opportunities concluded from the focus groups are shown as follows;

1. Allows the development of situations on-board simulators.
2. Allows the screen of trainees' coordination and skills to perform.

3. Can be integrated with advanced technology, such as; virtual reality.
4. Dynamic Selection was introduced.
5. Students will comprehend more if there is additional, reliable information about ships as well as other varieties.
6. A chance to introduce eye-tracking methods to the learners.
7. Ability of applying artificial intelligence.
8. Connecting with other devices that will help in collecting data about the trainees' reaction and interaction.

4.4 Threats

The final feature discussed in the SWOT analysis is the threats. The main threats that focus any simulation training system through the last few year is Corona Virus, where it stops most of the simulations that requires working on land. Another important threat is lack of economic resources, where full-simulation model already requires high costs, so lack in economic resources could make the simulation stops. Focus groups also mentioned lack of technology resources, lack of information and credibility of trainees to be serious threats that could the full-mission simulations. The following points are mentioned in the focus groups.

1. The difficulty in applying this simulation during Corona virus.
2. The lack of economic resources required to apply the simulation.
3. Lack of technology resources.
4. Lack of information.
5. Lose its credibility for the trainees.

5. Conclusion

The current research aims to identify the importance of applying training simulations to seafarers through focusing on full-mission simulator system as the simulation training applied inside the Arab Academy for Science, Technology and Maritime Transport. This importance is discussed through applying SWOT analysis. This analysis is done to five focus groups done with experts and decision makers inside the academy. Through the analysis, the study identifies the strengths, weaknesses, opportunities and threats that face full-mission simulation. The following table shows the main concluded points of the analysis.

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Table 1 SWOT Analysis

Strengths	**Weaknesses**
– Simulation of a ship with exact copies of all necessary instruments and displays that exists in the real ship. – Developing interactive simulations for the aim of helping seafarers to gain experience and improve their teamwork skills. – Studying the accessibility of nearby ships and ways of identifying weather conditions. – Addresses most of the regulatory requirements and workplace learning demands due to good level of fidelity offered. – A useful tool for specialized training with new crafts, ship equipment, or navigational areas, for offering case studies that ensure the safety of navigation. – An effective instrument to evaluate the circumstances for secure sailing during seaport construction or development. – High level of physical and behavioral realism. – Offered a full-featured, real-time computer simulation capability capable of assisting advanced training in navigation. – Engine Room Simulator was created to educate, train, and evaluate the staff of the Engine Department. – Basic physical and technical knowledge. – Measuring and tracking the trainee progress with objective performance metrics and reports. – Guarantee operations advancement and troubleshooting.	– Long time and the high cost required in adding new features. – Requires a great amount of resources to acquire and operate. – The proper division of individual experiences and perspectives in order to acquire an accurate assessment of the marine situation. – Overwhelming of trainees by external distractions, stress, and time constraints.

Opportunities	**Threats**
– Allows the development of situations on-board simulators. – Allows the screen of trainees' coordination and skills to perform. – Can be integrated with advanced technology, such as; virtual reality. – Dynamic Selection was introduced. – Students will comprehend more if there is additional, reliable information about ships as well as other varieties. – A chance to introduce eye-tracking methods to the learners. – Ability of applying artificial intelligence. – Connecting with other devices that will help in collecting data about the trainees' reaction and interaction.	6. The difficulty in applying this simulation during Corona virus. 7. The lack of economic resources required to apply the simulation. 8. Lack of technology resources. 9. Lack of information. 10. Lose its credibility for the trainees.

Another important point concluded from the analysis, is that decision makers and experts suggests integrated the virtual reality (VR) simulation with full-mission simulation in order to avoid the challenges that faces full-mission simulator. This point is presented in focus groups two and five as follows:

"I support the point of virtual reality, as this technology represents a value added to full mission simulator and of course for the experience provided to seafarers"

"I suggest applying the virtual reality as the Virtual reality simulation is a technique that enables users to interact with a 3D computer-generated environment in real time and become fully immersed in it"

"I recommend combine two simulation with each other; the full-mission simulator and virtual reality simulator"

6. **Recommendations and Limitations**

Based on the results obtained from the analysis of 5 focus groups, it was concluded that some recommendations made by decision makers and trainers in the academy to improve full mission simulation were as follows:

- Reducing non-essential marine services and training and examination procedures for seafarers through simulation exercises

- Increasing the academy's focus on collecting information on a regular basis, to ensure that simulation training content is continuously developed.
- Search for less expensive alternatives to ensure that the price of training does not increase.
- Adopting different simulations and integrating them with full mission simulation, for example, virtual reality simulation.
- Constant desire to drive new technological developments in the marine sector.
- Incorporating modern speaking approaches may improve trainees' performance.
- Work to create a cooperative spirit among the trainees, and this is because they acquire the team spirit skills that help them a lot in full mission simulation.
- Develop alternative plans to face any economic or environmental changes that may in turn affect the adoption of full mission simulation.

Despite these recommendations that we reached, there were some limitations that this research faced. First, there was a time limit and that was the reason why the research sample was small. Secondly, the research was limited to studying this in the Arab Academy for Maritime Transport only and did not include studying it in other training institutes or academies. Thirdly, this research was limited to studying this simulation in Egypt only and did not include a comparative study with another training center in a country that adopts this simulation to know the similarities and differences. Therefore, some recommendations can be made to future researchers, to take a larger sample in their research, to conduct a comparative study, and to study this simulation in a country other than Egypt.

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