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Contents

The role of NGOs in the shipping industry

Is there an effective role for NGOs in the shipping industry? How do they participate in the conservation and management of the oceans?

Recent challenges and global developments push the participation of Non-Governmental Organizations (NGOs) in many marine activities, and environmental NGOs participate in the conservation and management of the seas and oceans, which needs to combine the efforts of officials in that industry with NGOs working in the field of maritime work and environmental preservation. As we all know that the ocean plays a pivotal role in mitigating the climate and providing food for humanity.

Whereas, the traditional government management of marine resources as well as the companies involved in the shipping industry are complex and often problematic to recommend innovative solution away from political pressure. This highlighted the role of NGOs and new opportunities for participation as technological changes bring multi-use issues. The participation of NGOs in the conservation of the marine environment can be understood by analyzing the roles played by these organizations, especially with regard to research and consulting projects that need a lot of flexibility, multidisciplinarily and distance from bureaucracy, which contributes to making objective decisions and keeping pace with technological progress in the marine fields. It is hoped that an understanding of the systems and the roles; that these organizations play will provide a new perspective on the participation of NGOs in the conservation of the marine environment, and the development of the shipping industry.

NGOs are often members of people with knowledge and information in a variety of fields and expertise due to the flexibility that NGOs have in selecting their members. This means that they can make the information available to workers in that industry, as well as to those interested and researchers, and explain how they can use such information in developing the maritime sector them, and how to benefit from that information and experience, whether to increase their awareness. Moreover, to assist them in consulting in the areas of specialization as well as in scientific research.

In addition, NGOs provide opportunities for individuals to be heard widely, whether in scientific meetings or meetings of government bodies to develop different areas in the shipping industry or marine conservation. Moreover, NGOs can adapt faster and respond to changing societal needs more quickly than government organizations. Essentially, NGOs can be instrumental in ensuring transparency and accountability because of their access to information with the expertise of their members, the diversity of their knowledge, and their local and international relationships.

Editorial Board

The Effect of Safety Training on Risk Management while Using LNG as Fuel: Challenges and Possible Solutions

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المستخلص:

ويهدف هذا البحث إلى دراسة أثر التدريب على السلامة في إدارة المخاطر مع استخدام الغاز الطبيعي المسال لتقليل المخاطر والمشاكل الناجمة عن استخدام الغاز الطبيعي. لذلك، استخدم الباحث الفلسفة الوضعية في هذه الدراسة ونهج استنتاجي لأنهم أكثر توافقاً مع طبيعة البحث ومع ما يريد الباحث الوصول إليه. واتبع أيضا أسلوب كمي في جمع البيانات، حيث أعد استبيانا وتم توزيعه على 200 فرد يعملون في قطاع الطاقة. حيث تم تحليل البيانات باستخدام الأساليب الإحصائية مثل الارتباط ، والانحدار. وقد قبلت النتائج بفرضية الدراسة بأن هناك علاقة هامة إحصائيا بين التدريب على السلامة وإدارة المخاطر.

Abstract:

This research aims to study the impact of safety training on risk management while using Liquefied Natural Gas to reduce the risks and the problems arising from using the LNG. Therefore, the researcher used the positivism philosophy in this study and the deductive approach because they are more compatible with the nature of the research and with what the researcher wants to reach. He also followed a quantitative method in collecting data, as he prepared a questionnaire and distributed it to 200 individuals working in the energy sector. The data is analyzed using statistical methods such as correlation, and regression. The results fully accepted the study hypothesis that there is a statistically significant relationship between Safety Training and Risk Management.

1- Introduction

Due to the worldwide economic development and population growth, the energy demand has been increased by 2.4% annually over the last decades. Natural gas, one of the cleanest fossil fuels energizing the modern society, has been the fastest growing primary energy source owing to its transportability, high combustion efficiency, and low contribution to the greenhouse gases emission. These desirable attributes made natural gas an excellent option to bridge the gap between the conventional energy resource and the future of renewable energy (He et al., 2019.

Liquefied natural gas (LNG) and pipeline are two mature natural gas transportation technologies. The pipeline is the priority mode of natural gas transportation if the distance between the production site and the market is less than 2000 km. However, for long distance transportations across the oceans, transportation through pipeline is not technically and economically feasible. Therefore, LNG is the best choice to transport natural gas in long-distance, notably larger than 2000 km, cross-ocean, and offshore natural gas production. LNG is obtained by cooling the natural gas to 162 C at the atmospheric pressure. One cubic meter of LNG contains around 625 cubic meters of natural gas, making the energy density of LNG significantly higher than the natural gas. Besides, LNG is colorless, non-toxic, odorless, and noncorrosive [3], resulting in its widespread application in various industries. Due to methane as the predominant composition of LNG, it generates a very low level of greenhouse gases emission and nitrogen oxides, and almost no sulfur oxides when LNG is vaporized and combusted (He et al., 2019).

Liquefied Natural Gas is considered as fuel option nowadays. While, conventional oil-based fuels will remain the main fuel option for most existing vessels in the near future. Many new build and conversation projects are concerned about the commercial opportunities of LNG. However, taking the leap to LNG can only be made based on the best possible information and a thorough analysis of your needs, both today and in the future (Bengtsson et al., 2011).

The development of liquefied Natural Gas (LNG) as a competitive alternative fuel in the maritime industry is exciting. There is a variety of industrial, societal, and environmental reasons why LNG is widely viewed as a promising maritime fuel. The grow exploitation of natural gas fields has greatly increased the supply and dramatically reduced its price in North America and in the European Union. This has heightened interest in a fuel that already has a number of attractive qualities for the shipping industry (Lowell et al., 2013).

Liquefied Natural Gas is considered as extremely dangerous and toxic with container ships called floating bombs. Historically, LNG has the best safety record of all common fuel types and is completely non-toxic. The vapors of natural gas are able to set on fire easily and represent safety risk that must be managed, but these risks are basically less than for gasoline, diesel and other liquid fuels. LNG is cryogenically cooled natural gas, which is liquefied to reduce the volume for shipping and storage. LNG is mainly methane, but can contain up to 10% ethane and propane. When LNG spills on the ground or water, it vaporizes quickly and leaves behind no residues. If LNG spills on water, it does not harm waterways any way. As LNG vaporizes, the vapor could catch fire if there is a source of fire, but otherwise LNG disappear completely (Dodge, 2014).

Though there are many merits of LNG, it also has some challenges to overcome. Frost burn occurs when LNG is exposed to human skin because of being a cryogenic fluid. The phenomenon is also known as frostbite or cold burn. Structural failure may occur due to metal cracks and metal embrittlement of the LNG storage tank, which rises by LNG spill. Besides, different common usable materials such as plastic, carbon steel and rubber become brittle at an enormously cold temperature. Since methane does not sustain breathing, thus, due to a large concentration of methane dispersed in air and vapor accumulated near the ground may rise to asphyxiation. When LNG is released on water, it becomes less dense, which gives rise to rapid vaporization of liquefied natural gas and known as Rapid Phase Transition (RPT). Consequently, due to the accidental release of LNG, a strong pressure wave is developed and causes heat radiation and burning clouds (Arefin et al., 2020).

2. Features of LNG and Importance of using it

Gas is set to become the second largest source of energy by 2025, with renewables and natural gas accounting for 85% of energy growth and its potential has not been lost on maritime (Bilen et al., 2008). The shipping industry has already embraced LNG as a fuel, and according to data from Clarksons (2019), the existing world fleet is made up of 668 LNG-fueled and LNG-ready ships with an additional 409 in the order book. LNG is both a technically proven and a commercially variable solution for shipping today and is a good "transition" fuel, which is able to meet existing and imminent emissions requirements for NOx, SOx, and CO2 (Calleya et al., 2011).

One of the principle reasons to explore LNG is its potential for environmental benefits. Increasing regulatory pressure to improve fuel quality and lower ship-generated emissions of sulfur oxides (SOX), oxides of nitrogen (NOX), and Particular Matter (PM), particularly from 2015 forward, is spurring the development of more advanced vessel engine and after-treatment technology for conventional residual and distillate-fueled ships (Lowell et al., 2013).

Emission reduction requirements increase the baseline costs of business and greatly increase the demand for alternatives. Beyond the more stringent regulations for airborne pollutants, tighter CO2 emission standards and greater emphasis on efficiency for oceangoing vessels are helping to drive engine and design technology in new ships, as well as prompting some engine retrofits (Lowell et al., 2013).

Even with LNG's lower price and with an ever-stronger push from emission requirements, there are practical, infrastructure-related, and regulatory uncertainties that warrant consideration. As with any alternative fuel, there is the difficult question about how quickly the infrastructure can adapt to accommodate the new technologies. Even though the fuel price may be very low, the necessary infrastructure investments can be enormous. This issue is still more problematic for ships that must operate and be fueled worldwide. The necessary codes and guidelines for ships and for ports to enable LNG's use as a maritime fuel are being developed simultaneously. Central to the decision making process about whether to proceed with such investments is the question about quantifying the actual energy and climate change mitigation benefits associated with the use of LNG in comparison with conventional maritime fuels (Lowell et al., 2013).

2.1 Risk of using Liquefied Natural Gas

The LNG industry has been shipping bulk quantities by container ship since the 1960's. There are over 100 LNG container ships in operation today; the industry has conducted over 33,000 voyages since 1964 covering more than 60 million miles without there ever being a significant spill, loss of cargo, or environmental incident. There have been LNG ship groundings and engine room fires, incidents typical of the broader maritime industry, but none of the incidences has ever caused containment failures or cargo spills. LNG ships have multiple containment walls and insulation with 8 feet between the null and cargo making them very robust (Woodward and Pitbaldo, 2010).

The ability within the insurance coverage is focused on fire and damage and not on environmental pollution. Crude oil spills are well documented for the long-term damage they cause, but comparable environmental threats do not exist for LNG Insurance rates for natural gas vehicles are also lower than for gasoline or diesel vehicles (Shavell, 2018).

2.2 Challenges for LNG in Maritime

LNG vaporizes readily when it is released from containment. Then, the liquid will be heated by the surroundings, thus, causing it to vaporize. The vapor will be mixed with the surrounding air and carried out downward causing a cloud. Eventually, it will be mixed with additional air and will be further diluted. The vapor cloud may ignite if the flammable portion is exposed to a fire source. Secondary fires can be generated by the burn-backs of the primary vapor cloud and cause severe damage to the persons caught within the cloud (Arefin et al., 2020).

According to a safety study regarding LNG, the maximum effective distance of LNG

transportation with trucks is 230 m. Flash fire of LNG causes truck tank rupture, which is related to the distance effect. Boiling liquid expanding vapor explosion (BLEVE) may occur with lethal effects during rupturing an LNG truck tank with elevated pressure. Sometimes because of BLEVE, the released liquid immediately flashes and atomizes the resulting fireball. However, fireball lasts for only a couple of seconds, its effects can be very dangerous. If LNG truck tank rupture occurs during engulfing fuel firing, then the maximum effect distance would be 190 m. Pool fires occur due to immediate ignition of LNG, which can cause several damages to the surrounding equipment and burns to people caught within the cloud. The surface emissive power of LNG pool fires generally lies in the range of 220 - 50 kW/m2. However, a huge amount of smoke is produced during a large fire, which is very dangerous (Arefin et al., 2020).

Due to having different density, LNG has the potential to layer in unstable strata within the tank. These strata have the potential of rolling over to stabilize the liquid in the tank. Due to normal heat leak, the longer LNG layer gets heated and changes density until it becomes lighter than the upper layer. As a result, a liquid rollover may occur with sudden vaporization of LNG. However, if the design of pressure relief systems is not adequate the excess pressure can result in cracks or other structural failures in the tank. Since LNG is extremely cold, it can cause damage to eyes and tissue. Oxygen Deficient Hazard (ODH) results from the displace of air caused by the release of LNG. Due to the accidental release of flammable liquid from pressurized containment, the leak takes the form of a spray of liquid droplets and vapors and if it is ignited, the resulting fire is called torch fire. Torch fire possesses similar types of hazards as a pool fire. In some cases, for similar size pool and torch fire, the radiant heating power of a torch fire is frequently greater than that of a pool fire (Arefin et al., 2020).

In a high-pressure dual fuel engine, the combustion is nearly complete when LNG is injected at a pressure of 30–35 MPa with a small amount of diesel. However, when using in low-pressure dual-fuel LNG is injected at a low pressure, which is comparable to the Otto cycle. A major disadvantage of the dual fuel diesel engine is the high amount of methane slip compared to the diesel engine. At high and medium loads, the air fuel mixture enters the crevices and cylinder wall causes methane slip. Moreover, at low speed the emission problem is more severe because of a low air-fuel ratio. This phenomenon therefore causes high methane slip and fuel consumption because of bulk quenching in the coldest areas of the combustion chamber. In an Otto based dual fuel engine, at high power the methane slip is low, however, with the decrease of power, methane slip increases significantly (Arefin et al., 2020).

2.3 Possible Solutions

Researchers all over the world are trying to find out some ways to face the challenges to use LNG and have already found some techniques as discussed below. The safety barriers, i.e., layers of protections, may have been used for preventing, controlling or mitigating undesired accidents or events. Similarly, for preventing the depth of catastrophic accident, different types of safeguards and protection layers have been used. Currently, the LNG industry uses several layers of protection for minimizing and controlling the consequences connected with vapor dispersions, LNG spills and subsequent fires and explosions. To minimize cryogenic embrittlement, different types of special steels have been developed. Moreover, currently, operators are using LNG rollover models, which can optimize boil-o_ costs by inducing density stratification and by doing so, converting a dangerous configuration into a potentially operational asset. Basic responses to accidental LNG spills include detecting the spill, securing the origin and taking measures to prevent it from worsening. It is very important to secure the leak and the area, move the people away from the spill, prevent ignition sources and monitoring should be performed carefully until no vapor remains in the flammable limits. A potential technique to reduce the size of the flammable vapor cloud is to increase the vapor dispersion generated by the liquefied gas spill (Arefin et al., 2020).

The cloud generated by the spill of unconfined LNG on water travels at the speed of the wind before dispersion. Since it is denser than air, for land-based facilities, it has some advantages i.e., it can be easily controlled, though sometimes it can be a disadvantage if it takes longer to disperse. To determine Low Flammability Limit (LFL), spill rate, volume, vaporization rate and atmospheric condition are taken into account. However, reducing the pool surface area would be an effective solution to reduce LNG vaporization. Water spray curtains may be used as a promising technique to mitigate many toxic and flammable LNG vapors by reducing the concentration of LNG vapor clouds. A properly designed water curtain is capable of enhancing the dispersion of LNG vapor cloud and reducing the vapor cloud exclusion zone through mechanical effects, dilution and thermal effects. It is considered one of the most economical and efficient cloud control techniques. However, the effectiveness of different water curtains is still widely unknown because of the temperature increase and LNG concentration reduction (Arefin et al., 2020).

2.4 Safety Training

Use of liquefied natural gas as a fuel in marine operations in increasing due to the environmental protection regulations about emission limits and cost-effectiveness of liquefied natural gas. Lower carbon dioxide, nitrogen oxide, sulfur oxide and particulate matter emissions are formed while using liquefied natural gas as a fuel. International Maritime Organization pays attention to liquefied natural gas as gaseous fuel or any other low-flashpoint fuel using at ships. The code of safety using Gases or Other Low-Flashpoint Fuels (IGF) was adopted, and the amendments about mandatory minimum requirements for the training and qualifications of masters, officers, ratings and other personnel on ships subject to the IGF Code to the International Convention on Standards of Training, Certification and Watch keeping for seafarers, 1978 (STCW) is approved by the Maritime Safety Committee. With the amendments to the STCW, basic and advanced training requirements are added for the crew who work on ships subject to the IGF Code (Zincir and Dere, 2015).

Therefore, the basic and advanced training requirements has been investigated, and suitable competencies for simulator training has be determined. Only firefighting training competency at basic training is not suitable for simulator training. Bunkering and storage operations are important for LNG fueled ships. For this reason, it is focused on these operations, and related competencies at basic and advanced trainings are found. According to these competencies and their sub-topics, important bunkering and storage operations which engine officers should be learnt by simulator training are mentioned. A bunkering procedure is formed for usage at simulator training. A simulator-training outline is formed, and important system drawings are added which should be included in a simulator training (Zincir and Dere, 2015).

Due to increasing level of strictness at emission limits and energy efficiency regulations, various studies are made to reduce shipboard emissions. These studies can be main engine after treatment methods, which aim to reduce harmful combustion products, like filtering and cleaning equipment. On the other hand, prevention studies before the combustion process can be another type of emission abatement studies. Alternative fuel use at ship main engine and diesel generators is one of the prevention studies before the combustion process (Calleya et al., 2011). As an alternative fuel (LNG) is in demand. There are 668 LNG fueled ship in operation, and 76 new buildings are continuing (Zincir and Dere, 2015).

Also important that the Committee approved the amendments, which entered into force on 1 January 2017, about mandatory minimum requirements for the training and qualifications of masters, officers, ratings and other personnel on ships subject to the IGF Code to the 1978 STCW as Resolution MSC.396(95) and MSC.397(95) (Zincir and Dere, 2015).

Recent developments at both technology and international maritime regulations bring out the necessity of training of engine officers and ratings, which will work at LNG fueled ships. Training types in STCW are indicated as in service experience, training ship experience, training program or simulator training (STCW

2010). Addition to the theoretical training program, and onboard experience, simulator training supports learning and trainees get practical experience (Zincir and Dere, 2015).

3. Research Methodology

This study aims to examine the effect of safety training on the risk management while using LNG. In addition, require training, preventive measures, safety arrangements and reservations while dealing with the liquefied natural gas. The target population is defined according to the data collection method used, which is the questionnaire directed to the seafarers. In addition, the study followed a non-random technique of convenience sampling for the questionnaire designed, as it follows the process of reaching the sample through the easy to access. A sample size of 200 seafarer was used in the study with respondents' ratio of 50%, as the questionnaires were distributed to a sample of 400 seafarers but only 200 of them were returned and accepted. The variables used in this study can be categorized into two main types, which are; the dependent and independent variables.

Independent Variable: Safety Training.
Dependent Variable: Risk Management.

Figure 1, represents the proposed study model for this research, where the study aimed at the variables

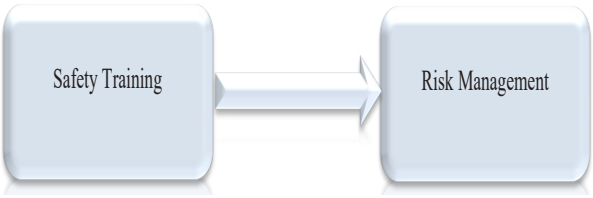


Figure 1: Research Framework

Table 1: Research Variables Statements

Variables	Measurement	References
Safety Training	Contribute to the safe operation of a ship subject to the IGF Code.	Zincir and Dere (2015)
	Take precautions to prevent hazards on a ship subject to the IGF Code.	
	Apply occupational health and safety precautions and measures.	
	Carryout firefighting operations on a ship subject to the IGF Code.	
	Respond to emergencies.	
	Take precautions to prevent pollution of the environment from the release of fuels found on ships subject to the IGF Code.	
	Familiarity with physical and chemical properties of fuels aboard ships subject to the IGF Code.	
	Operate controls of fuel related to propulsion plant and engineering systems and services and safety devices on ships subject to the IGF Code.	
	Ability to safely perform and monitor all operations related to the fuels used on board ships subject to the IGF Code.	
	Plan and monitor safe bunkering, stowage and securing of the fuel on board ships subject to the IGF Code.	
	Take precautions to prevent pollution of the environment from the release of fuels from ships subject to the IGF Code.	
	Monitor and control compliance with legislative requirements.	
	Take precautions to prevent hazards.	
	Apply occupational health and safety precautions and measures on board a ship subject to the IGF Code.	
	Knowledge of the prevention, control and firefighting and extinguishing systems on board ships subject to the IGF Code.	
Risk Management	Our top management team has a strong propensity for high-risk projects (with chances of very high return).	Szambelan and Jiang (2019) Boso et al. (2013) Ndubisi and Agarwal (2014)
	Our top management team believes that owing to the nature of the environment, bold, wide-ranging acts are necessary to achieve our organization's objectives.	
	When there is uncertainty, our organization typically adopts a bold, aggressive posture in order to maximize the probability of exploiting potential opportunities.	
	Export manager in our venture, in general, tends to invest in high-risk export projects.	
	This business venture shows a great deal of tolerance for high-risk export projects.	

4. Research Analysis and Findings

The researcher in this section tests the hypothesis of the research, which is that there is a relationship between research variables. First, the study starts with Validity and Reliability Tests. Second, descriptive analysis is used to data. Third, the researcher performs the normality testing in order to find out if the data is subject to the normal distribution or not. Finally, regression assumption is conducted.

4.1 Data Testing using Validity and Reliability for the Research Variables

In this section, the validity for the statements used to measure the research variables. The independent variable is safety training. In addition to the dependent variable, which is risk management. Validity analysis implies the extent to which an instrument measures or estimates what it supposes to quantify effectively and measure correctly. Convergent validity tests the data utilizing factor analysis (multivariate technique), where the average variance extracted for each of the scales was determined and calculated. The average variance extracted (AVE) shows the average community for latent factor, which should be 50% or more. In addition, item reliability can be evaluated by the size of the factor loadings of the measures on their corresponding constructs, which should be at least 0.4 (Bell et al., 2018). On the other hand, reliability analysis refers to the level of consistency of the scale used to measure the specified construct. Cronbach's Alpha, as the most commonly and usually utilized trial test of reliability, was applied. It was demonstrated that 0.7 is a satisfactory reliability coefficient but lower thresholds are sometimes used in the literature (Fuentes-Huerta et al., 2018).

This section tests the validity and reliability of the independent variable; it was measured using six statements. Table 2 shows the factor loading of the statements as well as the average variance extracted for the safety training. It was found that the factor loadings of the fifteen statements are greater than 0.4. In addition, the result of AVE was 63.315%, which is more than 50%; therefore, all the fifteen statements of the safety training are valid.

Table 2: Validity of Safety Training Statements

Items	Factor Loading	AVE
ST1	.614	
ST2	.604	
ST3	.591	
ST4	.603	
ST5	.715	
ST6	.641	
ST7	.621	
ST8	.625	63.315%
ST9	.627	
ST10	.693	
ST11	.563	
ST12	.683	
ST13	.671	
ST14	.638	
ST15	.608	

Regarding the reliability test, Table 3 shows the result of the reliability test. It is observed that the Cronbach Alpha of the safety training statements is 0.958, which is more than 0.7. This means that the statements of safety training statements are reliable to form this construct.

Table 3: Reliability Test of Safety Training Statements

Cronbach's Alpha	N of Items
.958	15

Regarding the validity and reliability of the dependent variable, it was measured using four statements. Table 4 shows the factor loading of the statements as well as the average variance extracted for the risk management. It was found that the factor loadings of the five statements are 0.741, 0.625, 0.587, 0.626 and 0.672 for R1, R2, R3, R4 and R5 respectively, which are greater than 0.4. In addition, the result of AVE was 65.013%, which is more than 50%, therefore, all the four statements of the risk management are valid.

Table 4: Validity Test of Risk Management Statements

	Factor Loading	AVE
R1	.741	
R2	.625	
R3	.587	65.013%
R4	.626	
R5	.672	

The reliability test of the assigned statements is shown in Table 5. It could be noticed that the Cronbach Alpha is 0.861 (more than 0.7), which means that the assigned statements are reliable to form this construct.

Table 5: Reliability Test of Risk Management

Cronbach's Alpha	N of Items
.861	5

4.2 Descriptive Analysis for the Research Variable

Table 6 illustrates the descriptive analysis for the research variables using the Mean, Minimum,

Maximum and Standard Deviation for the research variables. The mean value of Safety Training is found to be 4.9050 with a standard deviation of 0.29395 with minimum and maximum equal to 4.00 and 5.00 respectively. In addition, the mean value of Risk Management is found to be 4.8950 with a standard deviation of 0.30732 with minimum and maximum equal to 4.00 and 5.00 respectively. Therefore, the mean values are between neutral and agreement zone so there is still the area of improvement on research variables, which need to know the significant factors to the dependent to make the required improvement.

Table 6: Descriptive Analysis for the Research Variables

	N	Minimum	Maximum	Mean	Std. Deviation
Safety Training	200	4.00	5.00	4.9050	.29395
Risk Management	200	4.00	5.00	4.8950	.30732

4.3 Normality Test for the Research Variable

Normality is one of the assumptions that have to be verified to determine if a data set is normal. In order to check the normality for the data, two types of tests are conducted: formal and informal. Table 7 shows the formal testing of normality assumption for the research variables using the Kolmogorov-Smirnov test of normality. It could be observed that the research variables are not normally distributed, as the corresponding P-values are less than 0.05.

Table 7: Formal Testing of Normality for the Research Variables

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Safety Training	.532	200	.000	.332	200	.000
Risk Management	.529	200	.000	.352	200	.000

4.4 Testing the Research Hypotheses

In this section, the researcher tests the main assigned hypothesis of the study. The hypothesis is tested in the next section. According to the normality testing mentioned above, the researcher could use non-parametric test of Spearman correlation to show the relationship between the independent variable (Safety Training) and Risk Management (the dependent variable). Table 8 shows the relationship between Safety Training and Risk Management. It could be observed that there is a positive significant relationship between Safety Training and Risk Management as (P-Value < 0.05), (r > 0).

Table 8: Correlation Matrix between Safety Training and Risk Management

			Safety Training	Risk Management
Spearman's rho	Safety Training	Correlation Coefficient	1.000	.390**
		Sig. (2-tailed)	.	.000
		N	200	200
	Risk Management	Correlation Coefficient	.390**	1.000
		Sig. (2-tailed)	.000	.
		N	200	200

Table 9 shows the regression model fitted for the effect of Safety Training on Risk Management. It illustrates that there is a positive significant relationship between Safety Training and Risk Management, as the regression coefficient is 0.407 (β > 0) and P-value is 0.000 (p-value < 0.05). Moreover, the R square is 0.152, which means 15.2% of the variation in Risk Management can be explained by the model.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	R Square	P Value
		B	Std. Error	Beta				
1	(Constant)	2.897	.336		8.615	.000	0.152	0.000
	Safety Training	.407	.068	.390	5.954	.000		

4.5 Testing Regression Assumptions

This section investigates and verifies the regression assumptions for the above conducted models. The problems of multicollinearity, autocorrelation and heteroscedasticity are discussed below .

Multicollinearity: It investigates one of the important assumptions required to avoid redundancy of information in the model under study, which is the problems of multicollinearity. It occurs when two or more predictors in a model are highly correlated with each other. This leads to problems with understanding, which predictors contribute to the variance explained in criterion, as well as technical issues in calculating a multiple regression model. Therefore, redundant information about the criterion is provided.

Multicollinearity problem is detected using the Variance Inflation Factor (VIF), which shows the degree of correlation between the research variables. A VIF greater than 5 shows that there is a high correlation between the independent variables, implying the presence of a multicollinearity problem, and vice versa. By testing VIFs as shown in Table 10, it could be observed that the VIFs of the Research Variables are less than 5, implying that there is no problem of multicollinearity between the independent variables.

Table 10: VIF Values of the Research Variables

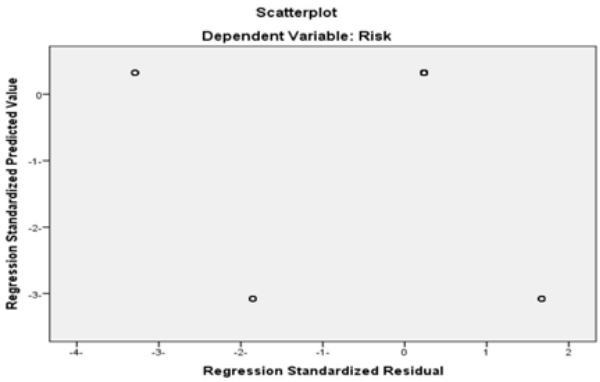
Model		Collinearity Statistics
		VIF
1	(Constant)	
	Safety Training	1.000

Autocorrelation: It is another important assumption of the ordinary least squares' method of regression analysis. It means that there is a relationship between the errors present in the model. It is tested using the Durbin-Watson (D-W), as it is one of the statistic tests examining the null hypothesis that the residuals are not autocorrelated against the alternative that the residuals follow an autocorrelation process. Applying the D-W test as shown below by observing the Durbin Watson value should be close to 2. Since this model test result is equal to 2.130, the null hypothesis of no autocorrelation is supported. This implies that there is no problem of autocorrelation.

Durbin-Watson Value = 2.130

Homoscedasticity Assumption: It is the problem of having inconstant variance in the model assigned. With respect to this, the scatter plot of the standardized residuals against the unstandardized predicted values is used to check this assumption visually. The results indicate that the relationships among variables are homoscedastic, as shown in Figure 2.

Figure 2: Scatter Plot for Heteroscedasticity



5.Conclusions, Recommendation and Limitation

This study aims to examine the impact of Safety Training on Risk Management. To test this goal, the researcher used the classical philosophy in this study and the inductive approach because they are more compatible with the nature of the research and with what the researcher wants to reach. Consequently, the data required to test the goal of the study was collected through the quantitative data issued from the questionnaire that was distributed to collect the required data by workers in the energy sector companies. Statistical methods such as: correlation and regression model had been used. Each of the measures of validity and reliability are also used, and the truthfulness and reliability of the data are intended as two important conditions that must be fulfilled and available to start using the available data to respond to the research hypotheses.

The recommendations of the current research are that the research should focus on other variables that affect the Risk Management in order to limit the problems and risks arising from using the Liquefied Natural Gas. Future research will be able to have a better timeframe to be able to collect a larger sample as well as follow the technique of random sampling. More future research is needed to explore the role of the training of using LNG in order to gain a general understanding of its problems and risks and tend to minimize these risks through focusing in safety training .

This research has several limitations through the study that I covered. First, the time limit to

finish the research, which was a hindrance to collecting a larger sample size to represent the data under study. The second limitation was the small number of sample size used in the questionnaires collected, which pushed them to the blanket count method.

References

Arefin, M.A., Nabi, M.N., Akram, M.W., Islam, M.T. and Chowdhury, M.W., (2020). A Review on Liquefied Natural Gas as Fuels for Dual Fuel Engines: Opportunities, Challenges and Responses. Energies, 13(22), p.6127.

Bengtsson, S., Andersson, K. and Fridell, E., (2011). A comparative life cycle assessment of marine fuels: liquefied natural gas and three other fossil fuels. Proceedings of the Institution of Mechanical Engineers, Part M: Journal of Engineering for the Maritime Environment, 225(2), pp.97-110.

Bilen, K., Ozyurt, O., Bakırcı, K., Karslı, S., Erdogan, S., Yılmaz, M. and Comaklı, O.,(2008). Energy production, consumption, and environmental pollution for sustainable development: A case study in Turkey. Renewable and Sustainable Energy Reviews, 12(6), pp.1529-1561.

Boso, N., Cadogan, J.W. and Story, V.M., (2013). Entrepreneurial orientation and market orientation as drivers of product innovation success: A study of exporters from a developing economy. International Small Business Journal, 31(1), pp.57-81.

Calleya, J., Mouzakis, P., Pawling, R., Bucknall, R. and Greig, A., (2011). Assessing the Carbon Dioxide Emission Reduction Potential of a Natural Gas Container Carrier. In International Conference on Technologies, Operations, Logistics and Modelling for Low Carbon Shipping, LCS (pp. 309-320).

Dodge, E., (2014). How Dangerous is LNG?. Breaking Energy.

He, T., Chong, Z.R., Zheng, J., Ju, Y. and Linga, P. (2019). LNG cold energy utilization: Prospects and challenges. Energy, 170, pp.557-568.

Lowell, D., Wang, H. and Lutsey, N., (2013). Assessment of the fuel cycle impact of liquefied natural gas as used in international shipping. The International Council on Clean Transportation.

Ndubisi, N.O. and Agarwal, J., (2014). Quality performance of SMEs in a developing economy: direct and indirect effects of service innovation and entrepreneurial orientation. Journal of Business & Industrial Marketing.

Shavell, S., (2018). Liability for harm versus regulation of safety (pp. 45-62). Routledge.
Szambelan, S.M. and Jiang, Y.D., (2019). Effectual control orientation and innovation performance: clarifying implications in the corporate context. Small Business Economics, pp.1-18.

Woodward, J.L. and Pitbaldo, R., (2010). LNG risk based safety: modeling and consequence analysis. John Wiley & Sons.

Zincir, B. and Dere, C., (2015). Adaptation of LNG fuel system workout to a simulator for training purpose of engine officers. In International Conference on Engine Room Simulators (ICERS12) Proceedings Book (pp. 115-122).

An examination of Egypt's wreck-related national laws in light of the Nairobi International Convention on the Removal of Wrecks, 2007

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المستخلص:

حطام السفينة هو أحد أكثر نتائج الحوادث البحرية كارثية. عندما تقع إحدى هذه الحوادث وتتحطم السفينة، لا يفقد مالك السفينة أحد الأصول القيمة فحسب، بل قد يواجه أيضًا تكاليف إضافية كبيرة في إزالة الحطام. تضع اتفاقية نيروبي الدولية بشأن إزالة الحطام ٢٠٠٧ (اتفاقية نيروبي لإزالة الحطام ٢٠٠٧) قواعد دولية موحدة لضمان الإزالة السريعة والفعالة للحطام الموجود خارج البحر الإقليمي وفي بعض الاحيان داخله. وهي تركز على وضع تدابير لتسهيل إزالة الحطام، وكذلك تحديد مخاطر الحطام. كما تفرض التأمين الإجباري وتنص على الحق في رفع دعوى ضد شركة تأمين المسؤولية.

نظرًا لأن حطام السفن يمكن أن يعرض الملاحة والبيئة البحرية للخطر، فقد تم إجراء تقييم للأحكام الحالية للقانون المصري التي تحكم إزالة الحطام، وتم اجراء تحليل قانوني لأحكام اتفاقية نيروبي لإزالة الحطام لعام ٢٠٠٧ لإثبات فوائد دمجها في القانون المصري. تستند النتائج إلى فحص التشريع المصري الحالي لإزالة الحطام وكذلك اتفاقية نيروبي الدولية بشأن إزالة الحطام لعام ٢٠٠٧. تم اتباع أسلوب وصفي تحليلي للبحث.

Abstract:

Shipwreck is one of the most disastrous outcomes of a maritime accident. When one of these incidents occurs and a ship is wrecked, the shipowner not only loses a valuable asset, but he may also face significant additional costs in removing the wreck. The Nairobi International Convention on the Removal of Wrecks 2007 (Nairobi WRC 2007) establishes uniform international rules to ensure the quick and effective removal of wrecks located beyond and, in certain circumstances, within the territorial sea. It focuses on measures to facilitate wreck removal, as well as hazard determination of wreck. It also mandates compulsory insurance and establishes a direct right of action against the liability insurer. Given that wrecks can endanger navigation and the marine environment, an assessment of current Egyptian law provisions governing wreck removal is made, and legal analyses are provided to demonstrate the benefits of incorporating the Nairobi WRC 2007 into Egyptian law. The findings are based on an examination of current Egyptian wreck removal legislation as well as the Nairobi International Convention on Wreck Removal, 2007. The research method was descriptive-analytic .

Keywords: shipwrecks, wreck removal, Egyptian Law, The Nairobi International Convention of the Removal of Wrecks 2007, Navigation hazard, Environmental hazard, Liability.

1- Introduction.

One of the worst possible outcome of a maritime casualties is shipwreck. When a ship is wrecked, the shipowner not only loses a valuable asset, but may also incur significant additional costs in removing the resulting wreck. Usually, the shipowner, when confronted with a worthless shipwreck, his first thought is, can I simply abandon this wreck and walk away without further liability? The increased interest in wrecks and wreck removal can be attributed to a number of factors. One motivating factor is most likely the increased amount of money spent on salvaging ships and removing wrecks (International Salvage Union, 2021).

Advances in the salvage and wreck removal industry, as well as cutting-edge technology, have enabled more complex removal processes to occur, and as a result, wrecks that could previously not be reached and removed can now be reached and removed (Gaskell and Forrest, 2019).

The costs associated with this ability to salve and remove wrecks in increasingly complex situations have increased dramatically (Nicholas Gaskell and Craig Forrest, 2016). Increased costs can also be attributed to interventions by states or other authorities in various salvage and wreck removal operations, which result in additional or different actions than the parties involved had anticipated (Gaskell and Forrest, 2019).

The removal of the passenger cruise ship Costa Concordia, which ran aground outside the island of Giglio off the coast of western Italy in 2012, is probably the most well-known case of a wreck removal operation in recent times. It is estimated that the wreck removal cost one and a half billion euros (Gaskell and Forrest, 2019). The total cost of the top 20 most expensive wreck removals over the last decade is currently around US$ 2.11 billion, with some cases still ongoing (Andreas Tsavliris, 2021).

The high costs of removing wrecks raise the question of why it is necessary to do so? The answer is complicated, because wrecks may need to be removed for a variety of reasons. These are classified into two groups. Firstly, a wreck may be an obstacle and pose a hazard to the navigation of vessels. This is especially likely if the wreck is located in a busy shipping area. The second category includes wrecks that pose a threat to the environment. The various interests and conflicts concerning wrecks and wreck removal have been condensed into two spheres: proprietary interests concerning wrecks on the one hand, and problems that wrecks can pose on the other (Jhonnie Kern, 2021).

Wreck-related hazards and dangers may necessitate actions to mitigate, reduce, or eliminate the involved danger or hazard. Legal tools are required to enable such actions and to assign risk and responsibility in such situations. For example, on June 2, 2021, the oil service boat Inspecta 7 sank off the coast of Ras Ghareb, on the Egyptian side of the Red Sea, killing the captain and an engineer while successfully rescuing eleven crew members. The Inspecta 7 was a supply ship for an oil company and was associated with the Ras Ghareb Ministry of Petroleum and Mineral Wealth. According to preliminary investigations, the ship collided with the wreckage of a sunken boat at the bottom of the sea .

The following sections of this paper outline the circumstances under which Egyptian authorities can currently demand the removal of wrecked vessels from their owners. The Nairobi International Convention on Wreck Removal 2007 (Nairobi WRC 2007), which entered into force on April 14, 2015, provides a framework for wreck removal in an attempt to internationally standardize wreck removal law.

This study argues that the current state of Egyptian wreck removal law necessitates the application of the Wreck removal convention 2007, by analysing the benefits of doing so. The Convention provides good opportunity for both Egyptian domestic wreck removal law and international wreck removal regime harmonisation. Furthermore, the key test for determining when a wreck must be removed under the Convention is a far superior alternative to the Egyptian test currently in use. Thus, If Egypt ratify the Convention, the Egyptian authorities must take the steps stipulated in article 3(2) to extend the Convention's application beyond Egypt's exclusive economic zone and into its territorial waters.

This study's limitations are geographically to Egypt's sea areas, including Egyptian internal

waters, territorial seas, and exclusive economic zones. This work does not address the high seas or other maritime jurisdiction areas of neighbouring states.

2- Definitions

Before delving into the circumstances under which the Egyptian Authorities can order the removal of wrecks, it is necessary to define a wreck. According to the Egyptian legislator, the term wreck is associated with the occurrence of a maritime casualty. Pursuant to Law No. 79/1961 a "maritime casualty" is refers to a ship that has been totally damaged, stranded, or is in danger. Therefore, the ship may become a wreck as a result of a maritime casualty.

The term "wreck" is defined in Law No.79/1961 as "anything discovered on the Egyptian coasts or in its territorial waters that is made up of the remains of a ship or its cargo" (Law No.79/1961). Also, The Nairobi International Convention on the Removal of Wrecks 2007 (Nairobi WRC 2007), combines the terms wreck and maritime casualty. A maritime casualty is defined by the convention as: “a collision of ships, stranding or other incident of navigation, or other occurrence on board a ship or external to it, resulting in material damage or imminent threat of material damage to a ship or its cargo” (WRC 2007, Article 1). This definition is so broad that it is difficult to imagine a scenario in which a wreckage does not also occur as a result of a maritime casualty as defined .

The term "wreck" is broadly defined in the Convention's Article 1(4) (a-d), which states that a wreck is: a) a sunken or stranded ship; or b) any part of a sunken or stranded ship, including any object that is or has been on board such a ship; or c) any object that is lost at sea from a ship and that is stranded, sunken or adrift at sea; or d) a ship that is about, or may reasonably be expected, to sink or to strand, where effective measures to assist the ship or any property in danger are not already being taken.

As can be seen, the definitions of wreck in both the Law No. 79/1961 and The Convention have some differences. Objects on board are considered wrecks under both legal frameworks, regardless of whether the ship is stranded or has sunk. Article 1(4)(c) of The Convention, for example, extends this to include objects lost overboard even if the ship has not become a wreck. This definition will include floating containers (Herbert and Lloyd's, 2013). According to The Convention, such items are thus considered wrecks on their own. As a result, in that issue, The Convention is sharing the Law No.79/1961. Furthermore, Pursuant to Article 1(4) of the convention, the term wreck refers to a situation in which the ship has not yet sunk or stranded but is expected to sink or strand and effective assistance measures for the ship or any property in danger are not yet in place.

3- Legal Frameworks Governing the Removal of Wrecks in Egypt.

Currently, five legislations govern the removal of wrecks in Egypt:

1- Law No. 79/1961 concerning maritime catastrophes and wrecks.
2- Military Minister Decree No. 726 of 1962 on maritime wrecks.
3- Ministerial Decree No. 525 of 2001 prohibiting the removal of any Maritime wrecks from Egyptian territorial waters without the Ports and Lighthouses Authority's permission.
4- The Transport Ministry Decree No. 360 of 2018 governing the removal of maritime wrecks and ships or other units grounded, stranded, or abandoned in ports.
5- The Transport Ministry Decree No. 260 of 2018 on the terms and conditions for issuing licences to remove wrecks and marine units grounded or sinking in Egyptian territorial waters.

Originally, The Egyptian ports and Lighthouses Administration, which has since been replaced by the Egyptian Authority for Maritime Safety (EAMS) (President’s Decree No. 399/2004 Establishing the EAMS), is the official wreck receiver statutorily tasked with receiving and removing wrecks in Egypt (law No. 79/1961).

Wreck removal is specifically addressed in Law No. 79/1961. According to the provisions of the latter, if a wreck occurs within Egyptian territorial waters, EAMS is responsible for ensuring the removal of the wreck if the ship owner or the person who has the right to the ship

fails to do so after being notified by EAMS.

It is worth noting that the EAMS's power over wreck removal is subject to the provisions of any other port-related enactment or law. This is to address any inter-agency conflict that may arise during the management and removal of wrecks in Egypt's territorial waters, especially when such wrecks are discovered within any Egyptian port (Ministerial Decree No. 360/2018). For example, Article 5 of the Ministerial Decree No. 360/2018 empowers Ports Authorities to remove wrecks that pose a risk to navigation when the ship owner, master, agent, or person with the ship's right fails to remove the wreck after being notified by them. Therefore, the port authorities would be acting within their statutory mandate to deal with hazardous wrecks found anywhere within Egyptian port limits.

The preceding indicates that, while EAMS may be the Official Receiver of Wrecks as enshrined in Law No. 79/1961, its exercise of that power is subject to the provisions of any other enactment or law relating to Egyptian ports.

Primarily, it is the ship owner's responsibility to remove the wreck. However, for various reasons the removal of the wreck may not take place immediately. The EAMS's duties as encapsulated under the law no, 79/1961 include:

1. Determining whether a wreck is hazardous.
2. Notifying the ship owner.
3. Setting the deadline for removal and
4. Removing a hazardous wreck where the ship owner fails to do so within the set deadline or where a wreck remains unclaimed.

When a ship owner decides to remove a wreck in accordance with Article 11 of Law No. 79/1961, he may do so himself or hire the services of a private salvor during the specified period (three months from wrecked date) after obtaining permission from EAMS (Ministerial Decree No. 260/2018).

Pursuant to Article 12 of law no. 79/1962, the EAMS must "set a reasonable deadline" by which the ship owner must remove the wreck if it poses an impending danger to navigation. The ship owner must then be notified in writing of the deadline and informed that if he fails to remove the wreck by the deadline, the EAMS will do so at the ship owner's expense.

When the EAMS performs its statutory duty of removing a wreck, the ship owner should normally reimburse it. However, there are times when the ship owner refuses to reimburse the EAMS or when the wreck itself is not claimed. In the case of the former, a claim for wreck removal must be filed, resulting in the creation of a maritime lien over the vessel in question. In this case, the EAMS's lien remains inextinguishable until remuneration is paid.

In the latter case, if a wreck remains unclaimed and there is no one to pursue, it is permissible to sell the wreck as long as the EAMS has been in possession of it and reimburse for its cost, with the remainder to be kept until three years pass, if no one claims ownership of the wreck, it will be returned to the Egyptian Government (Article 13, Law No.79/1962).

It is important to note that in any case where the ship owner elects to remove the wreck or decides to use a salvor, the EAMS or port authorities, based on the location of the wreck, also play an important role in stipulating the conditions of the removal while taking the threat to navigational safety into account (Ministerial Decree No.525/2001; Military Minister Decree No. 726/1962).

At this point, a review of the existing provisions of the International Convention on the Removal of Wrecks, 2007 will be beneficial.

4- The Nairobi International Convention on The Removal of Wrecks, 2007 (Nairobi WRC 2007)

On April 14, 2015, the Nairobi International Convention on the Removal of Wrecks entered into force, providing a framework for wreck removal. The convention currently has 56 contracting states as of June 2021 (IMO Treaties Status, 2021). The original main purpose of the convention was to grant the effected state rights to remove a wreck from its Exclusive Economic Zone (EEZ), if the wreck was deemed to constitute a hazard to safe navigation or to the marine environment (Martinez, 2011). The convention's goal is to harmonize wreck removal regulations in various legal systems and international law (LEG/CONF.16/INF.3, p. 1).

The convention intended also to fill a gap in international law by providing Coastal States with clear mandates for wreck removal when it comes to wrecks located outside of the territorial sea, as well as the ability to claim compensation for costs incurred as a result of the removal operation (Charles Michel and Chuck Michel, 2007).

Under the Convention, a State Party may take measures in accordance with the Convention in the case of wrecks located within the EEZ (the area between the 12-nautical mile territorial limit and 200 nautical miles from the coast of a State which is a signatory to the Convention) of state party that pose a hazard (Article 2(1)), and the registered owner must remove any wreck that is determined to be a hazard (Article 9(2)).

According to the convention, a wreck can be classified as a hazard in two ways. First, it could be a risk or an impediment to navigation. Second, it "may be expected to have significant negative consequences for the marine environment, or to cause damage to one or more States' coastlines or related interests" (Article 1(5)). The language in the preamble about wrecks posing a threat to navigation or the environment makes this clear. It is note worth that, this concern for the environment is not addressed in Egyptian legislation governing wreck removal.

The convention includes a list of criteria to consider when determining whether a wreck poses a hazard under Article 1, ranging from the ‘proximity of shipping routes or established traffic lanes' to the ‘amount and types of oil on board the wreck (Article 6).

The Convention provide that, once a hazard has been identified, the affected State has the right to take measures proportionate to the hazard. These measures must not go beyond what is necessary to remove the wreck. Furthermore, once the wreck has been removed, the measures taken must cease and must not unnecessarily conflict with the rights and interests of other States, including the State under whose flag the ship flew and the individuals, legal or physical, who are affected (Articles 2&3).

Pursuant to the Convention, a State Party shall require the master and operator of a ship flying its flag to report immediately to the affected State (the state's EEZ in which the wreck is located) when that ship is involved in a maritime casualty resulting in a wreck (Article 5(1)). Thus, it is sufficient if the incident is reported by either the owner or the operator. This report is required to assist the affected State in determining whether the wreck is a hazard under the Convention.

Furthermore, when the affected State becomes aware of a wreck, it must use all reasonable means to warn mariners and the concerned States of the nature and location of the wreck as soon as possible (Article 7). If the affected State has reason to believe that the wreck poses a hazard, it must take all reasonable steps to determine the exact location of the wreck and mark it (Articles 7 & 8).

When the affected State determines that a wreck poses a hazard in accordance with the convention, the State shall immediately notify the State of the ship's registry and the registered owner. The registered owner is responsible for removing the wreck (Article 9).

The registered owner is “the person or persons registered as the owner of the ship or, in the absence of registration, the person or persons owning the ship at the time of the maritime casualty” (Article 1). As a result, responsibility is directed toward the registered owner. It is worth to note that, in the absence of registration, the time of the wreckage is decisive in determining ownership. A subsequent sale of the ship does not transfer responsibility to the new owner in this case (Article 1).

The registered owner has the authority to contract with any salvor or other person to have the wreck removed. However, the affected State may impose certain conditions on the removal, but only to the extent necessary to ensure that the removal proceeds in accordance with safety and marine environment protection considerations (Article 9).

Although the registered owner is responsible for the wreck's removal, the State affected by the wreck has options. If the registered owner refuses to cooperate or cannot be reached in such situations, the affected State must set a reasonable deadline for the wreck's removal. The length of this deadline must be determined in light of the wreck's danger. The affected State

must notify the registered owner in writing of the deadline and specify that if the owner fails to remove the wreck within the time period, the affected State may do so at the registered owner's expense. Finally, if the hazard becomes particularly severe, the affected State must notify the registered owner in writing that the State intends to intervene immediately (Article 9 (6)).

When immediate action is required and the affected State has notified the State of the ship's registry and the registered owner, the affected State may also begin the removal prior to establishing a wreck removal deadline (Article 9 (8)).

The registered owner is responsible for the costs of locating, marking, and removing the wreck, and he can exonerate the responsibility by demonstrate that the maritime casualty that caused the wreck, resulted from an act of war, hostilities, civil war, insurgency, or a natural phenomenon of exceptional, unavoidable, and irresistible character; or was entirely caused by a third party's act or omission with intent to cause damage; or was entirely caused by the negligence or other wrongful act of any Government or other authority responsible for the maintenance of lights or other navigational aids in the exercise of that function (Article 10).

The Convention imposes strict liability on the registered owner for the wreck removal expenses. In this respect, it is noteworthy that wreck removal expenses are traditionally covered by P & I insurance (Skud Rule, 2021). Thus, it is frequently the cases that the shipowner and his P&I clubs will voluntarily undertake the removal of wreck (Shaw and Tsimplis, 2008).

It should be noted, however, that the registered owner's liability, as seen above, appears to only cover costs incurred by the affected State. This means that costs incurred by actors other than the affected State are not covered.

Also, the convention seeks to ensure enforceability by requiring compulsory insurance for ships with a gross tonnage of 300 tons or more calling any port or offshore facility in a State Party, regardless of where they are registered. Thus, each ship must be issued a certificate attesting to the fact that insurance or other financial security is in force in accordance with the convention (Article 12). In addition, when it comes to the enforceability of the convention, the convention includes an important provision allows an affected state to make a direct claim against the insurer or the person who provides financial security.

٥- The Implications of Egypt's Adoption of the International Convention on the Removal of Wrecks 2007.

Ratification and implementation of the International Convention on the Removal of Wrecks 2007 will provide Egypt with a foundation for extending various powers to require action, for example, under Art. 9(4) -(8) from flag states to Egypt as the affected coastal state under Art. 9(4) -(8). (10). The following is an analysis of Egypt's acceptance of the International Convention for the Removal of Wrecks 2007.

5.1- The advantages of Convention adoption for Egypt

The following are the benefits of the convention extension:

1- The power to compel the Master and operator to notify the EAMS of any wreck in the EEZ. This will support existing obligations to report maritime casualties in the EEZ while also allowing EAMS to receive more specific wreck removal information.

2- The power to compel registered owners to mark or remove most wrecks in the EEZ .

3- A criminal offence may be imposed on foreign flagged ships in the EEZ who fail to comply with the convention's obligations stated in Art. 9(2) - (4), such as removing the wreck, providing insurance details, or complying with deadlines or conditions set by the affected state for wreck removal.

These expanded regulatory powers in the EEZ are clearly advantageous, as evidenced by their utility in future cases.

The convention also includes new or improved liability provisions in the EEZ; e.g. The power of EAMS to recover from the legal owner of the wreck any expenses incurred by EAMS in connection with removing the wreck, as provided for in law No.79/1961, can be extended to include wrecks of foreign vessels in the EEZ.

The expansion of EAMS powers in the EEZ is inextricably linked to the benefits of the convention insurance regime. The convention's primary benefit to states is its compulsory insurance package, which includes a number of components.

1- The convention will allow EAMS to extend the law 79/1961 to recover wreck expenses incurred within Egypt's EEZ directly from the vessel's insurer as well as the shipowner.
2- The EAMS would not need to request and require the shipowner to provide satisfactory security for the removal of a wreck because convention insurance (at least for ships of 300 gt and larger) would be automatically in place for state party ships and other ships visiting Egyptian ports, as well as the vast majority of ships trading internationally.

In cases P&I Clubs are prepared to issue convention certificates, this will be extremely useful for Egypt. Finding a solvent insurer in a jurisdiction where it can be sued and has assets is a major problem for any maritime claimant, especially if the shipowner is a one-ship company with only one asset, a ship that is now worthless. When the Club is involved from the beginning, it is more likely to cooperate with the state, both in terms of practical arrangements (e.g., arranging for contractors) and (possibly) directly paying for expenses. The ability to commence an operation quickly has practical, environmental, and political benefits.

5.2 The disadvantages of Convention adoption for Egypt

The EAMS would need to establish very clear administrative procedures to meet the specific notification requirements in Articles (5-9), such as to flag states and registered owners. These procedures almost, undoubtedly, already exist in large part within EAMS. Similarly, EAMS would be required to create and maintain records in order to satisfy the convention's evidentiary requirements regarding whether action taken (or required) by it is both reasonable and proportionate under Art 2 .

Even though, in the author’s opinion, the clear benefits of applying the convention in Egypt's EEZ clearly outweigh any disadvantages or regulatory burdens that may arise for EAMS in the context of any maritime casualties that result in a wreck in the EEZ.

5.3 The benefits of extending the convention in Egyptian territorial sea

The primary advantage of applying the convention to the territorial sea for Egypt is the ability for the EAMS to directly sue the vessel's insurer. While EAMS may be entitled to recover from the shipowner the expenses incurred in removing the wreck in the territorial sea under Law No. 79/1962, the practical difficulty arises in the case of a foreign shipowner with no assets in Egypt. If the convention is extended to the territorial sea, EAMS would be able to sue the vessel's insurer directly.

The convention ensures that EAMS retains many powers in the territorial sea while limiting them in the EEZ (Article 4(4)). For example, the requirement for the affected state to notify the state of a ship's registry and the registered ship owner that the wreck has been determined to be a hazard; the limitation on the affected state’s intervention when the registered owner removes the wreck .

Furthermore, the convention states that Articles 9(7) and (8) do not apply to territorial waters; thus, EAMS is not bound by the limitation to remove a wreck only if the registered owner fails to do so within the deadline specified in paragraph 6. (a), or if the registered owner cannot be contacted, and EAMS actions are not limited by the requirement that such removal be carried out using the most practical and expedient method available, consistent with safety and marine environment protection considerations .

Moreover, in cases where urgent action is required and the State of the ship's registry and the registered owner have been notified, EASM is not obligated to remove the wreck using the most practical and expedient means available, consistent with safety and marine environment protection considerations.

Although, Article 9(4) allows a shipowner to contract with any salvor or other person to remove the wreck, and only allows the State to set pre-conditions for such removal “to the extent necessary to ensure that the removal

proceeds in a manner consistent with considerations of safety and marine environment protection." However, it is amended in its application to the territorial sea so that its application to the territorial sea is "subject to the national law of the affected state". As a result, this does not appear to limit EAMS's existing powers in the territorial sea.

5.4 The disadvantage of implementing the convention in Egyptian territorial sea

One potential practical disadvantage of extending the convention to territorial waters is that insurers may adopt a more stringent approach to cost payments (Gaskell and Forrest, 2019). An insurer may respond to future major incidents by willingly and quickly providing security or funds up to the convention limit (Article 12), which will not exceed the convention on limitation of liability for maritime claims (LLMC 1996) calculation. This could force EAMS to decide whether to incur any additional wreck-raising costs above that limit and seek to recover them from the shipowner (which may be insolvent). There is currently no indication that International Group P & I Clubs would take such a stance.

6- Conclusion

The Convention achieves the most balanced position on wreck removal available. It clarifies state parties' wreck removal powers in the exclusive economic zone and appears to grant governments explicit powers that they currently have only in theory. Furthermore, the Convention's strict liability and mandatory insurance provisions are likely to appeal to governments looking to increase their chances of recovering wreck removal costs from foreign shipowners.

As it is not clear how far existing Egyptian or international law can apply in the EEZ, at least to foreign flag ships—which are the overwhelming threat. The advantages of the application of the convention to Egyptian's EEZ justify its application over any existing regime. Furthermore, the Convention has been designed to make the application of its provisions to the territorial waters of state parties as simple as possible, where, Article 3(2) of the Convention provides a golden opportunity for Egypt's domestic wreck removal law, which is desperately needed, and this opportunity should not be passed up .

Egypt would benefit from adherence to the convention in three ways: First, the convention gives the coastal state the power to remove wrecks located at its EEZ or any other maritime area established by international law. Because Egypt has claims on the EEZ, it has the authority to remove wrecks located within that zone. Second, the compulsory insurance certificate imposed on registered owners would make it easier for the Egyptian authorities to recover expenses incurred as a result of wrecks because the Egyptian authorities could sue directly the insurer or other person providing financial security for the registered owner's liability. Third, while current Egyptian legislation allows Egyptian authorities to remove wrecks that pose hazard to navigation, the convention would grant them the same authority if the wreck poses an environmental hazard. Thus, in order to ensure effective control of maritime zones in terms of navigation safety and marine environment protection, it is recommended that Egyptian wreck removal laws be expanded to accommodate the enforcement of the International wreck removal convention 2007.

References:

Charles D., and Chuck M., (2007). Introductory note to the Nairobi international convention on the removal of wrecks, International Legal Materials, Vol. 46, No. 4 (July 2007), pp. 694-696, Published By: Cambridge University Press

Gaskell and Forrest, (2016). The Wreck Removal Convention 2007. Lloyd's Maritime and Commercial Law Quarterly, 2016, pp. 49-117. At p. 98.

Gaskell and Forrest, (2019). The Law of Wreck, Informa Law from Routledge. p. 5.

Herbert, J., and Lloyd's, (2013). The Challenges and Implications of Removing Shipwrecks in the 21st Century. London: Lloyd's, at p. 37

International Salvage Union, (2021). International Salvage Union Annual Review 2019.

Available at: https://www.marine-salvage.com/wp Annual_Review_2019.pdf. (Visited on 22 May 2021). at p.10

Kern, J., (2021). Wreck Law – A Systematisation of Legal Interests and Conflicts, Juridiska institutionens skriftserie, at p. 69

Law No. 79/1961, (1961), concerning maritime catastrophes and wrecks. 159 Official Gazette – Vol. 153 on 10 July 1961, Available at: https://www.mts.gov.eg/ar/site/pdf?f=

LEG/CONF.16/INF.3, (2007). International Conference on the Removal of Wrecks, 2007, Nairobi, 14-18 May 2007. Available at: https://docs.imo.org/Category.aspx?

Martinez, A., (2011). "Limitation of Liability in International Maritime Conventions: The Relationship between Global Limitation Conventions and Particular Liability regimes, Routledge, at p. 168

Military Minister Decree No. 726 of 1962 on maritime wrecks. 18 Official Gazette – Vol. 45 on 11 June 1962, Available at: https://www.mts.gov.eg/ar/site/pdf?f=

Ministerial Decree No. 525 of 2001 prohibiting the removal of any Maritime wrecks from Egyptian territorial waters without the Ports and Lighthouses Authority's permission. Available at: Egyptian Authority for Maritime Safety (EAMS) Site https://www.eams.gov.eg/Content/PDF/laws

President's Decree No. 399/2004, establishing the Egyptian Authority for Maritime Safety (EAMS), 2710 Official Gazette – Vol. 50 on 9 December 2004. Available at: https://www.mts.gov.eg/ar/site/pdf?f=

Shaw, R., and Tsimplis, M., (2008). "The Liabilities of the vessel", in Institute of Maritime Law, Southampton on Shipping Law, London: Informa, 2008, at p. 402.

Skud P&I Rules, (2021). Available at: https://www.skuld.com/contentassets/

Status of IMO, (2021). Available at: Treatieshttps://wwwcdn.imo

The Transport Ministry Decree No. 260 of 2018 on the terms and conditions for issuing licences to remove wrecks and marine units grounded or sinking in Egyptian territorial waters. 5 Official Gazette – Vol. 120 on 26 May 2018, Available at: https://www.mts.gov.eg/ar/site/pdf

The Transport Ministry Decree No. 360 of 2018 governing the removal of maritime wrecks and ships or other units grounded, stranded, or abandoned in ports. 3 Official Gazette – Vol. 136 on 13 June 2018, Available at: https://www.mts.gov.eg/ar/site/pdf?f

Tsavliris, A., (2021). Wreck removal issues – the contractors' perspective. International Salvage Union, 2021. Available at ://www.marine-salvage.com/media-information/articles/archive/wreck-removal on 25th May 2021.

The Impact of Simulation Training on Maritime Education Improvement

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المستخلص:

اهتم الباحثون التربويون باستخدام هذه التقنيات الحديثة التي تدعم المواقف التعليمية، وهناك العديد من المحاولات التي تسعى إلى دمج التقنيات الحديثة في التعليم. لذلك، تهدف هذه الورقة إلى دراسة تأثير تدريب المحاكاة (الواقع الافتراضي (VR) والواقع المعزز (AR) والواقع المختلط (MR)) على تحسين التعليم البحري. تستخدم هذه الورقة فلسفة الوضعية لتحقيق هدفها وتحليل فرضياتها بما في ذلك التصميم الكمي، وتم تصميم استبيان وتوزيعه على طلاب الأكاديمية العربية للعلوم والتكنولوجيا والنقل البحري (AASTMT). بعد توزيع الاستبيان على الطلاب تم جمع ٢٥٠ استبانة للتحليل واستخدم برنامج SPSS لتحليل البيانات. وجدت الورقة أن هناك تأثيرًا إيجابيًا كبيرًا للواقع الافتراضي والواقع المعزز على تحسين التعليم البحري. بينما، أثر الواقع المختلط ضئيل على تحسين التعليم البحري.

الكلمات المفتاحية: تدريب المحاكاة، التعليم البحري، الواقع الافتراضي، الواقع المعزز والواقع المختلط.

Abstract:

Education researchers have been interested in using these modern technologies that support educational situations, and there are many attempts that seek to integrate modern technologies into education. Therefore, this paper aims to study the effect of Simulation Training (Virtual Reality (VR), Augmented Reality (AR) and Mixed Reality (MR)) on Maritime Education Improvement. This paper uses the positivism philosophy to achieve its aim and analyze its hypotheses, including quantitative design; a questionnaire was designed and distributed on the students of The Arab Academy for Science, Technology and Maritime Transport (AASTMT). After distributing the questionnaire to the students, 250 valid questionnaires were collected for analysis and SPSS program was used to analyze the data. The paper found that there is a positive significant impact of VR and AR on maritime education improvement. While, insignificant impact of mixed reality on maritime education improvement.

Keywords: Simulation Training, Maritime Education, Virtual Reality, Augmented Reality and Mixed Reality.

1- Introduction.

The world has recently witnessed many developments in the field of educational technology. These developments are moving at a great speed that almost exceeds our speed in keeping pace with them, which has had the greatest impact on the educational process in terms of the emergence of new assistive technologies and learning tool. That makes us in dire need to keep pace with this technical development, the educational arena has witnessed qualitative leaps to keep pace with these developments (Alop, 2019).

There is no doubt that information and communication technology has contributed significantly to the development and change of learning, and led to the emergence of many innovative educational methods that depend on modern technologies. Education researchers have been interested in using these modern technologies that support educational situations. There are many attempts that seek to integrate modern technologies into education, starting with the use of computers in the educational process through the emergence of the internet and the associated boom in the field of education led to the emergence of e-learning, which aims to provide educational programs to learners at anytime and anywhere using many communication techniques with the aim of delivering information to the learner in the shortest time, less effort, and greater benefit (Dalaklis et al., 2016).

Among these modern technologies is the technology of virtual, augmented, and mixed reality, which is one of the most important technologies that integrate the real user environment with digital learning objects to support the educational situation in an interesting and attractive manner that helps to understand abstract concepts (Mallam et al., 2019).

It is clear that the use of VR in the educational process has an effective and attractive effect, because it provides the learner with various virtual educational environments that are difficult to access in the real environment, as it allows him to think and visualize abstract concepts such as watching and observing the eruption of the volcano from the bottom of the earth's crust until its eruption towards the surface earth. Moreover, interactions with experiences that are difficult to study in reality due to their danger, high costs, temporal and spatial dimension, or the speed and slowness of their occurrence in reality (Michael et al., 2019).

AR has become one of the fastest growing technological fields, and the fact that it provides great benefits to humans and affects many areas, and makes life activities easy and enjoyable. Among these areas is the education sector, there are many ways to use AR in education and improve the learning process, as the integration of AR in lectures and classrooms, it attracts students' attention (Luis et al., 2013). AR has many potentials that make it impact the traditional learning process, including the ability to change the place and time of study, and introduce new and additional methods and methods, making the classroom a more attractive place, and the information more understandable (Luis et al., 2013).

MR applications have become an urgent necessity that must be integrated into learning and education to take advantage of this huge number of benefits, because of their ability to improve these processes and make them more interactive. The teacher knows its concept, the idea of its work, its characteristics, and its uses in order to be able to employ it effectively in the learning process. According to strong foundations of educational design that ensures the development of more interesting and high-quality educational situations, thus achieving the highest rates of academic achievement and the desired educational goals (Nazir et al., 2019).

Literature Review

Attention to the quality of education is one of the indicators of the progress of any country and in recent times there has been great interest in the application of educational technology in its various forms according to the available capabilities and as the basis for development in educational institutions and the improvement of educational outcomes and the necessities it reflects for the development of the education system, its programs and methods. In addition, with the spread of the Corona virus and the social distancing it imposed on everyone and the huge damage it has caused in all human societies and the economy, there are radical and beneficial changes that have occurred in many

areas, the most important of which is the field of education (Buenaobra et al., 2018).

The issue of the development of education and its tools is one of the most important issues facing educational institutions, and since the world today is characterized by a huge technological and information revolution that affected various fields of life. It was necessary for educational institutions to move towards the exploitation of technology and its employment for the benefit of the educational process. Today, university students no longer desire to learning by reading books and copying texts, but they want to take advantage of the advantages of technology to use in the classroom (Kavanagh et al., 2017). Moreover, the educational process in the light of the modern technical age has become strongly dependent on modern tools used in publishing and authoring interactive educational curricula using traditional and modern educational methods, which makes the content of the educational materials and their presentation methods different from what they were in the past and the scientific achievements continued after that until the Internet appeared Which has been used since its inception in the process of generalization and learning, and has contributed to changing the way the scientific material is presented to the demands of the students (Luis et al., 2013).

VR is an emerging and innovative technology that aims to provide assistance to individuals to be able to understand and perceive data and information and deal with them easily. This technology is characterized by creating a kind of interaction, as well as virtual reality technology is a sophisticated technology that enables the individual to deal with a fictional environment, and is based on the basis of simulation between the individual and a three-dimensional electronic environment (Kavanagh et al., 2017). Moreover, virtual reality is one of the most important and latest computer applications that is concerned with designing an artificial three-dimensional environment that works to transfer human consciousness to a virtual environment that is formed electronically through the liberation of the mind to dive into the implementation of imagination away from the place of the body, in and its role in improving the educational process which the events take place in the supposed reality and not in reality (Freina and Ott, 2015). Furthermore, virtual reality is a graphic simulation of real reality at the time when the user interacts with the system using special tools such as: protective helmets, gloves, and glasses, and the user has the ability to interact and control the direction of movement (Němec et al., 2017).

Advantages of using VR in education (Ding and Wang, 2017);

• Physical learnability: Augmented and Virtual Reality is able to replace book paper, physical models, posters, and printed brochures with portable learning materials at a lower cost. Thus, education becomes more accessible, portable and mobile.

• It gives education fun and attractiveness: the AR with its interaction and integration of the elements of play in education, makes learning an enjoyable and non-stressful process and has a very positive impact on students and leaves them enjoying the lesson.

• Improves Collaboration Capabilities: Augmented and Virtual Reality applications offer many opportunities to diversify and breathe life into boring classes, and interactive lessons that involve all students in the learning process at the same time and help them improve teamwork skills.

• Makes the learning process faster and more efficient: Augmented and Virtual Reality helps students achieve better results through imagination and full immersion in the subject; Instead of reading a theory about something, students can actually see it with their own eyes.

• Practical learning: Apart from studying, this technology is very useful in professional training, for example, accurate reproduction of field cases in a particular field helps to master the practical skills necessary for a specific job.

• Safe and Effective Workplace Training: Augmented and Virtual Reality makes it possible to practice heart surgery or operate a spacecraft without putting other people at risk or wasting a lot of money when something goes wrong. Based on the above about VR technology and its applications in the field of education and training,

and increasing the interaction and participation of learners within the educational environment. Therefore, the ways will be to another technology (which is primarily derived from VR), which is the AR, where this technology works with a live display, directly or indirectly, of a real environment from the real world without a time delay. So, the modifications are added directly and the filming and modification are not done the display is in separate stages, but the stages are combined together through computer programs, where the input is audio and visual and image data, such as Global Positioning System (GPS) data and the output is a modified version of the real reality (Chang et al., 2013; Chen et al., 2017). AR is a type of VR that aims to replicate the real environment in the computer and enhance it with virtual data that was not part of it (Lee, 2012). In other words, the AR system generates a composite view for the user that mixes the real scene viewed by the user and the computer-generated virtual scene that enhances the real scene with additional information (Kesim and Ozarslan, 2012).

AR has several advantages that led to the emergence of their importance and justified the need for them in educational institutions, and they can be identified in the following points (Yahaya et al., 2015; Akçayır and Akçayır, 2017);

• Stimulating the motivation and enthusiasm of learners, where the scientific material is presented in an attractive and interesting manner in a manner that is compatible with the technology generation, where the learner is involved in ways that were not possible through the activation of the senses.

• The possibility of providing educational experiences through three-dimensional models, where the learner is able to view and analyze topics from different sides, and this gives a deeper understanding of the topics, as it provides a correct and comprehensive mental picture of educational experiences.

• Providing educational experiences in the same hard-to-reach educational site as Space, Volcano.

• Provide an opportunity for students to engage in indigenous practices, however difficult they may be in the real world.

• Handling dangerous materials without being harmed, such as: nuclear reactions, chemical reactions.

• It does not need a specific learning environment as it can be applied in the classroom.

• Taking into account individual differences, as it gives an opportunity to view the shapes from different sides and the learner interacts with real experiences away from misconceptions.

• Promoting cooperative learning and social interaction among learners in the same educational environment through the improvement of the computerized program on smart phones and the active participation of students in solving educational problems.

• Providing rich educational content, and helps to understand the content as it is firmly rooted in the student's memory than what he acquires through traditional means.

• Provides opportunities for more realistic learning and independent learning styles.

• It makes learning fun and challenges the learner's abilities to be creative.

• Achieving continuous learning for all, and improving collaborations between group members and between students and their teachers.

• Compensating the lack of resources in education, reducing the cost, and creating an exciting environment during education.

• Make the rich information available on the Internet accompany the learner wherever he is.

It is now witnessing the beginning of a new golden age for many technologies that are developing at a pace, which had not seen before, and the next era will be the era of MR. Many technology experts predict that MR, once it becomes widespread, will transform the world into entirely new places where people learn, work, communicate and interact (Maas and Hughes, 2020). MR is the addition of virtual objects or objects to the “real” environment to produce new and hybrid environments and visuals in which the user can walk, change the location and size of objects and control them naturally using hand gestures, eye movements and voice commands (Dieckmann et al., 2020). In the field of education, it is possible through MR technology to create virtual classrooms, attend and discuss teachers as if the student is

actually sitting in these rooms. Also, this technique helps students to understand and study anatomy effectively (Palaigeorgiou et al., 2019). MR applications in education are characterized by providing a safe environment for the learner to control it positively, simulating his behavior in real situations, and is also characterized by subjectivity in learning. It takes into account individual differences and increases the motivation, activity and participation of the learner, develops his motor skills, removes the fear of trying things, and develops innovation and curiosity. Moreover, it provides flexibility in modifying the components of the educational environment and changing some of its characteristics to suit the learner without being restricted to its traditional forms (Rathinasabapathi et al., 2019).

Therefore, this paper investigated the impact of simulation training (VR), (AR) and (MR) on Maritime Education Improvement through some previous studies.

According to these previous studies, there are few studies that examined the role of simulation training; VR, AR and MR on maritime education improvement. Therefore, the current paper contributed in examining this relationship. Furthermore, the studies were applied in developed and there were no studies applied in developing countries. Therefore, the researcher examined this relationship in developing countries represented in Egypt.

Research Methodology

This paper used the positivism philosophy to achieve its aim and analyze its hypotheses, including quantitative design; a questionnaire was designed and distributed to the students of The Arab Academy for Science, Technology and Maritime Transport (AASTMT). After distributing the questionnaire to the students, 250 valid questionnaires were collected for analysis. The SPSS program was used to analyze the data through descriptive analysis, normal distribution analysis, and to test the relationship between the variables through correlation and regression analysis.

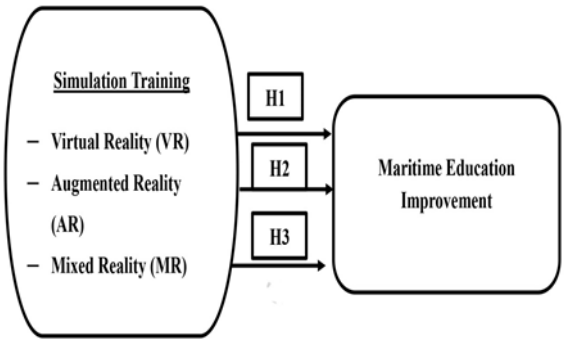

Figure 1: Conceptual Framework

Research Variables

Dependent Variable: Maritime Education Development

Independent Variable: Simulation Training ((VR), (AR) and (MR)).

Table 1: The Measurements of the Research Variables

Variables	SYMPOL	Statement
Virtual Reality (VR)	VR1	1- VR refers to all computer technologies promoting generation of virtual environments allowing the user to interact with them.
	VR2	2- The virtual platform was considered realistic and useful.
	VR3	3- VR proved to play a key role in fostering skills and to improve knowledge.
	VR4	4- Virtual simulation training could be regarded as an invaluable tool allowing students to put into practice their set of skills in a completely new and innovative manner of student/tutor interaction.
	VR5	5- During COVID-19 pandemic, the use of virtual reality was promptly adopted in universities to overcome this educational gap.
Augmented Reality (AR)	AR1	1- AR is an overlay of information on the real world.
	AR2	2- AR can further improve the workflow and facilitate workers access to information.
	AR3	3- AR can facilitate knowledge acquisition and communication.
	AR4	4- AR can transmit a live video feed to remote locations.
	AR5	5- Users are aware of what is going on in the real world when they are using AR (e.g., Google Glasses and Apple AR).
Mixed Reality (MR)	MR1	1- MR merges real and virtual worlds to produce hybrid synthetic environments where physical and digital objects co-exist and interact in real time.
	MR2	2- MR system could reduce the amount of time required at traditional MET facilities by allowing user access while onboard, travelling or at home.

Variables	SYMPOL	Statement
	MR3	3- MR systems could increase opportunities for immersive simulator training.
	MR4	4- MR can provide best-practice instructions and reminders in high stress situations.
	MR5	5- MR technology can be used to facilitate distributed and remote operations.
Maritime Education Improvement	ME1	1- All-important content was easy to locate and identify.
	ME2	2- The strategy provides clear means of obtaining technical help.
	ME3	3- Strategy is appropriate for the topic.
	ME4	4- Strategy has sufficient time for discussions.
	ME5	5- Strategy does not need further support.
	ME6	6- I know how I will use the course material in new situations.
	ME7	7- As a result of this course, I am able to apply my learning to other, similar courses.
	ME8	8- I have opportunities to apply the course material.
	ME9	9- With the knowledge gained from this course, I can more broadly explore a problem in the field of study.
	ME10	10- As a result of this course, I am able to apply my learning to a different context, such as my personal or professional life.

Research Hypothesis

Accordingly, from the framework the paper hypotheses could be stated as follows:

H1: There is a significant relationship between VR and Maritime Education Improvement.

H2: There is a significant relationship between AR and Maritime Education Improvement.

H3: There is a significant relationship between MR and Maritime Education Improvement.

Results Analysis

This section introduces the empirical study with the main findings and results after running the data analysis.

Validity and Reliability Test

Table 2 exhibits the validity and reliability test of these research variables. It very well be seen that the data exhibited Kaiser-Meyer-Olkin benchmark of sampling correctness and adequacy (KMO) more prominent than 0.5, which was viewed as great. As Kaiser-Meyer-Olkin (KMO) test is a statistical measure to determine how suited data is for factor analysis. The test measures sampling adequacy for each variable in the model and the complete model. The statistic is a measure of the proportion of variance among variables that might be common variance. It is important to understand that the Average Variance Extracted (AVE) was discovered to be over half (more than 50%). In addition, all Cronbach's alpha values are more noteworthy than 0.7.

Table 2: Validity and Reliability Test

Variables	KMO	AVE	Cronbach's Alpha	Items	Factor Loading
Virtual Reality	.810	54.712%	.790	VR1	.545
				VR2	.449
				VR3	.685
				VR4	.568
				VR5	.489
Augmented Reality	.695	53.599%	.711	AR1	.487
				AR2	.499
				AR3	.547
				AR5	.611
Mixed Reality	.804	59.630%	.823	MR1	.540
				MR2	.614
				MR3	.522
				MR4	.795
				MR5	.481
Maritime Education Improvement	.810	50.924%	.807	ME1	.587
				ME2	.463
				ME3	.505
				ME4	.466
				ME7	.562
				ME10	.473

Descriptive Analysis for the Research Variables

Descriptive statistics is a tool that explains and gives a clear understanding of the characteristics of a particular data set, by providing short summaries about the samples and how the data was measured. Descriptive analyzes give a list statistic that includes the means and standard deviations of each variable and also shows the frequency. It is noted from the table that the majority of the answers are biased towards the area of agreement. Table 3 shows the descriptive analysis of the research variables: Virtual Reality, Augmented Reality, Mixed Reality and Maritime Education Improvement.

Table 3: Descriptive Analysis for the Research Variables

Research Variables	N	Mean	Std. Deviation	Frequency				
				1	2	3	4	5
Virtual Reality	250	4.4840	.63510	0	0	19	91	140
Augmented Reality	250	4.5160	.58232	0	0	11	99	140
Mixed Reality	250	4.5040	.60286	0	0	14	96	140
Maritime Education Improvement	250	4.5040	.60286	0	0	14	96	140

Normality Testing

The formal testing of normality assumption for the research variables was done using the

Kolmogorov-Smirnov test of normality as shown in Table 4. It could be observed that the research variables are not normally distributed, as the corresponding P-values are less than 0.05.

Table 4: Formal Test of Normality Assumption

Variables	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Virtual Reality	.352	250	0.000	.719	250	0.000
Augmented Reality	.357	250	0.000	.704	250	0.000
Mixed Reality	.355	250	0.000	.711	250	0.000
Maritime Education Improvement	.355	250	0.000	.711	250	0.000

The informal test for the normal distribution of the data showed that the value of both Skewness and Kurtosis are between the minimum and the maximum, and this means that the data of this study are abnormal because the numbers are not between ±1. Table 5 shows the informal test of normality. According to the results of the formal test of the normal distribution of the data and the informal test of the normal distribution of the data, the results indicate the use of non-parametric tests.

Table 5: Informal Test of Normality

	N	Skewness		Kurtosis	
	Statistic	Statistic	Std. Error	Statistic	Std. Error
Virtual Reality	250	-.840	.154	-.329	.307
Augmented Reality	250	-.739	.154	-.432	.307
Mixed Reality	250	-.792	.154	-.349	.307
Maritime Education Improvement	250	-.732	.154	-.349	.307

Hypotheses Test

Correlation and regression analysis were conducted in which the paper finds answer to the paper's hypotheses and reaches the relationship between the independent and dependent variables of the paper .

Testing the Relation between Simulators and Maritime Education Improvement

This section represents the results of testing the relation between Simulators and Maritime Education Improvement, where the Pearson's correlation is used depending on the results of normality test. Table 6 shows the relation between Simulators; Virtual Reality, Augmented Reality, Mixed Reality, Maritime Education Improvement.

It could be observed that there is a significant relation between them as P-value is less than 0.05 (P-value =0.000). Moreover, a positive relation is proved between simulators; virtual reality, augmented reality, mixed reality, maritime education improvement, as the correlation coefficient is 0.483, 0.583 and 0.425 respectively.

Table 6: Correlation Analysis of the Research Variables

		1.	2.	3.	4.
1. Virtual Reality	Pearson Correlation	1			
	Sig. (2-tailed)				
	N	250			
2. Augmented Reality	Pearson Correlation	.560**	1		
	Sig. (2-tailed)	.000			
	N	250	250		
3. Mixed Reality	Pearson Correlation	.556**	.560**	1	
	Sig. (2-tailed)	.000	.000		
	N	250	250	250	
4. Maritime Education Improvement	Pearson Correlation	.483**	.583**	.425**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	250	250	250	250

In addition, Table 7 shows the regression model of the relation between virtual reality and maritime education improvement. It could be noticed that there is a positive significant impact of virtual reality on maritime education improvement, as the regression coefficient is 0.458 ($\beta > 0$) and P-value is 0.000 (P-value < 0.05). Moreover, the R-square is 0.233, which means that 23.3% of the variation of the maritime education improvement can be explained by the virtual reality.

Table 7: Regression Analysis of the Relationship between Virtual Reality and Maritime Education Improvement

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	R Square
	B	Std. Error	Beta			
(Constant)	2.450	.239		10.247	.000	.233
Virtual Reality	.458	.053	.483	8.679	.000	
A. Dependent Variable: Maritime Education Improvement						

From the above results, the first hypothesis, which states that "There is a significant relationship between Virtual Reality (VR) and Maritime Education Improvement" is fully supported .

Moreover, Table 8 shows the regression model of the relation between augmented reality and maritime education improvement. It could be noticed that there is a positive significant impact of augmented reality on maritime education improvement, as the regression coefficient is 0.604 ($\beta > 0$) and P-value is 0.000 (P-value < 0.05). Moreover, the R-square is 0.340, which means that 34% of the variation of the maritime education improvement can be explained by the augmented reality.

Table 8: Regression Analysis of the Relationship between Augmented Reality and Maritime Education Improvement

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	R Square
	B	Std. Error	Beta			
(Constant)	1.777	.243		7.309	.000	.340
Augmented Reality	.604	.053	.583	11.308	.000	
A. Dependent Variable: Maritime Education Improvement						

From the above results, the second hypothesis, which states that "There is a significant relationship between Augmented Reality (AR) and Maritime Education Improvement" is fully supported .

Furthermore, Table 9 shows the regression model of the relation between mixed reality and maritime education improvement. It could be noticed that there is a positive significant impact of mixed reality on maritime education improvement, as the regression coefficient is 0.425 ($\beta > 0$) and P-value is 0.000 (P-value < 0.05). Moreover, the R-square is 0.181, which means that 18.1% of the variation of the maritime education improvement can be explained by the mixed reality.

Table 9: Regression Analysis of the Relationship between Mixed Reality and Maritime Education Improvement

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	R Square
	B	Std. Error	Beta			
(Constant)	2.588	.261		9.911	.000	.181
Mixed Reality	.425	.057	.425	7.402	.000	
A. Dependent Variable: Maritime Education Improvement						

From the above results, the third hypothesis, which states that "There is a significant relationship between Mixed Reality and Maritime Education Improvement" is fully supported .

Discussion

This paper used a sample of students at The Arab Academy for Science and Technology and Maritime Transport (AASTMT) to collect data, and this data was analyzed in SPSS to study the relationship between Maritime Education Development and Simulation Training ((VR), (AR) and (MR)). From it, the paper presented three hypotheses, which stated that "H1: There is a significant relationship between Virtual Reality (VR) and Maritime Education Improvement."

"H2: There is a significant relationship between Augmented Reality (AR) and Maritime Education Improvement."

"H3: There is a significant relationship between Mixed Reality (MR) and Maritime Education Improvement."

From these hypotheses, it could be observed that there is a significant relation between them as P-value is less than 0.05 in the correlation analysis and the result of the regression analysis was that it could be noticed that there is a positive significant impact of virtual reality on maritime education improvement, as a P-value is less than 0.05. Moreover, the R-square is 0.233, which means that 23.3% of the variation of the maritime education improvement can be explained by the virtual reality.

The second hypothesis stated "There is a significant relationship between Augmented Reality (AR) on Maritime Education Improvement", It could be observed that there is a significant relation between them as P-value is less than 0.05 in the correlation analysis and the result of the regression analysis was that it could be noticed that there is a positive significant impact of augmented reality on maritime education improvement, as a P-value is less than 0.05. Moreover, the R-square is 0.323, which means that 32.3% of the variation of the maritime education improvement can be explained by the augmented reality.

The third hypothesis stated "There is a

significant relationship between Mixed Reality (MR) on Maritime Education Improvement", It could be observed that there is a significant relation between them as P-value is less than 0.05 in the correlation analysis and the result of the regression analysis was that it could be noticed that there is a positive significant impact of Mixed reality on maritime education improvement, as a P-value is less than 0.05. Moreover, the R-square is 0.181, which means that 18.1% of the variation of the maritime education improvement can be explained by the mixed reality.

Conclusion

Mainly, the paper aimed to study the effect of Simulation Training (Virtual Reality (VR), Augmented Reality (AR) and Mixed Reality (MR)) on Maritime Education Improvement. And from it, she collected data from Arab Academy for Science and Technology and Maritime Transport (AASTMT) students, and a sample size of 250 questionnaires was collected from respondents who were valid for analysis, and after analyzing this data using through descriptive analysis, normal distribution analysis, and to test the relationship between the variables through correlation and regression analysis, the study found that there is a positive significant impact of virtual reality and augmented reality on maritime education improvement, as P-value is less than 0.05. Insignificant impact of mixed reality on maritime education improvement, as P-value is more than 0.05. From this result, the paper partially supported the impact of Simulation Training on Maritime Education Improvement. This is made the paper consistent with the previous literature and proved the positive and significant effect of Simulation Training on Maritime Education Improvement.

Recommendations

There are a number of recommendations that the research reached from the results and conclusions, and the study recommends the following:

-Giving students and parents ample time to deal with the changing educational landscape and prepare themselves for the transition to online learning. This is also additional time for higher education institutions and faculty to prepare their educational materials to improve internet infrastructure and create educational platforms among others in light of the COVID-19 pandemic.

- Adapt and implement a catch-up framework, which gives students the opportunity to graduate within the prescribed period of their curriculum despite the COVID-19 outbreak. The frame shows time maximization without

- Total quality and no year delays for Navy students completing semester education and one-year on-board training and graduation.

- In implementing the framework, it is wise for the school to prepare a contingency plan in case the government allows face-to-face learning to resume and reduce online interactions. And in such a situation, drafting safety and health protocols within the school building is a must to ensure that you are safe from the COVID-19 pandemic is essential.

- Provide a step-by-step application of e-learning materials such as Augmented Reality (AR) and Virtual Reality (VR) that naval students can use online or offline.

- When everything is back to normal, continue to incorporate minimal use of online learning delivery into your marine education. Gradual integration is much better than abrupt transformation.

- When implementing online learning, supplement it by distributing printed educational materials to marine students such as workbooks and work texts.

Limitations

In addition, the research faced several limitations, which are represented first in the size of the research sample, as the research obtained 250 respondents of the questionnaire that was configured for the research, and this resulted in the lack of complete support for the paper hypotheses. Secondly, that the research targeted Egyptian educational institutions, and this limited the existence of a variety of responses to the questionnaire. Finally, the data used in the research were cross-sectional, which makes it difficult to study the evolution of the different variables in the research. This issue is of particular importance when considering the dynamic nature of some research variables.

References

Akçayır, M. and Akçayır, G., 2017. Advantages and challenges associated with augmented reality for education: A systematic review of the literature. Educational Research Review, 20, pp.1-11.

Alop, A., 2019, April. The Challenges of the Digital Technology Era for Maritime Education and Training. In 2019 European Navigation Conference (ENC) (pp. 1-5). IEEE.

Balcita, R.E. and Palaoag, T.D., 2020. Augmented reality model framework for maritime education to alleviate the factors affecting learning experience. International Journal of Information and Education Technology, 10(8), pp.603-607.

Baldauf, M., Dalaklis, D. and Kataria, A., 2016. Team training in safety and security via simulation: A practical dimension of maritime education and training.

Baldauf, M., Dalaklis, D. and Kataria, A., 2016. Team training in safety and security via simulation: A practical dimension of maritime education and training.

Buenaobra, N.A., Cerna Jr, D., Ephrem, G., Noel, C. and Ramos III, S., Impact of Virtual Reality in Maritime Education and Training: The Case of the Maritime Academy of Asia and the Pacific.

Chen, P., Liu, X., Cheng, W. and Huang, R., 2017. A review of using Augmented Reality in Education from 2011 to 2016. Innovations in smart learning, pp.13-18.

Ding, N. and Wang, Y., 2017. The application of virtual reality in education: advantages and challenges. Modern educational technology, 27(2), pp.19-25.

Freina, L. and Ott, M., 2015, April. A literature review on immersive virtual reality in education: state of the art and perspectives. In The international scientific conference elearning and software for education (Vol. 1, No. 133, pp. 10-1007).

Frossinis, D., Anaxagora, N. and Chatzopoulou, E., 2021. Improved Safety On-board Using Augmented Reality Technology as a Training Tool. In The Big Data-Driven Digital Economy: Artificial and Computational Intelligence (pp. 175-189). Springer, Cham.

Gerup, J., Soerensen, C.B. and Dieckmann, P., 2020. Augmented reality and mixed reality for healthcare education beyond surgery: an integrative review. International journal of medical education, 11, p.1.

Kavanagh, S., Luxton-Reilly, A., Wuensche, B. and Plimmer, B., 2017. A systematic review of Virtual Reality in education. Themes in Science and Technology Education, 10(2), pp.85-119.

Kesim, M. and Ozarslan, Y., 2012. Augmented reality in education: current technologies and the potential for education. Procedia-social and behavioral sciences, 47, pp.297-302

Lee, K., 2012. Augmented reality in education and training. TechTrends, 56(2), pp.13-21.

Luis, C.E.M., Mellado, R.C. and Díaz, B.A., 2013. PBL methodologies with embedded augmented reality in higher maritime education: augmented project definitions for chemistry practices. Procedia Computer Science, 25, pp.402-405.

Lvov, Michael S., and Halyna V. Popova. "Simulation technologies of virtual reality usage in the training of future ship navigators." (2019).

Maas, M.J. and Hughes, J.M., 2020. Virtual, augmented and mixed reality in K–12 education: A review of the literature. Technology, Pedagogy and Education, 29(2), pp.231-249.

Mallam, S.C., Nazir, S. and Renganayagalu, S.K., 2019. Rethinking maritime education, training, and operations in the digital era: applications for emerging immersive technologies. Journal of Marine Science and Engineering, 7(12), p.428.

Maung, C.T., 2019. Simulation training and assessment in maritime education and training.

McMillan, K., Flood, K. and Glaeser, R., 2017. Virtual reality, augmented reality, mixed reality, and the marine conservation movement. Aquatic Conservation: Marine and Freshwater Ecosystems, 27, pp.162-168.

Němec, M., Fasuga, R., Trubač, J. and Kratochvíl, J., 2017, October. Using virtual reality in education. In 2017 15th International Conference on Emerging eLearning Technologies and Applications (ICETA) (pp. 1-6). IEEE
\
.

Pellas, N., Kazanidis, I. and Palaigeorgiou, G., 2019. A systematic literature review of mixed reality environments in K-12 education. Education and Information Technologies, pp.1-40.

Saidin, N.F., Halim, N.D.A. and Yahaya, N., 2015. A review of research on augmented reality in education: Advantages and applications. International education studies, 8(13), pp.1-8.

Sharma, A., Kim, T.E. and Nazir, S., 2021. Implications of Automation and Digitalization for Maritime Education and Training. In Sustainability in the Maritime Domain (pp. 223-233). Springer, Cham.

Weng, C., Rathinasabapathi, A., Weng, A. and Zagita, C., 2019. Mixed reality in science education as a learning support: a revitalized science book. Journal of Educational Computing Research, 57(3), pp.777-807.

Wu, H.K., Lee, S.W.Y., Chang, H.Y. and Liang, J.C., 2013. Current status, opportunities and challenges of augmented reality in education. Computers & education, 62, pp.41-49.

EFFICIENCY ANALYSIS OF NORTH AFRICA CONTAINER TERMINALS

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المستخلص:

لقد عززت عمليات تحوية البضائع وبشكل كبير من كفاءة الميناء والخدمات التي يقدمها ، لأنها مكنت الموانئ من تحقيق أقصى فوائد ممكنة مستفيدة من اقتصاديات الحجم (السايح، ٢٠١٥) ، بل وأصبحت كفاءة الموانئ عامل حاسم في تنافسية أي بلد وآفاقه التجارية، وبالتالي فإن تحليل الكفاءة الفنية لموانئ الحاويات كلً على حدة يهدف للإبقاء على مستوى عالي من التنافسية بين ابرز اللاعبين والذي يُعد مهمة صعبة وشاقة (كولينان ووانج، ٢٠٠٥).

تهدف هذه الورقة إلى تقييم وقياس كفاءة أداء موانئ ومحطات الحاويات بمنطقة شمال إفريقيا وذلك من استخدام عدد من بيانات ومتغيرات تلك الموانئ وبالاخص تلك المتعلقة بالبنيتين التحتية والفوقية لموانئ منطقة الدراسة وضمن دورة إقتصادية واحدة فقط وبالتحديد في الفترة الممتدة بين ٢٠١٤ و ٢٠١٨، وفي هذا الاطار تم إستخدام النماذج الأساسية لمحلل طوق البيانات (DEA)، وعلى ضوء نتائج هذه التحليلات تم ترتيب الموانئ ومحطات الحاويات المذكورة.

لقد أظهرت نتائج الدراسة أن معظم موانئ ومحطات الحاويات بمنطقة شمال إفريقيا أنها غير كفؤة فنياً، وعليه تعتبر نتائج هذه الدراسة أحد الادوات التي يمكن إستعمالها من قبل مُشغلي ومديري الموانئ ومحطات الحاويات بمنطقة الدراسة بهدف تعزيز مستوى القدرة التنافسية لتلك الموانئ والمحطات، والذي بدوره سيؤدي إلى تعزيز الجودة الشاملة لخدمات الموانئ وزيادة حصتها السوقية وهامش الربح لديها.

الكلمات المفتاحية:

شمال إفريقيا ، ميناء الحاويات ، عدد الحاويات المناولة ، الكفاءة ، DEA-CCR و DEA-BCC.

Abstract:

Containerization has significantly enhanced port efficiency and service, because it enables ports to gain the maximum benefits of economies of scale and scope (Elsayeh, 2015). The efficiency of ports has become a critical factor for a country's competitiveness and its trade prospects. Thus, analyzing the efficiency of individual container ports for the survival and competitiveness of the industry and its players is very important task (Cullinane and Wang, 2005).

This paper aims to assess performance of North African container ports and terminals through measuring their aggregate, pure and scale efficiencies. In so doing, sets of panel data including number of input and output variables related to North African container port infra/superstructure were used for one shipping cycle in the period between 2014 and 2018. Also, the basic models of Data Envelopment Analysis (DEA) were used in order to assess aggregate, pure and scale efficiencies, as well to rank the stated ports and terminals based on efficiency values.

Study results revealed that most North African container terminals suffer from inefficiency. Nonetheless, the study outcomes intended to provide a powerful management tool for port operators and managers in North Africa area (NA) to promote the competitiveness level of the stated ports which leads to enhance total quality service of the ports and enlarge the market share ratio and profit margins.

Keywords: North Africa, Container port, TEUs, Efficiency, DEA-CCR and DEA-BCC.

1- Introduction

Containerization is a system with land and ocean components. It may be defined as "an intermodal system of transport for different types of cargo that makes use of standard containers capable of standardized method of moving and handling, which make transport and storage of containers faster and easier to interchange between ship, railway and trucks" (Fernández, 2017).

In this way, container port is known as a physical link or interface between component of containerization system and water and land transport modes (Dowd et al, 1990). Rodrigue et al., (2020) clarified that container terminals are the most integrated points or nodes of maritime transport process, since containers are the most commonly used means of transport for door-to-door services.

Compared with general cargo port operation, container port operation is cheaper, more efficient and faster (Vacca et al, 2010), while port efficiency is a substantial element that encourages port competitiveness and improves regional development (Almadani, 2015). In very broad words, operation efficiency decides turnaround time of ships at ports (Liu, 2010). Hence, improvement of container port efficiency is essential task and nowadays is more needed, because an efficient operation of container port can significantly make the best use of its resources and can facilitate countries exports and imports.

To this end, North African ports always have been considered as a proportion of Mediterranean basin or Middle Eastern region (MENA). However, this study will attempt to evaluate container ports efficiency of major container ports from Port Said to Tanger Med. These ports often share the same foreland parallel to its geographic location. Ports under this study are: West Port Said, Damietta, Alexandria, Tobruck, Misurata, Khoms, Tripoli, Sfax, Sousse, Rades, Annaba, Alger, Bejaia, Skikda and Tanger Med port. It is important to note that Benghazi port from Libya is excluded from this study due to port closure between 2013 and 2017. Table-1 shows North African container ports under this study and their geographical positions.

Table-1 Major Container Ports in North Africa Region

Port Name	Country	Position
West Port Said	Egypt	31° 26 N 32° 30 E
Damietta	Egypt	31° 28 N 31° 47 E
Alexandria	Egypt	31° 12 N 29° 54 E
Tobruck	Libya	32° 04 N 24° 00 E
Misurata	Libya	32° 21 N 15° 13 E
Khoms	Libya	32° 40 N 14° 15 E
Tripoli	Libya	32° 54 N 13° 11 E
Sfax	Tunisia	34° 44 N 10° 46 E
Sousse	Tunisia	35° 49 N 10° 38 E
Rades	Tunisia	36° 46 N 10° 17 E
Annaba	Algeria	36° 54 N 07° 46 E
Alger	Algeria	36° 46 N 03° 04 E
Bejaia	Algeria	36° 45 N 05° 04 E
Skikda	Algeria	36° 53 N 06° 53 E
Tanger Med	Morocco	35° 45 N 05° 48 W

(Source; Sea rates, 2021)

1.1 Research Aims and Objectives

This paper aims to evaluate the operating (aggregate and pure) and scale efficiencies of North African container ports and terminals, and also to rank North African container ports and terminals in the period between 2014 and 2018. In so doing, number of DEA models are used; the DEA-CCR, the DEA-BCC and the scale efficiencies. As such, research aims break down to the following objectives:

1.1.1 To review the literature related to container port efficiency using DEA approach.

1.1.2 To technically benchmark relative efficiency scores of the stated ports.

1.1.3 To rank North African container ports and terminals based on their efficiency scores.

1-2 Research question

In order to achieve study aims and objectives, this paper will answer the following question: What are the relative efficiency scores of North African container ports and how can they be ranked based on their efficiency scores?

Regarding structure of this paper, it is divided to five sections that are well arranged in a coherent manner. After this introductory section, Section Two is devoted to review the available literature on container port efficiency using DEA approach, while Section Three of this paper will present DEA principles. Section Four will analyze and rank the stated ports based on their efficiency scores. Paper results and

recommendations are furnished in the fifth and final section.

2- Literature Review

Mediterranean Sea links east and west markets of the globe, and acts as an intersection point between Asia, Africa and Europe continents. In fact, North African seaports are considered as a component of Mediterranean and/or MENA regions.

Fundamentally, review of literature aims to present the body of literature and to recognize the potential research gap(s). In this paper, review of available literature is organized chronologically based on articles publication date within Mediterranean and MENA region, in order to be able to observe technical efficiency development of container ports over time.

DEA was introduced in 1978 by Charnes, Cooper and Rhodes. It was built on principles of microeconomic theory in order to compare all similar units simultaneously that taking into account several dimensions (Charnes et al, 1978).

In this regard, Emrouznejad and Yang (2018) found 2974 DEA articles published by the top 21 international journals over the last 40 years and they categorized them in five fields (agriculture, banking, supply chain, transport and public policy).

In this vein, the study of Roll and Hayuth (1993) is regarded as a milestone in measuring seaport efficiency using DEA. It is the first attempt to apply DEA-CCR and data of twenty international seaports using; capital, labor and cargo uniformity as inputs. In fact, it was a purely theoretical study and focused on international ports from seaside operations rather than landside operations.

Al-Iraqi et al (2008) measured DEA-CCR and DEA-BCC of twenty two container ports and terminals in East Africa and MENA regions. The empirical results revealed that: (i) port technical efficiency can play an important role for congestion and waiting time in seaports, and (ii) time is a significant factor in assessment of sea-port efficiency and its competitiveness.

Almeshwaki et al (2015) evaluated technical efficiency of nineteen container ports and terminals in MENA region using DEA-CCR model and cross-sectional data of the year of 2005. The main outcome of the study revealed that only ports of Jebel Ali, Beirut and Salalah were efficient, while the remaining ports were relatively inefficient.

Almadani (2015) benchmarked technical efficiency of four Libyan container ports and terminals against eighteen international container ports for the year of 2010. He found that the Libyan container terminals are relatively inefficient. He added that the shipping lines avoid Libyan seaports and instead of that they use South European ports instead, due to lack of efficient and sufficient equipment also.

Elsayeh (2015) investigated the effect of technical efficiency on container port competition using various DEA models and panel data between 1998 and 2012 for the top twenty two container ports and terminals in Mediterranean basin. He found that the average technical efficiency of the investigated ports was below 50%.

Kammoun (2018) applied basic models of DEA to estimate efficiency level of 7 container terminals in Tunisia between 2007 and 2017. The study results show that 3 out of 7 container terminals were efficient. However, Kammoun's study focused only on landside operations of Tunisian national container terminals.

Recently, Mahdi and Moad (2019) used panel data between 2014 and 2017 to measure operational and scale efficiencies of the major eight container terminals in Morocco. The study results revealed that only Tanger Med and Jorf Lasfar ports were relatively efficient, while Dakhla port, which had the smallest resources, was an efficient port in the year of 2016 only.
Atta (2019) measured technical efficiency of the major thirty container ports and terminals in

Mediterranean and Black sea regions using five models of DEA and panel data in the period between 2002 and 2017. The study results reveal that only six container ports out of the thirty were relatively efficient and efficiency level of the stated ports was enhanced over time.

Gap Analysis

From the above review, it is clear that the studies on North African seaports efficiency are seldom and they have not been benchmarked all together before. Also, there were no available or published studies on evaluation of Algerian seaports efficiency. In contrast, most researches and published studies focus on the advanced and emerging markets. Consequently, this study is significance and original and is expected to enrich the literature in this matter.

3- Methodology

According to Zhu (2014), performance evaluation is important and is a continuous enhancement task for business bodies to stay competitive. It plays fundamental role in the global market, where competition is intense and grows more so each day. He also argues that performance evaluation and benchmarking force any business to improve, and to prosper in a business environment.

In the context of seaport efficiency evaluation, the term relative efficiency is always used because effi-ciency of each port or Decision Making Unit (DMU) is assessed in relation to other DMUs in the selected sample. However, adding or deleting an inefficient DMU does not alter the efficient frontier and the efficiencies of the existing DMUs. Inefficiency scores change only if the efficient frontier is altered (Kutin et al, 2017).

Regarding selection of orientation model, this paper used an input-oriented model because it is more related to operational and managerial aspects, while output-oriented model is closely related to planning and strategy formulation (Cheng, 2014; Elsayeh, 2015).

3-1 The Operational Efficiency Measurement

3-1-1 DEA-CCR Model

The DEA-CCR model seeks to maximize DMUs efficiency value through selection of the best weights associated with each input and output factor (Chen and Gamassa 2017). In this model, the efficiency is defined as a ratio of weighted sum of outputs to a weighted sum of inputs, where the weights structure is calculated by means of mathematical programming, and Returns to Scale (RTS) is assumed constant (CRS) (Cooper et al, 2007). Equation-1 presents DEA-CCR output-oriented version.

$$\max \varphi = \left(\sum_{i=1}^{m} s_i^- + \sum_{r=1}^{s} s_r^+\right) \qquad (1)$$

Subject to

$$\sum_{j=1}^{n} x_{ij}\lambda_j + s_i^- = x_{io} \qquad i = 1, 2, \ldots, m;$$

$$\sum_{j=1}^{n} y_{rj}\lambda_j - s_i^+ = \varphi y_{ro} \qquad r = 1, 2, \ldots, s;$$

$$\lambda_j \geq 0 \qquad j = 1, 2, \ldots, n.$$

(Source: Cooper et al., 2007)

3-1-2 DEA-BCC Model

Banker, Charnes and Cooper (1984) adopted a new DEA formulation known as DEA-BCC or output maximization model. In this model, RTS is assumed to vary (VRS). It extracating the pure/local technical efficiency from the scale efficiency (Cheng, 2014; Zheng and Park, 2016). For VRS modality, the use of input minimization or output maximization depends on the situation being evaluated (Cooper et al, 2007). Equation-2 presents DEA-BCC output-oriented version.

$$\max h_k = \sum_{r=1}^{s} U_r\, Y_{rk} \qquad (2)$$

Subject to

$$\sum_{i=1}^{m} V_i\, x_{ik} = 1$$

$$\sum_{r=1}^{s} U_{rj}\, Y_{rj} - \sum_{i=1}^{m} V_{ij} X_{ij} \leq 0 \qquad j = 1,2,\ldots..n$$

$$u_r \geq \varepsilon \qquad r = 1,2,\ldots....s$$

(Source: Cooper et al., 2007)

3-2 The Scale Efficiency Model

Scale Efficiency model is known also as Doyle and Green (1994) model. It can be defined as a ratio of CCR to BCC, as shown in Equation-3. However, when scale efficiency = 1, then a seaport is operating at the most efficient scale, while if SE is less than one, it would be due to DRS (over production), and/or due to IRS (under production)(Cooper et al, 2007).

$$SE = \frac{\theta^* CCR}{\theta^* BCC} \qquad (٣)$$

(Source: Cooper et al., 2007)

3-3 Data Collection

Basically, every research is centered on relationship among variables. However, every variable in study must have an operational definition, which is specific to the study, and not necessarily unique (Cullinane et al, 2005).

As shown in Table-2, this research is used set of data related to container port structure, which divided to four input including; water depth, total terminal area, total storage capacity and number of quay cranes. On the other hand, the unique output variable for this research is annual container throughput in terms of TEUs, as it is widely accepted as output variable.

Table-2 Study Variables

Variable name	Input/Output	Unit
Water depth	Input	(m)
Total terminal area	Input	(m^2)
Total storage capacity	Input	(TEUs)
Total number of quay cranes	Input	Number
Total container throughput	Output	(TEUs)

(Source: Authors)

4- Results and Discussion

One important reason for undertaking DEA method is to classify efficient and inefficient DMUs and the outcome of DEA analysis is relative efficiency (Manzoni and Islam, 2009 and Elsayeh, 2015). Moreover, DEA-CCR model is designed to measure aggregate (technical) efficiency, while DEA-BCC is designed to measure pure technical (local) efficiency .

Table-3 and Figure-1 show that under DEA-CCR analysis Tanger Med port had efficiency value equal to unity in 2015 and 2018, while Alexandria had an efficiency score equal to unity in 2016 and 2018 and Annaba port had efficiency value equal to unity in 2018 only. The remaining container ports under this study were relatively inefficient according to DEA-CCR analysis.

Table-3 Operational efficiency scores of North Africa container ports 2014-2018

Year / Port	2014		2015		2016		2017		2018		Rank
	CCR	BCC	CCR	BCC	CCR	BCC	CCR	BCC	CCR	BCC	
KHOMS	0.416	0.434	0.341	0.356	0.370	0.386	0.280	0.293	0.338	0.352	12
TRIPOLI	0.142	0.203	0.103	0.146	0.094	0.133	0.060	0.086	0.052	0.074	14
MISURATA	0.319	0.324	0.567	0.575	0.495	0.503	0.413	0.419	0.354	0.360	10
TUBROCK	0.038	0.038	0.015	0.015	0.096	0.096	0.089	0.089	0.176	0.176	15
ALEXANDRIA	0.888	0.888	0.967	0.967	**1.000**	**1.000**	0.958	0.958	**1.000**	**1.000**	1
DAMIETTA	0.383	0.424	0.363	0.402	0.369	0.409	0.416	0.460	0.581	0.642	9
PORT SAID	0.290	0.295	0.371	0.378	0.253	0.258	0.277	0.283	0.281	0.286	13
RADES	0.715	0.715	0.734	0.734	0.729	0.729	0.724	0.724	0.675	0.675	6
SFAX	0.190	0.203	0.458	0.489	0.432	0.461	0.461	0.493	0.469	0.501	11
SOUSSE	0.392	0.521	0.448	0.595	0.475	0.631	0.728	0.967	0.853	**1.000**	7
ALGER	0.511	0.759	0.593	0.882	0.590	0.877	0.622	0.924	0.624	0.927	5
SKIKDA	0.447	0.515	0.501	0.578	0.541	0.624	0.573	0.660	0.546	0.630	8
BEJAIA	0.810	0.856	0.768	0.811	0.820	0.866	0.870	0.919	0.768	0.812	4
ANNABA	0.853	0.853	0.934	0.934	0.950	0.950	0.955	0.955	**1.000**	**1.000**	2
TANGER	0.772	0.772	**1.000**	**1.000**	0.895	0.895	0.895	0.895	**1.000**	**1.000**	3
Mean	**0.478**	**0.520**	**0.544**	**0.591**	**0.541**	**0.588**	**0.555**	**0.608**	**0.581**	**0.629**	

(Source: Authors)

Regarding DEA-BCC analysis, as shown Table-3 and Figure-1 that Annaba and Sousse ports had efficiency value equal to the unity in 2018. Similar to DEA-CCR, Tanger Med port had efficiency score equal to unity in 2015 and 2018, while Alexandria had an efficiency score equal to unity in 2016 and 2018. The remaining ports were relatively inefficient under DEA-BCC analysis.

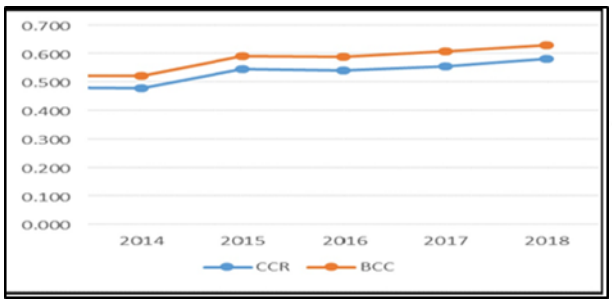

Figure-1 Mean efficiency scores of North Africa container ports 2014-2018
(Source: developed by authors)

Regarding Scale Efficiency analysis, Table-4 shows that ports of Alexandria, Tobruck, Rades, Annaba and Tanger Med exhibit CRS, which means that these ports were operating at their optimal scale (most productive scale size). Tobruck, Rades and Annaba as small ports are experiencing full scale efficiency because they use the least amount of input resources compared to the other ports under this study.

Table-4 DEA-Scale Efficeincy and Nature of RTS for N.A container ports 2014-2018

Year / Port	2014		2015		2016		2017		2018	
	SE	RTS	SE	RTS	SE	RTS	SE	RTS	SE	RTS
KHOMS	0.959	IRS	0.958	IRS	0.959	IRS	0.956	IRS	0.960	IRS
TRIPOLI	0.700	IRS	0.705	IRS	0.707	IRS	0.698	IRS	0.703	IRS
MISURATA	0.985	IRS	0.986	IRS	0.984	IRS	0.986	IRS	0.983	IRS
TUBROCK	1.000	CRS	1.000	CRS	1.000	CRS	1.000	CRS	1.000	CRS
ALEXANDRIA	1.000	CRS	1.000	CRS	1.000	CRS	1.000	CRS	1.000	CRS
DAMIETTA	0.903	DRS	0.903	DRS	0.902	DRS	0.904	DRS	0.905	DRS
PORT SAID	0.983	IRS	0.981	IRS	0.981	IRS	0.979	IRS	0.983	IRS
RADES	1.000	CRS	1.000	CRS	1.000	CRS	1.000	CRS	1.000	CRS
SFAX	0.936	IRS	0.937	IRS	0.937	IRS	0.935	IRS	0.936	IRS
SOUSSE	0.752	IRS	0.753	IRS	0.753	IRS	0.753	IRS	0.853	IRS
ALGER	0.673	IRS	0.672	IRS	0.673	IRS	0.673	IRS	0.673	IRS
SKIKDA	0.868	IRS	0.867	IRS	0.867	IRS	0.868	IRS	0.867	IRS
BEJAIA	0.946	IRS	0.947	IRS	0.947	IRS	0.947	IRS	0.946	IRS
ANNABA	1.000	CRS	1.000	CRS	1.000	CRS	1.000	CRS	1.000	CRS
TANGER	1.000	CRS	1.000	CRS	1.000	CRS	1.000	CRS	1.000	CRS

(Source: Authors)

Port Said, on the other hand, is the only port experiencing DRS, which means that the current size or port input resources are larger than port's optimal size. In contrast, the remaining nine ports under this study encounter IRS, meaning that these ports resources or sizes are smaller than port's optimal size, and they need to consider expanding their sizes or input resources from the current level to obtain optimal scale size.

5- Study Conclusion and Policy Implication

As a quantitative research, this paper benchmarked the relative efficiency of fifteen container ports and terminals in NA area between 2014 and 2018. In doing so, a set of data including input and output data related to these ports and terminals infra/super structure was collected, then benchmarking analysis was carried out through applying 3 models of DEA.

It is important to note that this study is significant and original, as it is the first to evaluate technical efficiency of major container terminals in NA region using DEA approach.
Although there is an improvement in efficiency scores for most ports, the DEA analysis clarified that most North African container terminals are suffering from inefficiency. In broad words, under DEA-CCR analysis, there are four out of fifteen container ports were efficient during the period of study, while five ports were efficient under DEA-BCC analysis; this is because DEA-BCC offers information on PTE and SE taken together and it yields higher efficiency values than DEA-CCR, which identifies technical efficiency only.
Scale efficiency analysis revealed that five ports out of fifteen experience CRS, as they are operating at their optimal scale, whereas nine ports exhibit IRS. Thus, managers of these ports need to consider investing or expanding their sizes or input resources from the current level to obtain optimal scale, as well as using hours efficiently parallel to increasing total working hours, and by introducing online services, which are urgently needed, should accelerate office work and cargo clearance procedures (Almadani, 2015). Port Said is the only port under this study which encounters DRS. Hence, managers of this port need to optimize current port's resources.
Although this study provided a worthy information for container ports managers helping them to develop resources utilization for a steady development of operational efficiency, there are areas which were not covered and are considered as areas for further research. These include expansion of the area of study to include more ports in the region, as well as applying

additive models of DEA, such as Super, Sensitivity and Slack variable analyses.

6-References

- Al-Iraqi A., Adli M. and Tajudin K. (2008): An extended DEA windows analysis: Middle East and East African seaports. Journal of Economic Studies, Vol. 37 (2), pp. 208-218 .
- Almadani I., (2015): Examination of port performance in a developing economy: Libya ports case study. RMIT. Melbourne.
- Almeshwaki I. and Shah M., (2015): Technical Efficiency Analysis of Container Terminals in the Middle Eastern Region. The Asian Journal of Shipping and Logistics. Vol 31(4), pp. 477-486.
- Atta, K. (2019): The Impact of Horizontal Integration on Mediterranean Container Port Competitiveness. PhD Thesis. AASTMT. Alexandria. Egypt.
- Banker R., Charnes A. and Cooper W., (1984): Some models for estimating technical and scale inefficiencies in data envelopment analysis. Management science, Vol.30, pp.1078-1092.
- Charnes A., Cooper W., and Rhodes (1978): Measuring the efficiency of decision making units. European journal of operational research, Vol.2, pp.429-444
- Cheng G. (2014): Data envelopment analysis software and MaxDEA. Intellectual Property Press. USA.
- Chen Y., and Gamassa P., (2017): Comparison of port efficiency between Eastern and Western African ports using DEA Window Analysis. International Conference on Service Systems and Service Management. Dalian.
- Cooper W., Seiford M. and Tone K., (2007): Data Envelopment Analysis: A Comprehensive Text with Models, Applications, References and DEA-Solver Software. USA: Springer.
- Cullinane, and Wang T., (2005): The application of mathematical programming approaches to estimating container port production efficiency. Journal of Productivity Analysis, Vol.(24), pp.73-92.
- Dowd T. and Leschine T., (1990): Container terminal productivity: a perspective. Maritime Policy and Management, Vol 17 (2), pp. 107–112.
- Emrouznejad and Yang (2018): Survey and analysis of the first 40 years of scholarly literature in DEA: 1978–2017. Socio-Economic Planning Sciences, Vol. (61), pp. 4-8.
- Elsayeh M., (2015): The Impact of Port Technical Efficiency on Mediterranean Container Port Competitiveness. PhD thesis, The University of Huddersfield. UK.
- Roll Y. and Hayuth Y., (1993): Port performance comparison applying data envelopment analysis (DEA). The flagship journal of international shipping and port research, Vol.20 (2), pp.153-161.
- Fernandez M. (2017): Concentration evolution of the container throughput in the Mediterranean ports. Master thesis, The Polytechnic University of Catalunya. Spain.
- Kammoun R, (2018): The Technical Efficiency of Tunisian Ports: Comparing DEA and SFA Scores, Logistics & Sustainable Transport, Vol. 9 (2), pp.73-84.

- Kutin N., Nguyenb T. and Valléec T., (2017): Relative Efficiencies of ASEAN Container Ports based on Data Envelopment Analysis , The Asian Journal of shipping and logistics, Vol.33(2), pp. 67-77.
- Liu N., (2010): The Efficiency of Container Terminals in Mainland China: An Application of DEA Approach, 4th conference on Communications, Networking and Computing. China.
- Mahdi B. and Moad E., (2019): Efficiency of Moroccan Seaports: Application of DEA Using Window Analysis. Engineering, Vol. (11), pp. 107-118.
- Manzoni, A. and Islam, S. (2009): Performance measurement in corporate governance: DEA Modelling and implications for organizational behavior and supply chain management, Heidelberg.
- Rodrigue J. P., Slack B., and Comtois C. (2020): The geography of transport systems. Fourth Edition. Routledge, NY.
- Sea Rates (2021): Sea ports. Online at: https://www.searates.com/maritime(Accessed 07 July 2021).
- Vacca, Salani and Bierlaire (2010): Optimization of operations in container terminals: hierarchical VS integrated approaches. EPFL. Lausanne. Switzerland.
- Zheng and Park (2016): A study on efficiency of container terminals in Korea and China. The Asian Journal of shipping and logistics, Vol.32 (4), pp 213-220.
- Zhu J. (2014): Data Envelopment Analysis, a handbook of models and methods. Springer.

THE FEATURES OF MACHINE LEARNING APPROACHES FOR SUEZ CANAL NAVIGATION

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المستخلص:

إن إدخال التقنيات الجديدة في مختلف الموانئ في جميع أنحاء العالم بعيد كل البعد عن أن يكون مفهومًا مستقبليًا.

في الحقيقة ، تعد قناة السويس من أهم الممرات المائية في العالم نظرًا لكونها الوحيدة التي يمكنها تلبية الضرورة البيئية ومعايير الإنتاجية العالية مع الحفاظ على بعض النفقات المستدامة ، فإن قناة السويس ستكون الوحيدة التي ستكون قادرة على البقاء في المستقبل البعيد.

ان أهمية قناة السويس من حيث الوظيفة التي تلعبها في التدفق الاقتصادي العالمي تتطلب تحويلها إلى قناة ذكية. للتكنولوجيا الذكية تأثير واضح على القطاع البحري ، حيث يتم تطبيقها على السفن المسيرة اليا التي تنقل كمية كبيرة من البيانات بدقة وسرية باستخدام السفن لربط الحركة اللوجستية المزدحمة و الموانئ المختلف في الشحن والتفريغ ، الأمر الذي كان له أثر إيجابي على الشحن البحري.

الهدف الرئيسي من هذه الدراسة هو التوصية باستخدام نمط التعلم الآلي ، يسمي weighted K (Neighbors - Regressions (KNN لمحاكاة تطبيق استبدال المعرفة المتخصصة بإرشاد السفن داخل قناة السويس بتوجيه ذكي باستخدام تقنية الذكاء الاصطناعي (AI)، وهي إطار عمل التعلم الآلي(ML) ،للقضاء على الأخطاء البشرية.

تشير هذه الدراسة إلى مزايا استخدامات عمل إطارKNN ، دون تطبيق عملي. علاوة على ذلك، أوضحت الدراسة أهمية الاعتماد على التكنولوجيا الحديثة في أحد أشكالها ، الذكاء الاصطناعي AI ،في تطوير نظام الارشاد في قناة السويس من خلال تحويل الخبرة العملية التي يمتلكها المرشد داخل القناة إلىML للمساعدة في جذب السفن المسيرة اليا وتقليل الخطأ البشري وكذلك التعامل مع المخاطر التي قد تواجه قناه السويس من قبل المرشدين.

ستساهم هذه الورقة في أن تكون قناة السويس جاهزة لاستقبال السفن المسير اليا مما يساعد قناة السويس على جذب هذه السفن للعبور ودخول منطقة قناة السويس (Suez Canal Zone) التي تقدم خدمات تجارية ولوجستية تخدم التنمية المستدامة لقناة السويس مصر عام ٢٠٣٠. مما يسهل على SC Zone تجهيز قدراتها لمواجهة التحديات المستقبلية ومواكبة كل ما هو جديد وإبقائها في المقدمة دون منافس ، حيث تتسابق الموانئ العالمية للتحول إلى موانئ ذكية ، وهذا يسهل على قناة السويس التعامل معها.

Abstract:

The introduction of new technologies at various ports across the world is far from being a futuristic concept. In truth, the Suez Canal (SC) is one of the most important waterways in the world. Due to being the only ones that can fulfil the ecological necessity and high-productivity standards while maintaining certain sustained expenses, the SC will be the only ones that will be able to remain in the distant future.

The SC's significance in terms of the function it plays in global economic flow necessitates its transformation into a smart channel. Smart technology has had a clear impact on the maritime sector, as it is applied to autonomous ships that transmit a large amount of data accurately and confidentially by using ships to connect logistical traffic, separating ports in loading and unloading, which has had a positive impact on marine freight.

The major goal of this study is to recommend to use ML pattern , namely Weighted K Nearest Neighbors – Regression (KNN) to simulate the application of replacing expert knowledge of the Suez Canal Pilotage with smart guidance utilising Artificial Intelligence (AI) technology, namely the Machine Learning (ML) frame work, to eliminate human errors .

This study It refers to the advantages of uses the KNN frame work ,without practical application. Moreover , the study demonstrate the importance of relying on modern technology in one of its forms, Artificial Intelligence AI, in developing the SC Pilotage system by transforming the practical experience that the guide has inside the canal into ML to help attract autonomous ships and reduce human error, as well as deal with the risks that may face the SC by the pilots.

This paper will contribute that the SC should be ready to receive Autonomous ships , which helps the SC to attract these vessels to transit and enter the Suez Canal Zone (SC Zone) which provides trade and logistical services that serve the sustainable development of Egypt in 2030. Which makes it easier for the SC Zone to equip its capabilities to meet future challenges and cope with everything new and keep it at in the forefront without a competitor , as global ports are racing to transform into smart ports, and this makes it easier for the SC to deal with it.

Key words : Suez Canal , Artificial Intelligence , Machine Learning

1- Introduction

The SC is a man-made sea-level waterway in Egypt that connects the Mediterranean and Red Seas via the Suez Isthmus. The SC Company dredged it between 1859 and 1869, and it was officially opened on November 17, 1869. By skipping the South Atlantic and southern Indian oceans, the canal allows boats to travel between the North Atlantic and the northern Indian Ocean through the Mediterranean and Red seas, cutting the journey distance by approximately 7,000 kilometer's (4,300 mile). It runs from Port Said's northern terminus to Port Tewfik's southern terminus in the city of Suez. Its total length, including its northern and southern access channels, is 193.30 km (120.11 mile) (Reham et.al, 2020).

The importance of the Suez Canal Route (SCR) is that it allows for a reduction in transit times and a higher predictability of transit times for the intercontinental East-West connection between Asia, the Middle East, Europe, and the US East coast. Furthermore, in the medium run, it will more efficiently address the demand for increased capacity. It is extremely important to the entire world, as well as Egypt. With the advancement of maritime transportation and global trade, this significance is growing. Maritime transport is the most cost-effective mode of transportation, with waterways transporting more than 80% of global trade volume (seaborne trade). The importance of saving distance, time, and operating expenses for vessels that transit the Canal is also emphasized . (Suez canal.gov.eg 2020).

The new Canal is expected to increase transit capacity to 97 ships per day, up from 49 previously. Based on the government's estimations and current fares, this increased capacity may provide a potential revenue boost of more than US $13 billion by 2023 if it is completely utilized. The "SC Corridor Area Project" SC-Zone is a massive investment plan aiming at turning the Canal region into a center of economic development by building research institutes, industrial hubs, and logistics districts along this East-West linking route (Baccelle ollviero et al. 2015).

The management of pilotage in the Suez Canal is a critical component of achieving discipline and success. A pilot is required for all vessels entering and exiting the canal. Pilotage is required, and the pilot's key responsibilities include providing advise on how to maneuver the vessel, which course to steer, and so on. He offers the Master his experience and practical knowledge of the Canal, but because he cannot know every vessel's flaws or maneuverability difficulties, the duty falls entirely on the Master . When the size of the spacecraft is taken into account, the pilot's function becomes even more important. Pilots are required on ships that carry cargo or are utilized as oil tankers since they are large and difficult to maneuver. The size of the ship necessitates the presence of a pilot capable of safely navigating the vessel. The pilot also contributes to the conservation of marine species and ecosystems.

Currently, a race of technological innovation, integration, and transformation is pushing maritime industries and businesses to transform from digital to smart. Becoming a smart port means developing solutions to address current and future challenges faced by seaports, such as spatial constraints, productivity pressures, fiscal constraints, safety, security risks, and sustainability. Today's technology and business model advances can help to propel the smart port forward. The demand for a smart port is driven by three key challenges: (I) Outstanding operational performance, migrating activities (II) Challenging external markets (III) New opportunities for business. Moving toward a truly smart port that fully utilizes the Internet of Things (IoT) network and smart data (Deloitte ,2017) . SC must be able to find and exploit new business models within the larger ecosystem in order to attain and cope with this technology.

The SC pilot has become one of the challenges that the SC is facing, as it is the backbone of the seaborne economic movement. When a pilot makes a mistake or is exposed by the pilot, the SC is terminated . For example, the presence of a Corona virus pandemic can easily disrupt trade in the SC, as the research seeks to prevent the risks that may face the SC, such as replacing pilot knowledge with a machine model that can apple to take the dissension to help global trading continue in the face of any risks, and dealing with the upcoming autonomous ships that do not rely on the human crew.

The use of smart technology in the SC's system of work and control will have a clear impact on global trade movement, enhancing the SC's importance in the world seaborn trade , as the SC is unique after a shift to a smart channel, putting it out of competition with the rest of the navigation channels, especially when pilotage inside the canal becomes smart, which will be a distinguishing feature of the SC:

I. A higher commercial return: the cost of goods and services would be affected by the effectiveness of maritime transportation and its administration at the SC.

II. Transformation of Institutions: The management of ports is delegated to several government agencies, such as transit vessels, customs, and public safety, which simplifies and automates the process.

III. Transformation that is carried out automatically: collect for sample operation, notably during pandemic calamities.

IV. Ecological wise : clean and clear environment.

In this research, a number of addresses were compiled exclusively, not the number ,they used AI in various fields as follow prevent the ships collision pattern , navigation ships in rivers and seas, the use of automated drones in ships surveying and the use of logistics in industrial ports, and their use in congestion.

2. Literature-Review

Experts have discovered during the last two decades that by the time students meet, the technological revolution that has affected all scientific fields has become the buzz of all marine researchers. Researchers' thoughts on how to keep up with this technology in the marine industry .
MacKinnon et al .(2020) alert that artificial intelligence (AI) may be the key to increasing shipping safety and efficiency. Tactical judgments to assess traffic patterns and prospective vessel contacts might face numerous problems in adhering to the International Regulations for the Prevention of Collisions at Sea, which were established in 1972 (COLREGs) . While these are thought to be the defining norms of the road, they can be "violated" in practice to handle traffic problems without putting the situation at risk. In order to develop solutions that are both safe and dependable for autonomous shipping. The following issues were resolved as a result of the investigation: (i) ML is a term that refers to the process of a computer learning something Deep machine learning necessitates a large amount of data. In contrast to the car sector, obtaining in situ data is challenging. Although simulation technologies may be able to bridge this gap, naturalistic behaviors may be lost in the process. (ii) Technology standardization and regulation: Various technology suppliers will develop AI and automation. Because these are dependent on algorithm development, there will very certainly be a need for control in terms of standards and regulation.

Mottaeva(2020) By employing a technical instrument, study how automation technology can be employed in river and sea ships. The set contains data collected for exhibiting the current in approach. The results show that autonomous ships may achieve great precision in navigation, and ports will evolve into modern ports, based on empirical technique.
Eriksson(2020) showed how artificial intelligence (AI) may be used to improve managerial decision-making and leadership skills. The study had been conducted by a systematic literature review, which included a review of papers that are both relevant and objective. The authors based their research on a theoretical framework by adopting a deductive approach. Because that was discovered to be the research gap during the literature assessment, the problem formulation was stated as "the adaptation of leadership skills and managerial decision-making processes owing to the use of AI in the workplace". The thesis fulfilled the study's goal of identifying leadership and AI developments that will help firms succeed in the future.
Helmut(2020) explain why smart technology is important to AL's smart logistics and smart

production goals. The findings of this research study should serve as a springboard for further research into the application of AI, ML, and DL technologies in the field of Smart Logistics in industrial enterprises, as well as a framework for practitioners in industrial companies to successfully implement cutting-edge technologies. A systematic review of the literature served as the foundation for the methodology. (SLR) for the evaluation of previous research papers on the application using secondary data Specifically, (Anahita et al.(2020) clarified the framework and key performance indicators (KPI) for the Smart Port's construction. Suggested Smart Port Index (SPI) is based on literature-based KPI's that ports can employ to improve their literature on resiliency and sustainability. The Methodology provided port authorities with a quantitative tool based on smart port best practices, encompassing the four primary activity areas (operations, energy, environment, and safety and security). The Smart port index was created as a convex combination of the sub-indices and related subdomains of a smart port.

Elnoury(2020) investigated Drones, sheds insight on the technical advancement process in the classification societies' inspection-surveys and supervision mechanisms nowadays. According to the findings, classification societies can employ Drones for next surveys in order to handle and deal with autonomous ships.

L. Jiang (2019) clarified that efficiency of each operation in the port may be enhanced, and the logistics cost can be decreased, by adopting the (IoT)model to develop a logistics information platform in the functional planning and construction of the port. The issue demonstrates that port traffic is influenced by a variety of circumstances, which can lead to issues with maritime traffic safety and efficiency. Furthermore, a theoretical research approach was used in the context of a real-life problem. The research findings demonstrate that the series of activities of ships in the port traffic flow simulation system is more accurate in reflecting the features of port traffic flow and is more in line with the actual traffic circumstances of the port.

World maritime university WMU (2019) With the new Norwegian seafarers education ,examined the use of AI on board ships, autonomous ships, and digitalization ships, as well as the future distant seafarers. This Technology's goal is to describe how autonomous shipping has progressed in a specific country.. According to United Nations Conference on Trade and Development UNTCAD(2019), the stages of digitization in maritime transportation may be split into three categories: (I) Optimization increasing the efficiency and dependability of existing processes in order to lower trading expenses. (ii) Expansion going beyond efficiency to provide new service and commercial opportunities. (iii) Transformation based on data-driven revenue streams and alterations in trade flows, rethinking logistics, trade, and business models.

Okarle(2016) offered an overview of the relationship between law and technology, with a focus on global economic growth (pp147). With the growing expansion of automation in ports, it's vital to look at how well the principles of international maritime law on port operation stand up in an automated environment. The researcher examines some of the most important responsibility and liability clauses in international maritime law and suggests solutions to deal with the rising flood of technological automation .

Find out:

Literature reviews summary: It became clear to us that smart technology has become the cornerstone for all researchers and also for the world as a whole, as the concern has become limited to how this technology should be used in the marine field , and that researchers seek to use it and restrict it in various marine axes. (MacKinnonetal.,and Motiva 2020) notice to use the AI for autonomous ships to avoid the collision, (Eriksson and Hemlut 2020)applied the AI for enhance the managerial skills and the smart logistics becomes more initiative .(WMU and UNTCAD 2019) discussed and improve the ways to change the marine sector to be digitalize.

3- Machine Learning and Use it

ML , as an interdisciplinary field, has connections to the mathematical fields of statistics, information theory, game theory, and optimization. It is naturally a subfield of computer science because our goal is to teach machines to learn. In some ways, ML can be considered a subset of AI , because the ability to convert experience into knowledge or find significant patterns in complex sensory input is an important component of human (and animal) intelligence.
Rats Learning to Avoid Poisonous Baits: The ML Meaning is well-known in this context. When rats come across food with an unfamiliar appearance or smell, they will consume very little amounts at first, and their subsequent feeding will be determined by the taste of the food as well as its physiological effect If the novel food causes an adverse reaction, it will be associated with the disease, and the rats will refuse to consume it. If the animal has had a bad experience with the meal in the past, it is likely that it will have a bad experience with it again in the future. (Shwartz et al. 2014).
ML concept represented in the above example adds to the research the importance of using the , ML can serve the movement of guiding ships inside the SC in forecasting in making clear decisions in the conduct of the navigation movement and preparing an organized mechanism that depends on :

I. Recognizes trends and patterns quickly : ML can analyse large amounts of data and identify specific trends and patterns that humans would miss.

II. There is no need for human objection: ML can predict , analyse and modify using algorithms by itself without interferences .

III. Ongoing Improvement : As ML algorithms gain experience, their accuracy and efficiency improve. This enables them to make more informed decisions.

IV. Dealing with massive data: ML algorithms are adept at dealing with massive data, and they can do so in dynamic or uncertain environments.

Benefit from ML approaches is the study of very big and complicated data sets, such as astronomical data, converting medical archives into medical knowledge,weather forecasting, genetic data analysis, Web search engines, and electronic commerce. As more digitally recorded data becomes available, it becomes clear that there are riches of useful knowledge buried in data archives that are far too huge and complex for humans to comprehend (Shwartz et,al .2014).

4- Machine Learning in Suez Canal

ML-based architecture, i.e. artificial neural network, will make up a significant portion of ship intelligence. Within autonomous vessels, the same architecture will be used to construct the appropriate agent behavior. Other transportation systems, such as autonomous navigation systems in self-driving cars, have used similar frameworks to produce promising results in terms of travelling with the appropriate safety levels (Liu,S et.al.2017) In general, machine learning-based frameworks turn the problem of a self-driving vessel into a data categorization problem. Convolutional neural networks (CNN, or ConvNet) are a type of deep learning framework (Collobert et al., 2008) that can tackle complex picture classification problems and have been employed in self-driving cars. The same classification approach can be used to capture Pilots behavior, which is similar to agent behavior in ship navigation. Initially, such deep learning frameworks should serve as observers for human navigators operating manual or remote-controlled watercraft. The main goal of this phase, which was previously classified as a training procedure, is to train the appropriate neural networks to capture ship behavior in response to navigator actions. As a result, artificial neural networks can accommodate suitable elements of vessel seakeeping and maneuvering behavior.

4.1 The Benefits for Using Machine Learning In Suez Canal

In autonomous ships, ML application may necessitate a localized decision-making process, in which case a distributed intelligence strategy should be explored. As a result, the ship should be an agent-based system with dispersed

intelligence all over it. ML type frameworks, i.e. ship intelligence, provide the backbone of such agents, which imitate Pilots activities in ship navigation. Additionally, a decision-supporting layer should be present to help vessels stay aware of their surroundings and avoid colliding. As a result, a significant amount of research and development will be necessary to obtain the required ship intelligence within deep learning frameworks and machine learning applications for autonomous vessel decision support.

4.2 The Importance of Change To Receive The Autonomous Ships Technology

The primary problem for the maritime industry is to ensure the security of the Big-Data systems in use. Although a significant amount of study has been done in the automobile sector, the findings are not simply transferable to the maritime sector. This is owing to variances in the physics of a ship vs. a car, differences in weather conditions leading to various sensing needs, and differences in traffic situations rendering datasets produced for the automobile industry mostly useless in the marine sector. There is a need to develop a model of "excellent seamanship" using modern machine learning techniques such as safe reinforcement learning and multi-agent imitation learning to address the broader challenge of marine vessel autonomy .

4.3 Barriers should to be adjusted.

I. SC authority and national legislation should be agree to replacing the pilotage expert knowledge to machine learning .

II. SC pilots' certificates and competencies will need new mechanism to deal with new ships technology Autonomous Ships.

III. Basic infrastructure to realize Autonomous Ships: Ship-to-Shore Communications Infrastructure to be ready in SC.

IV. SC should be capable of receiving the autonomous ships technology in the upcoming years .

5. Techniques, Methods and Models of ML

According to ML, "algorithms that use computational methods to 'learn' information directly from data without relying on a preexisting equation as a model." (MathWorks, 2016). The most intriguing part of ML is that as the number of samples utilized for learning increases, so does the performance of the algorithms. In recent years, ML has emerged as a major change in the fields of data science and AI (Press, 2015). Adopting ML, on the other hand, comes with its own set of problems, including the need to use a massive amount of data in order to generalize an ML model with high accuracy, as well as the scarcity of individuals with the necessary expertise to implement it. (Marouani, 2018) argue that it is past time for engineers to hone their skills in data science in general, and ML research and implementation in particular, in order to fill the void left by a data scientist shortage. Figure 1 depicts a map of commonly employed machine learning techniques, strategies, and models based on the learning analysis form. (MathWorks, 2018), (MathWorks, 2016), and (Witten, 2005).

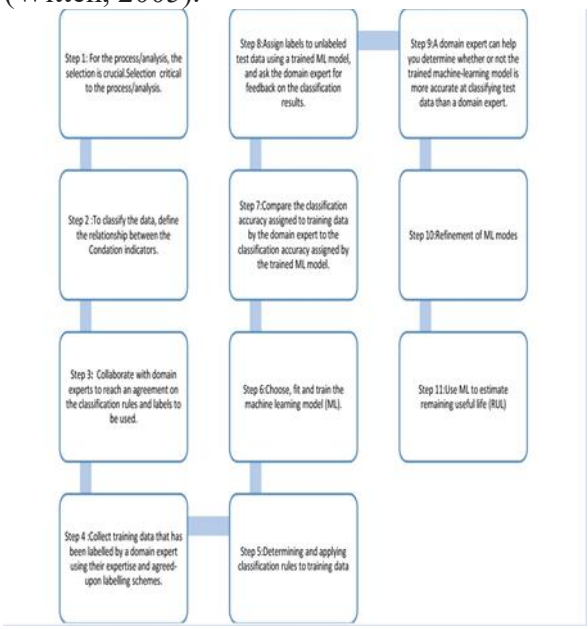

Figure 1: demonstrates the methodology used in a sequential manner to achieve the research objectives (Zhou & Chen, 2018).

End users and developers of ML models should be brought together, according to (Zhou and Chen ,2018), in order to instill trust in the capabilities, strengths, and weaknesses of the developed ML model. This strategy requires

maximum stakeholder participation from the concept development phase to product deployment (in this case, domain experts in vibration analysis). As seen in Figure 1, this strategy has been incorporated into the process through feedback loops.

The importance of Figure1 shows the ability of the model to transfer the experience, skills and instructions that the pilot has to ML, and he has to be precise in implementation, because it depends on the main axes, which are the analysis and classification of skills, the special skills of each maneuver based on the opinions of expert guides and the special experience of passing ships in the SC in different emergency conditions.

The methodology used is on descriptive analysis by tacking a SC as survey study , by using the quantitative research approach is based upon an empirical cycle that has a deductive nature to clarify a certain attitude , context and concept in order to achieve a specific goals or destination. Quantitative research is based on the basic approach that knowledge about reality can be obtained 'through the eyes of the researcher'. It is common to call this the expert approach, it is the researcher who creates an image of the phenomenon to be examined. The research attempts to test the theoretical constructs as represented by the model he has developed which are then used to help formulate the problem definition, research objective and research question.This method can add to the research to:

I. The set of data represents 'the reality' and consists of 'objective facts.'

II. A sharp distinction can be made between the facts the researcher is working with and the way he interprets them.

III. Any other researcher who conducts the same research will principally generate similar facts and results

Conceptual model consists of units (concepts, theoretical constructs) with attributes and relationships between those attributes and concepts based on theoretical constructs, One of the most important functions of a conceptual model is that it helps researchers relate their research to existing theories, focuses their research, clarifies how they think about the things that are going on, and provides a way for them to pay attention systematically to the embeddedness of their subject matter. As a result, we will be reliant on our investigation creation ML model that meets these criteria Can review large volumes of data and discover specific trends and patterns that would not be apparent to humans.

6. Conclusion

This research concern scientific origin and has a practical addition that can be applied in the SC, as it has become necessary to apply this research to cope with the modern development in the maritime field and to show the SC in a modern technological form, as this research adds a new scientific position. The research stress the important and the advantages of using the AI in the SC pilotage that present the main sector of the seaborne trade .

Finding:

I. Improvements that are made over time The accuracy and efficiency of ML continue to improve as they gain more experience. Thus, they are able to make more informed decisions.

II. Handling data with a wide range of dimensions and types

7. Bibliography

• Anahita Molavi, Gino J. Lim & Bruce Race (2020) A framework for building a smart port and smart port index, International Journal of Sustainable Transportation,(May ,2019), https://doi.org/10.1080/15

•Angela Mottaeva (2020) Technical Automation Tools for High-Precision Navigating of Sea and River Ships Copyright Information The Editor(s) (if applicable) and The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2021 DOIhttps://doi.org/10.1

• Baccelle ollviero et al . "The new suez canal economic impact on Mediterranean maritime trade." Srm, July 2015

http://www.srm-maritimeconomy.com/wp

• Elnoury Ahmad & Mohy Ahmad (2021) "The Effect of New Technology on Permutation of Classification Societies Lay Out" ,Journal AIN , Volum 26,(pp20-25).

• Chair of Industrial Logistics, A Review of Further Directions for Artificial Intelligence, Machine Learning, and Deep Learning in Smart Logistics MontanuniversitaetLeoben,8700,Leoben,Austria; helmut.zsifkovits@unileoben.ac.at 2 Industrial Engineering and Automation (IEA), Faculty of Science and Technology, Free University of Bozen-Bolzano, 39100Bolzano,Italy;erwin.rauch unileoben.ac.at; May 2020

• Collobert, R., and Weston, J., (2008), "A Unified Architecture for Natural Language Processing: Deep Neural Networks with Multitask Learning". Proceedings of the 25th International Conference on Machine Learning. ICML '08. New York, USA: ACM: 160–167

- Isaiah Okorie (2016) Australian Maritime College, University of Tasmania, Launceston, Tasmania, AustraliaCorrespondenceisaiah.

- L. Jiang, G. Huang, C. Huang and W. Wang, (2019) "Data Mining and Optimization of a Port Vessel Behavior Behavioral Model Under the Internet of Things," in IEEE Access, vol. 7, pp. 139970-139983, 2019

• Liu, S., Tang, J., Zhang, Z., and Gaudiot, J. L., (2017), "Computer Architectures for Autonomous Driving," in Computer, vol. 50, no. 8, (pp. 18-25).

- Lokukaluge-Perera.(2018) "Autonomous Ship Navigation Under Deep Learning and the Challenges in COLREG.

- Marcus Karlsson Karlstad(2020) Developing service based on artificial intelligenceHandles@kau.se

• Malin Eriksson &Camran Djoweini (2020) "Artificial intelligences impact on management" KTH VETENSKAP OCH KONST ,STOCKHOLM,SWEDEN

• MathWorks, Inc. (2016). Getting Started with Machine Learning. Natick, Massachusetts, United States. Retrieved 11 April, 2018, from https://www.mathworks.com/tagteam

•MathWorks, Inc. (2018). Machine Learning with MATLAB - Training Course. Machine Learning with MATLAB, 1(MLML418). Natick, Massachusetts, United States: MathWorks Training Services.

• MathWorks, Inc. (2018). Mastering Machine Learning - A Step-by-Step Guide with MATLAB. Natick, Massachusetts, United States .

• MatWorks, Inc. (1994-2019). RUL Estimation Using RUL Estimator Models. (MathWorks, Inc.) Retrieved 18 December, 2018, from MathWorks: https://au.mathworks.com/help/predmaint

• Marouani, S. (14 Nov, 2018). Can engineers help fill the data scientist gap? (Engineers Australia) Retrieved 30 Nov, 2018, from Create - Engineering Ideas into Reality: https://www.createdigital.org.au

• Press, G. (15 Dec, 2015). 6 Predictions For Big Data Analytics And Cognitive Computing In 2016. (Forbes) Retrieved 12 Dec, 2018, from Forbes: https://www.forbes.com/sites/fastforward

• Reham M. Hafeza and Ibrahim Madney (2020) "Suez Canal Region as an economic hub in Egypt location analysis for the mass real estate appraisal process" HBRC JOURNAL 2020, VOL. 16, NO. 1, (pp59–75) https://doi.org/10.1080/16874048

•Scott N. MacKinnon and Reto Weber, Fredrik Olindersson, and Monica Lundh (July2020) "Artificial intelligence in Martime Navigation A Human Factor" Prespective https://www.researchgate.net/publication

• Shai Shalev-Shwartz and Shai Ben-David (2014) " Understanding Machine Learning"Cambridge University Press, (pp19-25)

• United Nations Conference On Trade And Development UNTCAD-NO.75 JUNE2019 unctadinfo@unctad.org

•World Maritime University DOI: http://dx.doi.org/10.21677/itf.

International Transport Workers' Federation (ITF), London, UK.

•Witten, I. H. (2005). Data Mining - Practical Machine Learning Tools and Techniques (2nd ed.). San Francisco, CA, USA: Morgan Kaufmann Publishers.

• Zhou, J., & Chen, F. (2018). Chapter 1 -2D Transparency Space - Bringing Domain Users and Machine Learning Experts Together. In B. Abdollahi, G. Alarcon, A. Anaissi, M. Arsenovic, M. J. Barnabe, J. Zhou, & F. Chen (Eds.), Human and Machine Learning (pp. 3-19). Cham, Switzerland: Springer International Publishing AG.

Factors affecting E- learning from the point of view of students and faculty members

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المستخلص:

يهدف هذا البحث الى دراسة العوامل المؤثرة على التعلم الاليكتروني وتحديدا فيما يتعلق بالتعليم البحري، تم عمل استبيان لطلبة الدراسات البحرية الأساسية، وطلبة الدراسات البحرية التأهيلية وطلبة الدراسات العليا البحرية بالإضافة الى أعضاء هيئة التدريس، لدراسة تأثير اختلاف طبيعة المقررات واختلاف المستوى التعليمي للدارسين وأيضا طرق التواصل بين الدارسين وأعضاء هيئة التدريس على التعليم الاليكتروني، من وجهة نظر الدارسين وأعضاء هيئة التدريس. أظهرت الدراسات ان اختلاف طبيعة المقررات سواء كانت عملية او نظرية تؤثر على التعليم الاليكتروني حيث ان دراسة المقررات النظرية تكون مناسبة أكثر في التعليم الاليكتروني. أيضاً اختلاف المستوى التعليمي للدارسين اظهر اختلاف في رأيهم عن طريق التواصل مع أعضاء هيئة التدريس وطرق توصيل المادة العلمية، كما أظهرت الدراسة ان الفئة العمرية للدارسين لا تعتبر عامل مؤثر على عملية التعليم الاليكتروني وفي النهاية من الجيد المزج بين التعليم الاليكتروني وكذلك التعليم في الفصول من اجل الاستفادة من مميزات كلا النظامين والحصول على جودة جيدة للتعليم البحري.

Abstract:

This study investigates factors affecting the method of e-learning, especially maritime education. A survey was conducted for students of nautical basic studies, students of Competency courses students and students of Maritime Postgraduate Studies. In addition to the faculty members, to know the effect of; nature of the course, level of the learner and the methods of communication on e-learning from their point of view. The results of the study showed that e-learning is affected by the nature of the courses (theoretical-practical), where theoretical courses are easier to teach than practical courses, and the educational level also affects students' comprehension, and students' opinions differed about ways of communication between them and faculty members, as there are many. It is one of the electronic communication methods, and the age of students did not affect e-learning, so it is necessary to mix the two methods of education (face-to-face education and e-learning) to take advantage of the advantages of each method to obtain the required quality of maritime education.

1- Introduction.

Although there has been an evolution of distance learning in the recent years specially as a result of the new technology introduced, the beginning of distance education is old enough that it exceeds 100 years ago (Sadeghi M, 2019). At the end of 2019 and the beginning of 2020, most of the educational institutes have moved to online environments. This is compared to what was happening previously before the spread of COVID-19, when online education was only being used to support the main courses (Martin et al., 2020). The system of lockdown pushed the instructors to find new ways of thinking about how to deliver information, at least on a personal level. Instructors tried to provide education after the entire educational systems were suspended and educational activities moved online, regardless of whether students, teachers, and support staff were pedagogically and physically ready for this conversion. However, teachers had the least amount of freedom to adapt with the new techniques of the e-learning education process (Dolenc et al., 2021). (Khalil et al, 2020) stated that the single option for the students was to follow the instructors.

1.1 Advantages of distance learning

Distance learning may not be the best option for every student seeking a college or university degree. The program however seems to have a list of advantages which outweighs the list of disadvantages. According to (Nagrale P. 2013) E-learning provides an online learning method where students can learn at their own convenience and requirements. Moreover, Students can access the course materials at different times with unlimited number of views and get updated content at their fingertips no matter where the place or residency is .

Furthermore, (Rehab, T., 2021) stated that e-learning allows continuous learning of any concept of life learning. Another advantage of e-learning is that it makes sure that students are in sync with contemporary learners. It provides access to exclusive, prolific, and up-to-date content. The access to the content is open, secure, and uninterrupted. (Tibaná-Herrera et al., 2018) E-Learning ensures fast mode of delivery by saving time and effort through easy and fast learning. Exclusive delivery of lessons is being provided through e-learning as lessons can start easily and can be combined in one session rather than following the pace of the group. Web-based learning helps promote active and independent learning (Rusly et al., 2021).

According to (Apriyanti C, 2020), for any given program, the distance learning degree fee (online or otherwise) may be much more affordable than the normal on-campus degree fee. Distance learning is considered as a good and economical option, as learners don't have to move their residency in the same country where the educational institution is located. In addition to that, the distance learning courses are offered in cheaper prices than the traditional education. (Brown, 2017) showed that self-responsibilities are increased among the e- learning students as they feel responsible for studying their own courses.

According to (Rusly et al., 2021), communication can happen between students and each other or with instructors at various times which helps in the improvement of communication skills. E- Learning has been shown to be beneficial in establishing the critical thinking ability of learners. It is useful in making students thinkers, active and risk learners in a protected environment; it enables students to learn independently and is less dependent on teachers for learning. (Ferri Fernando et al., 2020) stated that if learners opt for distance education, they do not have to travel through crowded places, local buses or trains. Only an internet connection is needed whether at home or any other place. On the other hand, the saved time can be invested in revising and getting more of the studying material. Course contents can be accessed unlimited number of times with the e-learning which is required when revising before the exam.

As per (Basilaia G et al., 2020), it is easier for the instructors as they can conduct the learning process anytime and anywhere. In addition to that, Instructors have a variety of options for teaching online such as: instructors can record lessons, conduct webinars, and sell courses online. They can increase their income by using online platforms, creating new trainings, policies and ideas. E-learning can be considered as a fast way for learning whether this learning a compulsory education or for entertainment.

Learnability, content and time taken can reasonably be checked. It is very useful for helping learners who are shy and prefer to learn alone.

(Brown, 2017) assumes that students who do not have time to go to colleges and universities while doing part-time or full-time jobs to make ends meet, e- learning becomes a blessing for them as they can learn during their spare time. Learners can teach themselves from the comfort of their own home and earn a certificate. Those who need to upgrade their CV by getting a better knowledge and without breaking their current work at the time, e-learning might be the leading alternative for them. Learners can proceed to attend their job along with enhancing their capabilities through e-learning.

1.2 Limitations of distance learning

(Shim T.E et al., 2020) The suggested improvement in the fields of online learning is coming because of the students' points of dissatisfaction. For example, increment of the network coverage and stability is one of the disappointments related to online learning. In addition, the interaction between students and teachers is another field of disappointment. In e-learning, internet is not only being used to send the materials to students or submitting assignments to teachers but also is used for the interaction and discussions between students and teachers or students and each other.

(Bao W, 2020) says that in the online learning there is an existent student concentration problem because of the lack of the eye to eye contact. To overcome this problem, the class speed and the amount of information in each class should be adjusted accordingly. Also new methods and ways of teaching should be used to attract the student's attention during classes. It is the role of both teachers and learners to achieve a perfect e-learning. There always must be effective tools to increase the interaction between students and teachers. According to (Whalen J, 2020), lecturers as well felt over-stressed as they were not well prepared for the sudden change to the online learning, same as the students. Thus, to promote the efficiency of online learning, the obstacles must be well known and proper solutions to overcome them must be sought. According to (Schlesselman, 2020), the crisis has not ended yet, and there are expectations to face an equivalent crisis as happened in 2020 which may require to implement the usage of online learning. As a result, institutes should be trained and well prepared for the use of online learning. It must be more planned and systematic. According to (Cavanaugh, 2005), Online learning is not easy for students as the achieved outcomes are not as the normal class education. Another obstacle in the online learning is that students usually attend the classes at home and during this time student's concentration will be impeded by normal house / family activities. In addition to that is the increase which occurs in the internet usage. Online learning saves a lot of time, but the understanding of material and courses contents is strongly affected.

(Estriegana et al., 2019) stated that one of the big points of weakness of the online learning is when the program includes laboratory work, practical exercises, etc. This point can be clearly observed in different fields of education. According to (Perić, 2019) even if the latest technologies are being using in the online learning process, there will always be a lack of the 100% reliability of the equipment / technologies. This problem that may occur during the online class means lack of concentration of both students and teachers which strongly affect the e-learning quality.

1.3 Models of distance learning.

According to (Jaber et al., 2020) Educational scientists identified e-learning in a simplified way and divided it into two basic types. The first is computer-based learning while the second is Internet-based e-learning. This method is considered the most accurate because it distinguishes e-learning from online learning. The types of e-learning are also determined according to the learning tools used. There are 10 types of e-learning which are Computer Managed Learning (CML), Computer Assisted Instruction (CAI), Synchronous Online Learning, Asynchronous Online Learning, Fixed E-Learning, Adaptive E-Learning, Linear E-Learning, Interactive Online Learning, Individual Online Learning and Collaborative

Online Learning.

2. Literature review

According to (Osman et al., 2018) the factors affecting the distance learning are classified into technological factors such as system, service and content quality. On the other hand, human factors are learners and instructor's attitudes, computer literacy and teaching methods. The nature of courses varies between theoretical and practical courses. Regarding the lecturers of theoretical courses, they have less challenges and obstacles during the online learning than the practical courses (Nambiar, 2020) Similarly, reports from the students showed that they were more satisfied to study theoretical courses online rather than the practical courses (Khalil, 2020).

According to (Moore et al., 2005) the average range of distance learners is from 25 to 50, while the main age according to (Guri-Rosenbilt, 1999) is from 30-34. In Colorado et al., 2012 the research sample replies were 47.6% of less than thirties and from 35 to 45 were 35.9%; in addition, more than 46 years composed a percentage of 16.5% and 83% of the sample GPA was from 3.6 to 4.0. He stated in his studies that the factor of the student's age did not affect the students' academic performance. (Fadl et al., 2021) made a study to compare between postgraduate and undergraduate students in their perception on the online learning. The study showed that postgraduates who had positive impressions were 59.8 % in comparison with 40.2% with negative impression. On the other hand, those figures for the undergraduates are 66.7% and 33.3% respectively.

(Dudar et al., 2021) shows in the article that in order to achieve the target of the distance learning and get results close or similar to face-to-face education, lecturers and learners have to use various applications and platforms. They each should do a part to complete the whole process as shown in the below figure. Internet quality and communications infra structure can be a great obstacle in case of e-learning. Still up to date, many countries are not fully covered with a proper internet facility. Poor physical infrastructure and limited computer access are among the great barriers that face the e-learning process. (O'Doherty et al., 2018)

According to (Shraim 2019), the study was to compare between students and teacher's satisfaction in the online examinations. The students had good impressions regarding the online examinations and according to the survey they were satisfied despite they declared that exam was difficult. Regarding the teachers, they were having more obstacles as a result of technological knowledge and use of software; moreover, some teachers had to ask for advice from other colleagues. That was not the main obstacle or point of dissatisfaction as teachers have mentioned that it was impossible to monitor and to be sure that the students will complete the exam on their own and without referring to prohibited material or third parties before submitting the exam.

After reviewing the above studies, it was observed that the previous studies had explained the effect of technological factors affecting the e-learning, the age of the students in relation to the e-learning academic performance and the comparison between postgraduate and undergraduate perceptions in the online learning. Moreover, this study aims to cover the gap in studying the students ability to understand the courses according to the academic level, their satisfaction according to their age, their preferred examination methods in addition to their preference for means of communication with faculty members and the effect of the nature of the courses on their understanding through e-learning as well as the faculty members preference of the examination methods, the possibility of continuous evaluation of both the theoretical and practical course needs more studies in addition to discussing the previous factors in the maritime e-learning education, analyzing and discussion and it was conducted as mentioned below.

2. Methodology

The aim of the study is to determine whether there are differences in attitudes among the surveyed sample of population towards specific factors which are: nature of the course, level of the learner and methods of communication that affect the e-learning system in maritime

education. The sample was chosen from different levels of students, taking into account the variable age of students and faculty members. The students were exposed to different forms of examination methods, methods of communication with faculty members, and the means used in the educational process.

The current research was conducted through the social survey method, and the data were collected at the end of the second semester 2020/2021. The answers of 235 participants were recorded, this sample is considered suitable for the number of students studying at the maritime Institute, and the margin of error calculated in the answers was 2.9%. The sample consisted of three groups of students divided according to their educational level, in addition to a fourth group of faculty members. The first group consisted of students of nautical basic studies (119 students), the second group of students of competency courses students (23 students), the third group of students of maritime postgraduate studies (27 students), and the fourth group of faculty members (59 members).

All students and faculty members surveyed have access to the internet and mobile phone to fill out the questionnaire, and the link to the questionnaire that includes the guidelines for filling out the answers was sent online. There was no obligation to complete the questionnaire for any of the students and lecturers, and the direct benefit of students' participation in the study is the opportunity to express their opinions about their expectations and views on the factors affecting e-learning.

The content of the questionnaire was validated by expert evaluation. The questionnaire consists of 12 questions, 8 closed questions (Likart five-point scale has been used). and 3 open questions. These questions seemed appropriate for the purpose of the current research, their grouping and coding into general categories that would allow secondary analyses.

The questions aimed to clarify the extent to which students understand the courses through e-learning, and to know the best means of communication with faculty members.

The questions were meant to determine the best method for assessment, and to identify the extent to which e-learning affects the nature of the course.

The collected data were coded, tabulated, and statistically analyzed using IBM SPSS statistics software version 25.0, IBM Corp.

• Descriptive statistics: were done for qualitative data as numbers and percentages.

• Inferential analyses: for independent variables were done using Pearson Chi-Square for differences between proportions. It was used for relation between each two variables .

• The level of significance was taken at P value <0.05 is statistically significant, otherwise is non-significant. The p-value is a statistical measure for the probability that the results observed in a study could have occurred by chance.

The analysis focused on identifying the differences between student samples and faculty members who practiced e-learning to answer the following research questions:

- Did the e-learning method help to understand the scientific course clearly؟
- What are the preferred assessment methods for students and faculty members؟
- Does the e-learning method allow for the continuous evaluation process؟
- What are the means used to communicate and deliver information؟
- Does the nature of the scientific course (Theoretical- Practical) affect the delivery of information to students؟

3. Results

The first objective of this study was to determine the extent of students' satisfaction of scientific courses according to the educational level. For this purpose, a 5-point scale questions were used. The distribution of answers is shown in Table (1) which shows a significant difference between the academic level of the students, where the P value = 0.009. (P value < 0.05) Basic Nautical Studies students scored the highest in their approval of their ability to understand courses through e-learning with

81.01%, followed by Maritime Postgraduate Studies' students with 80.00%. This was followed by Competency courses students with 63.48%. It follows from this that students' satisfaction with scientific courses varies according to the academic level.

Table (1): The differences between students' ability to understand the courses according to the academic level.

		E-learning helped me to understand the course easily and clearly					Total	Weighted mean	%	χ^2	P. value
		Strongly disagree	Disagree	Neutral	Agree	Strongly agree					
Student level	Postgraduate student	1	1	3	14	8	27	4.00	80.00	20.443*	0.009
	Competency courses student	2	5	6	7	3	23	3.17	63.48		
	Basic studies student / undergraduate student	7	5	11	48	48	119	4.05	81.01		
Total		10	11	20	69	59	169	3.92	78.46		

In addition, there are no significant differences in students satisfaction based on their ages with the e-learning process. Where P value > 0.05 = 0.515. Which shows that the age of students does not affect the process of studying electronically. Whereas, all age groups agree on the rates of satisfaction with e-learning, with an average percentage of 80%. Apart from the age group (31-40), the percentage of satisfaction with e-learning decreases to the right of 72%, despite the fact that it is still a high percentage, as shown in Table (2). Consequently, this shows that all age groups can benefit from e-learning.

Table (2): Student satisfaction with e-learning according to age

		I have been satisfied with studying the course online					Total	Weighted mean	%	χ^2	P value
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree					
Age	17-20 years	2	3	6	11	18	40	4.00	80.00	19.11	0.515
	21-25 years	5	4	11	30	47	97	4.13	82.68		
	26-30 years	1	1	0	5	5	12	4.00	80.00		
	31-40 years	1	1	3	6	3	14	3.64	72.86		
	41-50 years	0	0	0	2	0	2	4.00	80.00		
	51-60 years	0	0	0	4	0	4	4.00	80.00		
Total		9	9	20	58	73	169	4.05	80.95		

The second objective of this study was to investigate the extent of the ability to implement continuous assessment of students through e-learning, and to clarify the extent to which students prefer the type of assessment according to the educational level.

Table (3) shows a significant difference between academic levels of the students in preference to how exams are conducted; however, the P value =0.001 (P value < 0.05), clarifies that Competency courses students prefer to take the written exam with a percentage of 60.9%, compared to 39.1% who prefer the online exam. On the other hand, basic nautical studies and maritime postgraduate studies' students prefer online exams with a percentage of approximately 79%, while 21% of them prefer the written exam. Furthermore, faculty members prefer the written exam with a percentage of 86.4%, compared to 13.6% who prefer the online exam as shown in Table (4). Students' preference for taking exams online is due to the possibility of implementing it at home and avoiding the tension that may occur with written exams. On the contrary, faculty members prefer written exams to ensure the integrity of the exams, and to avoid malfunctions that may occur in the Internet.

Table (3): Students' preference of the examination method.

			Which exam method do you prefer?		Total	χ^2	P value
			Written evaluation	Online evaluation			
Student level	Postgraduate student	No.	6	21	27	14.495*	0.001
		%	22.2	77.8	100.0		
	Competency courses student	No.	14	9	23		
		%	60.9	39.1	100.0		
	Basic studies student / undergraduate student	No.	27	92	119		
		%	22.7	77.3	100.0		
Total		No.	47	122	169		
		%	27.8	72.2	100.0		

Table (4): Faculty members preference of the examination method

		Which exam do you prefer?		Total
		Written evaluation	Online evaluation	
Faculty members	No.	51	8	59
	%	86.4	13.6	100.0

Table (5) shows the possibility of carrying out student assessment continuously. Despite the absence of a significant difference between the type of course (Theoretical- Practical), as P value = 0.189. (P value > 0.05), the majority of students and faculty members acknowledged the possibility of implementing continuous evaluation in the education system electronically.

Table (5): The possibility of continuous evaluation of both the theoretical and practical course

		I am being regularly evaluated during e-learning					Total	Weighted mean	%	χ^2	P value
		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree					
Nature of course	Theoretical	3	7	13	54	41	118	4.04	80.85	6.134	0.189
	Practical	0	3	3	18	27	51	4.35	87.06		
Total		3	10	16	72	68	169	4.14	82.72		

The third objective of this research was to determine the best means used in communication between students and faculty members. First, from the students' point of view, Table (6) shows a significant difference between the nature of the course (theoretical-practical), where the P value = 0.035. (P value < 0.05), which controls the means of communication.

Firstly, in theoretical courses, students prefer to use social media e.g., WhatsApp with a percentage of 69.5%; additionally, in practical courses, a percentage of slightly less than 62.7%. Only 10.2% of students prefer to use the official platform of the university in theoretical courses, and 23.5% in practical courses. E-mail is used but with a very weak rate of 0.8% in the theoretical course and 3.9% in the practical course. While Google Classroom has a relatively large share of use, 19.5% in the theoretical course and 9.8% in the practical course. Secondly, from the point of view of the faculty members, the official university platform and social media (e.g. WhatsApp) have the largest share in the way of communicating with students. The official platform is used with a percentage of 51.4% in the theoretical course and 30.4% in the practical course. While social media e.g. WhatsApp is used by 45.7% in the theoretical course and 52.2% in the practical course.

Finally, the final objective in this research was to determine the role of the nature of the course (theoretical-practical) in the ease of transferring information to the student through e-learning. A significant difference was found between the type of course (theoretical - practical), where the P value = 0.016. (P value < 0.05). From the point of view of the faculty members, theoretical courses are easier to teach and transfer information to students. The percentage of theoretical courses is 76.7%, while the percentage of practical courses is 69.6% as shown in Table (7).

Table (6): Students' preference for means of communication with faculty members

			What is your preferred method of communication with the lecturer?				Total	χ^2	P value
			Google class room	e-mail	university official platform	social media i.e., WhatsApp			
Nature of course	Theoretical	No.	23	1	12	82	118	8.629*	0.035
		%	19.5	0.8	10.2	69.5	100.0		
	Practical	No.	5	2	12	32	51		
		%	9.8	3.9	23.5	62.7	100.0		
Total		No.	28	3	24	114	169		
		%	16.6	1.8	14.2	67.5	100.0		

Table (7): The effect of the nature of the course on students' understanding through e-learning

		The e-learning method helped me to transfer the course information smoothly and clearly					Total	Weighted mean	%	χ^2	P value
		strongly disagree	disagree	Neutral	agree	strongly agree					
Nature of course	theoretical	0	1	8	23	4	36	3.83	76.67	12.132*	0.016
	Practical	1	6	2	9	5	23	3.48	69.57		
Total		1	7	10	32	9	59	3.69	73.90		

4. DISCUSSIONS

E-learning has become an important alternative to reform the entire traditional education system, especially during crises that prevent the implementation of traditional education (face to face), as happened during the Covid 19 pandemic. Consequently, faculty and students have had to adapt to the new social conditions and transition to online education .

In this context, the study focused on maritime education students, with the aim of determining their attitudes towards e-learning, focusing on the factors that affect e-learning, and taking advantage of the advantages and disadvantages of this system. The students' perspectives were identified, because they are the beneficiaries of this system, and they can provide clear information about this type of education, and thus contribute to the improvement of maritime education, as the analysis focused on identifying the differences between groups.

The results of the current research show that among the studied population, there is a difference in the students' ability to understand the courses according to the educational level. It should be noted that the understanding and comprehension is higher among the basic studies students, and lower among the Competency courses students. This result is consistent with (Fadl et al., 2021).

There is no difference between the ages of students in understanding and comprehension. This result is consistent with (Guri-Rosenbilt, 1999).

With regard to the positive side of e-learning, the research showed that continuous assessment of students can be implemented through e-learning in theoretical and practical courses. This result is in agreement with (Shraim 2019) showing the many and different means used in the communication process between faculty members and students.

As for the negative side of e-learning, the research showed that the quality of information delivered to students depends on the nature of the course. Faculty members believe that theoretical courses are much easier to teach than practical courses, which makes e-learning not valid for all types of courses. Groups of students also differed on their preference for the assessment method; basic studies and graduate students preferred the online assessment method, while Competency courses students' students preferred the written examination.

In conclusion, this research has identified the factors that control the success of the e-education process for marine students from the perspective of students and faculty. The e-learning system may continue and a complete return to face-to-face learning may not be entirely possible. Will education methods differ in the future? The current pandemic has proven that there are aspects of the education process that were unimaginable in the past.

Moreover, it seems that the time has come to move to another level, which is the blended learning that combines face-to-face teaching with online teaching, thus creating a blended learning system. This level has been studied extensively by (Graham, 2019) and (Brown, 2017).

Finally, it is certain that face-to-face interaction cannot be excluded from the process. Also, the benefits of e-learning cannot be denied, meaning that saving time and rest may become indispensable in students' lives in the future.

Henceforward, it is recommended to make a comparison between the two education systems, face-to-face education, and e-learning in maritime education in terms of student outcomes at the end of semesters.

REFRENCES:

Apriyanti, C., 2020. Distance learning and obstacles during Covid-19 outbreak. Jurnal Ilmiah Pendidikan Dasar, 7(2), pp.68-83.

Bao, W., 2020. COVID-19 and online teaching in higher education: A case study of Peking University. Human Behavior and Emerging Technologies, 2(2), pp.113-115.

Basilaia, G., Dgebuadze, M., Kantaria, M. and Chokhonelidze, G., 2020. Replacing the classic learning form at universities as an immediate response to the COVID-19 virus infection in Georgia. International Journal for Research in Applied Science and Engineering Technology, 8(3), pp.101-108.

Brown, C., 2017. Advantages and disadvantages of distance learning. Retrieved from. Brown, R. 2003, Blending learning: Rich experiences from a rich picture. Train. Develop. Austr. 30, 14–17.

Cavanaugh, J., 2005. Teaching online-A time comparison. Online Journal of Distance Learning Administration, 8(1).

Colorado, J.T. and Eberle, J., 2012. Student demographics and success in online learning environments .

Dolenc, K., Šorgo, A. and Virtič, M.P., 2021. The difference in views of educators and students on Forced Online Distance Education can lead to unintentional side effects. Education and Information Technologies, pp.1-27.

Dudar, V. L., Riznyk, V. V., Kotsur, V. V., Pechenizka , S. S., & Kovtun, O. A. 2021. Use of modern technologies and digital tools in the context of distance and mixed learning. Linguistics and Culture Review, 5(S2), 733-750.

Estriegana, R., Medina-Merodio, J.A. and Barchino, R., 2019. Student acceptance of virtual laboratory and practical work: An extension of the technology acceptance model. Computers & Education, 135, pp.1-14.

Fadl, H.A.O., Hamza, A.H.A., Eissa, M.E.M., Osman, H.I.A., Ali, H.A.I. and Mohamed, N.A.Y., 2021. Perception of undergraduates and postgraduates pertaining online Learning during the COVID-19 Pandemic: a Cross-sectional Study amongst Sudanese Health Professional Students.

Ferri, Fernando, Patrizia Grifoni, and Tiziana Guzzo. "Online learning and emergency remote teaching: Opportunities and challenges in emergency situations." Societies 10, no. 4 (2020): 86.

Graham, C.R., 2019; Current research in blended learning. In Handbook of Distance Education, 4th ed.; Moore, M.G., Diehl,W.C., Eds.; Routledge: New York, NY, USA, pp. 173–188.

Jabar Al-Atabi, Akram & Al-Noori, Bushra. (2020). E-Learning In Teaching. Oye, N.D., Salleh, M. and Iahad, N.A., 2012. E-learning methodologies and tools. International Journal of Advanced Computer Science and Applications, 3(2).

Khalil, R., Mansour, A.E., Fadda, W.A., Almisnid, K., Aldamegh, M., Al-Nafeesah, A., Alkhalifah, A. and Al-Wutayd, O., 2020. The sudden transition to synchronized online learning during the COVID-19 pandemic in Saudi Arabia: a qualitative study exploring medical students' perspectives. BMC medical education, 20(1), pp.1-10.https://doi.org/10.1186/s12909-020-02208-z

Martin, F., Stamper, B., & Flowers, C. 2020. Examining student perception of their readiness for online learning: Importance and confidence. Online Learning, 24(2), 38-58.

Moore, M. G., & Kearsley, G. 2005. Distance education: A systems view (2nd ed.). Belmont, CA: Wadsworth Publishing Co.

Nambiar, D., 2020. The impact of online learning during COVID-19: students' and teachers' perspective. The International Journal of Indian Psychology, 8(2), pp.783-793.https://doi.org/10.25215/0802.094

Nagrale, P. (2013). Advantages and disadvantages of distance education. https://surejob.in/advantages-and-disadvantages-of-distance-education.html

O'Doherty, D., Dromey, M., Lougheed, J. et al. Barriers and solutions to online learning in medical education – an integrative review. BMC Med Educ 18, 130 (2018). https://doi.org/10.1186/s12909-018-1240-0

Osman, M.A.F., Wahid, A. and Zakria, A., 2018. Assessment of factors affecting e-learning: preliminary investigation. In 1st International Conference on Open Library to Open SocietyAt: Sukhotai Thammatirat Open University, Nonthaburi, Thailand. Retrieved from: https://www. researchgate. net/publication/327666987_Assessment Affecting_E-learning_Preliminary_investigation

Perić, N., 2019. E-learning: Analysis, Advantages and Disadvantages. PaKSoM 2019, p.45.

Rehab, T., 2021. Effects of Test Anxiety, Distance Education on General Anxiety and Life Satisfaction of University Students. Psycho-Educational Research Reviews, 10(1), pp.107-117.

Rusly, N.H.M., Vijayaratnam, P. and Sivarajah, A., 2021. COVID-19 PANDEMIC AND ONLINE LEARNING: THE CHALLENGES OF INSTRUCTORS IN TERTIARY INSTITUTIONS. International Journal of Education and Pedagogy, 3(2), pp.14-26.

Sadeghi M. A Shift from Classroom to Distance Learning: Advantages and Limitations. IJREE. 2019; 4 (1) URL: http://ijreeonline.com/article-1-132-en.html

Schlesselman, L.S., 2020. Perspective from a teaching and learning center during emergency remote teaching. American journal of pharmaceutical education, 84(8).

Shim, T.E. and Lee, S.Y., 2020. College students' experience of emergency remote teaching due to COVID-19. Children and youth services review, 119, p.105578.

Shraim, K., 2019. Online examination practices in higher education institutions: learners' perspectives. Turkish Online Journal of Distance Education, 20(4), pp.185-196.

Tibaná-Herrera, G., Fernández-Bajón, M.T. and de Moya-Anegón, F., 2018. Global analysis of the E-learning scientific domain: a declining category? Scientometrics, 114(2), pp.675-685.

Whalen, J., 2020. Should teachers be trained in emergency remote teaching? Lessons learned from the COVID-19 pandemic. Journal of Technology and Teacher Education, 28(2), pp.189-199.

THE RESPONSE OF DIGITAL SYSTEM TO CONTROL POLLUTION IN SUEZ CANAL AND EGYPTIAN WATER

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المستخلص:

بعد حادثة السفينة إكسون فالديز وانتشار التلوث بالسواحل الامريكية الزم قانون التلوث النفطي الأمريكي لعام ١٩٩٠ وجود خدمة نظام الكترونى معتمد للاستجابة للطوارئ لناقلات النفط التي تبحر في مياه الولايات المتحدة .وبالتالى اصبح التحديد الدقيق لكمية الزيوت المنسكبة من العوامل الرئيسة لتحديد سبل المكافحة وكمية المعدات المطلوبة لسرعة استخدامها للحد من انتشار التلوث بالزيت . يتكون النظام الالكترونى للاستجابة للطوارئ من قاعدة بيانات تحتوي على نموذج إلكتروني لجميع ناقلات النفط. يقوم فريق العمل بإدخال حالة التحميل في النموذج الإلكتروني مع حالة الطوارئ التي تحدث ، فيقوم البرنامج بتحديد الخسائر وتقديم اقتراحات لتقليل هذة الخسائر

يوضح هذا البحث أهمية استخدام برنامج الكترونى يساعد فى مكافحة التلوث من السفن العابرة لقناة السويس أو الراسية في الموانئ المصرية من خلال الاستراتيجيات التالية:

١. التركيز على البنود الرئيسية لقناة السويس (خصائص قناة السويس ، نظام التشغيل ، تنظيم العبور، الطقس ، التيار ، أنواع قاع البحر ، حالات جنوح السفن العام الماضي.

٢. دراسة حالة لسفينة ناقلة نفط عملاقة أثناء عبورها لقناة السويس وتحليل مواقع الضرر المختلفة بخزان النفط والكمية النسبية للنفط المتسرب في كل حالة بالتطبيق على النموذج الالكترونى.

٣. يسمح التحديد الدقيق لكمية الزيت المتوقع انسكابها بالبدء السريع لإعداد معدات مكافحة الانسكاب النفطي بقدرة كافية للتحكم في الانسكابات النفطية وتقليل الأضرار التي تلحق بالبيئة.

توضح الورقة البحثية ضرورة استخدام النظم الالكترونية المعتمدة فى قناة السويس والموانى المصرية التى تساعد فى التنبؤ بكمية الزيوت المنسكبة واتخاذ القرار فى حالات الطوارئ للحد من اثارها الضارة بالبيئة.

Abstract:

After the M/V Exxon Valdez accident and the spread of pollution in the American coasts, the American Oil Pollution Act of 1990 required the existence of an approved electronic emergency response system service for oil tankers sailing in the waters of the United States. Therefore, accurate determination of the amount of oil spilled became one of the main factors to determine the means of control and the quantity of equipment required for speed of use. To reduce the spread of oil pollution. The Electronic Emergency Response System consists of a database that contains an electronic form for all oil tankers. The work team enters the status of the load in the electronic form with the emergency that occurs, so the program determines the losses that will occur and provides suggestions to reduce these losses.

This research demonstrates the importance of using an electronic program that helps in combating pollution from ships transiting the Suez Canal or anchored in Egyptian ports through the following strategies:

1. Focus on the main items of the Suez Canal (characteristics of the Suez Canal, operating system, transit regulation, weather, current, seabed types, ship stranding cases last year
2. A case study of a giant oil tanker ship during its transit to the Suez Canal and analysis of the different damage sites in the oil tank and the relative amount of oil spilled in each case by applying the electronic model
3. Accurate determination of the amount of oil expected to be spilled that allows for the rapid start-up of oil spill control equipment with sufficient capacity to control oil spills and minimize damage to the environment.

The research paper explains the necessity of using the electronic systems adopted in the Suez Canal and the Egyptian ports, which help in predicting the amount of oil spilled and taking decisions in emergencies to reduce its harmful effects on the environment.

Keywords: OIL SPILL, EMERGENCY RESPONSE SYSTEM, FLOODING, OUT FLOW, HEAD

2. Introduction

The Suez Canal is a man-made sea-level waterway in Egypt which connects the Red Sea and the Mediterranean Sea. It has enabled water transportation between Europe and Asia without passing through Africa since its opening on November 17, 1869. The Canal was 26 feet deep when it was constructed. The Canal is now 66 feet deep after several enlargements. There are six passing areas on the Canal. It is the world's longest canal without locks, and seawater runs naturally into it. The Egyptian Suez Canal Authority (SCA) owns and operates the canal.With a growth in demand for marine transport and global trade, the Suez Canal's importance is growing. The Suze Canal can handle up to 25,000 ships a year. Consequently, 100% of container ships, 92% of bulk cargo ships, and 62% of oil carrier ships can pass through the Suez Canal, (see fig 1)

Fig 1 Suez Canal lay out (Abdel-Razek, Sherine (2015).

The Suez Canal retains its strategic significance, owing to the Middle Eastern oil trade and the Pacific Asian economic trade. The Suez Canal has a significant effect on the route from the

Persian Gulf to the Northern European range, as it reduces a 21,000 km journey across Africa that takes 24 days to a 12,000 km journey that takes 14 days. As a result, depending on the ship's pace, the Suez Canal will save between 7 and 10 days of shipping time.

Given the strategic importance of the Suez Canal as a global shipping corridor, the safety and security of the canal is a priority for the shipping industry. The large size and increasing number of ships transiting the Suez Canal were the cause of accidents. This halted traffic in the Suez Canal. One of the most dangerous of these accidents that resulted in an oil spill.

The Egyptian Suez Canal Authority is working to contain any oil leakage in the canal by making pollution control centers and a crisis management plan that trained on periodically (Authority SC (2021))

In this paper, the use of the digital system presented to help speed up combating any oil leakage in the Suez Canal.

3. BACKGROUND

Oil spill hazard is defined as an occurrence that happens unexpectedly and is complex in nature. It results in the death of animals, disruption to property or the natural ecosystem, and has a significant impact on local events. Such an event requires comprehensive funding, machinery, expertise, and labor from a variety of organizations, as well as effective planning that necessitates complex action and takes a long time. Large areas of coastal areas are vulnerable to such threats, which can disrupt the socio-economic and social lives of coastal residents, resulting in property destruction and environmental degradation (Assilzadeh & Gao, 2010).

Oil spills in seawater are the fastest source of degradation of marine life, as they are more dangerous than waste litter and litter. Oil spills asphyxiate marine life to death, and lead to behavioral changes and a breakdown in the thermal insulation of those who survive. It is fundamentally altering the entire ecosystem of the affected area, such as the long coastline or the deep ocean (Li, et al., 2017).

According to the Egyptian naval hydrography department, the average annual atmospheric temperature is about 24°c, which increases in summer, and the average annual relative humidity is about 50%. The temperature considered one of the main factors affecting the weathering of oil at sea. High temperature, kind of oil spilled, wave direction increases the rate of spreading of the oil

on water and increases its viscosity (Abdel-Hameed, 2016).

3.1 SUEZ CANAL OPERATION

For free double-lane flow, the channel is too narrow. The ships, thus, travel through convoys, using bypasses. Out of 193 km (120 mil), the double passes are increased in all (50%) after opening new Suez Canal project in 2015. The new Suez Canal increased the standard ships ability from 76 to 97 standard ships can pass the canal in 24 hours and also decrease the ship normally transits the canal form18 to 11 hours.9 km, bypass TIMSAH 5 km and bypass DEVERSOIR 27,5 km(extreme bitter lake at north end) (17 mil). In 1980, the bypasses were been finished. A ship normally transits the canal between 12 and 16 hours. Around 76 standard ships will pass the canal in 24 hours .As free two-way traffic not permitted in the canal, all ships transit regularly in convoy lines. It scheduled for a scheme of 24 hours. A single convoy begins from Suez at 6 a.m. every day. at 6 a.m. This convoy transported unhindered. It uses the eastern path. Two southbound convoys interwoven in the northbound journey of this caravan. The first begins in the north at 0.00 o'clock from PORT SAID, with the big bitter lake anchoring. The second southbound convoy begins at 07.00 hours from Port Said with anchors to make the northbound convoy go via the west bypass of Ballah. This convoy has smaller and often unloaded ships. ( )

3.2. EFFECT OF ACCIDENT ON CONVOY SAILING:

According to Suez Canal characteristics any kind of accident (Fire-Collision /Grounding with Major leakage or spillage of oil cargo) during the Convoy sailing especially at a single lane of traffic can stop the navigation partially or completely so the time become very important factor for dealing with the accident.

3.2.1 SHIPPING ACCIDENTS:

In 2004, the oil tanker M/V AL SAMIDOON grounding in the Suez Canal. As a result, oil spill 9,000 tons of crude oil, which moved, with the effect of high current. The Suez Canal emergency plan for control oil spill was been activated, using booms, skimmers and dispersants. The slicks drifted to the north in the direction of Mediterranean Sea (N. A. Farid, 2014).

On February 26, 2006, the oil tanker M/V "GRIGOROUSSA" ran aground at Suez Canal, leaked 2,700 tons of oil and polluted 8 miles of coastline.(Steven Dexter 2018)

On March 23, 2021, the Container ship M/V "EVER GIVEN" ran aground at Suez Canal, lodging herself against both banks of the waterway. The period of six days, the salvage team from Suez Canal Authority (SCA) consists of more than 11 tugs and 2 dredgers cooperate with international salvage company to start salvage plan as a combined of dredging to remove the ground under the ship hull and using the tugs bollard pull to return the ship to the deep water. (Gambrell, Jon (2021).

4. SUEZ CANAL CONTANGANCY PLAN

The Suez Canal Authority (SCA) For Several years has been establishing measures to respond within its jurisdiction to oil pollution incidents. to ensure the procedures and activities of the authority are in accordance with the national contingency plan for the oil spill, the EEAA will collaborate together with the SCA to develop a written emergency plan for the pollution of oils.

The national contingency plan depends on the following strategy:

a) Stop or decrease the oil outflow source.

b) Control the oil slick, where no threat to aquatic or maritime infrastructure is present.

c) Attempt to monitor and restore oil by mechanical means at sea.

d) Use dispersants according to the national policy.

e) Protect vulnerable areas based on the NOSCP's priority score.

f) Clean-up of the shoreline

Responsibility for oil spill inside the Suez Canal remains with the Suez Canal authority in compliance with its mandate. (ABD El-GeliL(1998)).

The pollution control plan aims to define procedures and responsibilities in the event of a

Suez Canal emergency response system in order to minimize the time for oil spill control due to

oil spill. The Suez Canal Authority owns group of pollution control centers along the canal these

centers consist of large fleet of specialized marine units. This fleet includes a large number of locomotives, halls and rapid launching, in addition to oil pollution control equipment, which includes 20 different scrapers suitable for all types of spilled oil, in addition to 9000 meters of rubber barriers, 4 washers for high-pressure berths with hot water and solvents, 10 floating tanks in addition to 3 movable cylindrical tanks for receiving returned oils (SOBEH, H (2018).

5. The Research problem

• The gaps in the baseline studies of different oil spills. It shows the baseline depend on natural resources and socioeconomic resources in the local area are essential for developing the impact studies on environmental and economic and enforced recovery plans in order to accurate monitoring of a spill. (Feng et al. (2014))

• A number of studies confirmed the risks present in the study area, as the increase in traffic density and the possibility of accidents occurring suddenly clarified. Consequently, a digital system must be set up for daily monitoring of Egyptian waters at short intervals to detect any oil spill as soon as it occurs and to help reduce its effects (Abou El-Geit, et al., 2013).

6. Research objectives

The previous revision explained that the maritime system is operating by human people; because of human errors end in casualty situations .To make greater strides towards reducing marine casualties dealing with the fact to only reducing it by more training and regulation. Therefore, the main target of this research are:

1- Study the aim of digital emergency response system.

2- Establish digital emergency response system to cover Egyptian waters.

3- Decreasing the effect, the accident by digital emergency response action.

4- Apply the digital emergency response system on VLCC in the Suez Canal.

stranded oil tanker during transit Suez Canal. Enable Suez Canal Authority to start accurate salvage plan with clear starting data on scientific basis. To meet this objective, a methodology based on qualitative and quantitative analysis will be considered, which consists of four steps:

i. To review the large-scale oil spill cases during transit SC.

ii. To review the open literature on the topic of oil spill control and method for calculation oil out flow.

iii. Apply ERS on VLCC as a case study for VLCC during transit Suez Canal.

iv. Analyses the results obtained from the program.

1.1.1 ERS REGULATION REQUIREMENTS

ERS complies with the following regulations and industry guidelines:

- MARPOL 73/78 Annex I, Regulation 37 and MARPOL Regulation 1/37(4), as which state that ship must have digital land-based programs for calculation damage stability and residual structural strength.
- Requirements of OPA 90 in 33 CFR 155.240.
- IACS Rec. No. 145 and ISM Code, Section 8, which requires the ship operator to establish procedures to respond to potential emergency shipboard situations, including the use of drills and exercises to ready for emergencies.
- The Guidelines OCIMF on Capabilities of Emergency Response Providers.

1.2 SOFTWARE TOOLS

HECSALV commercial software used in this study as example. Is enable a simulation of stranding ship and accurate define the quantity

• Suez Canal (SC) using Emergency Response system (ERS) and already have database contain

7. Research methodology

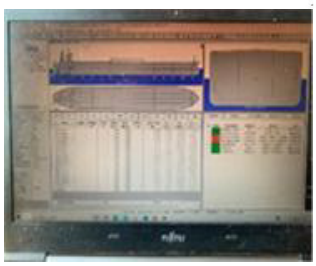
The current research demonstrates how to start of oil spill, it enables good analyses for the ship

oil out flow according to the position of hull damaged. It simulates salvage plan steps for quantity of oil out flow in the worst-case scenario and direct calculate oil spilled quantity after accurate define the position of the height of opening from water line. Software tools capability including simulation for ground reactions, Tank damage, Tide-level-change and oil out flow calculation:

Many software tools used by ERS the worldwide used:

1-HECSALV 2-GHS 3-NABA

In this research HECSALV will be applied for the case study, (see fig 2)



(A)

Before loading

(B) after loading

Fig 2 Software (HECSALV) before & after insert the loaded condition

9.CASE STUDY

CALCULATION OF THE OIL SPILL QUANTITY FROM VLCC SHIP BY USING ERS IN DIFFERINT CASES:

model for all tanker transit SC using HECSALV commercial software.

• SC using ERS in the active mood by enter the actual loading condition for the tanker before enter SC using HECSALV model. (Tidal and current positive or negative effect are not considered in this case study)

• The VLCC ship had one damage in cargo oil tank no 1 starboard side (COT1SB) (FIG1) the calculation for oil outflow from the damaged hole and the remaining oil is obtained using ERS in the following 5 levels for the same tank For the damaged position :

i. Case 1 damage no. (COT1SB) at lower part of the tank (fig 4)

ii. Case 2 damage no. (COT1SB) at (8) m from base line (fig 5)

iii. Case 3 damage no. (COT1SB) at (10) m from base line (fig 6)

iv. Case 4 damage no. (COT1SB) at (12) m from base line (fig 7)

v. Case 5 damage no. (COT1SB) at (15) m from base line (fig 8)

VLLC M/V (KAHLA) Ship particular

LBP m 319.000 Beam m 60.000

LOA m 333.000 Depth m 30.400

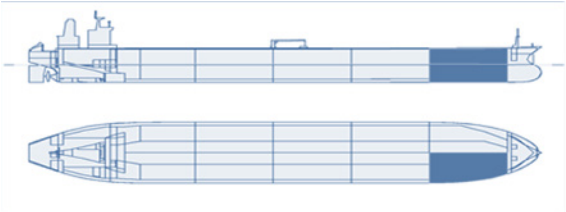


Fig 3 VLCC Cargo Tank No 1 Starboard Side

Compartment	Intact Status LT	Remaining Oil LT	Oil Outflow LT
NO.1 COT S	10,259	5,204	5,055

In this case, the program ERS (HECSALV) (Herbert-ABS. (2015)) applied to the case of an oil spill from VLCC ship in different situations to predict the exact amount of leakage.

Assumption that;

Initial Loading case before damage

T_{FP}	m	15.551	Cargo Oil	tons 194,577
T_{AP}	m	17.15		
Displacement	tons	245,383	NO.1 COT S	tons 10,259

9.1CASE 1 DAMAGE NO.1 COT S AT LOWER PART OF THE TANK FIG (4)

Location of Damage

Calc. Point	m-FP	m-BL	m-CL
Low Point	12.950A	3.00	4.575 SB

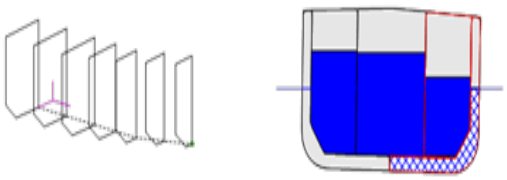


FIG 4 case 1 damage in 3 meter from bottom
Oil Outflow Summary (damage NO.1 COT S at lower part of the tank)

Compartment	Intact Status LT	Remaining Oil LT	Oil Outflow LT
NO.1 COT S	10,259	7,802	2,457

9.2.CASE 2 DAMAGE NO.1 COT S AT 8 M FROM LOWER PART OF THE TANK (FIG 5)

Location of Damage

Calc. Point	m-FP	m-BL	m-CL
Low Point	12.950A	8.00	4.575 SB

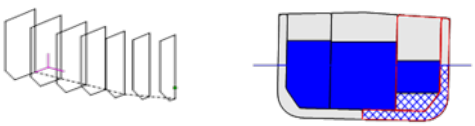


FIG 5 .case 2 damage in 8 meter from bottom

Oil Outflow Summary (damage NO.1 COT S at 8m from base-line)

9.3.CASE 3 DAMAGE NO.1 COT S AT 10 M FROM LOWER PART OF THE TANK (FIG 6)

Location of Damage

Calc. Point	m-FP	m-BL	m-CL
Low Point	12.950A	10.00	4.575 SB

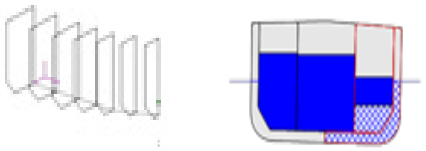


FIG 6 case 3 damage in 10 meter from bottom
Oil Outflow Summary (damage NO.1 COT S at 10 m from base-line))

Compartment	Intact Status LT	Remaining Oil LT	Oil Outflow LT
NO.1 COT S	10,259	3,971	6,288

9.4CASE 4 DAMAGE NO.1 COT S AT 12 M FROM LOWER PART OF THE TANK (FIG 7)

Location of Damage

Calc. Point	m-FP	m-BL	m-CL
Low Point	12.950A	12.00	4.575 SB

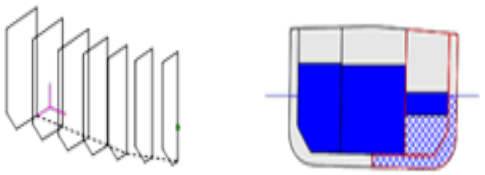


FIG 7 case 4 damage in 12 meter from bottom
Oil Outflow Summary (damage NO.1 COT S at 12 m from base-line))

Compartment	Intact Status LT	Remaining Oil LT	Oil Outflow LT
NO.1 COT S	10,259	2,736	7,523

9.5.CASE 5 DAMAGE NO.1 COT S AT 15 M FROM LOWER PART OF THE TANK (FIG 8)

Location of Damage

Calc. Point	m-FP	m-BL	m-CL
Low Point	12.950A	15.00	4.575 SB

FIG 8 case 5 damage in 15 meter from bottom

Oil Outflow Summary (damage NO.1 COT S at 15m from base-line))

Compartment	Intact Status LT	Remaining Oil LT	Oil Outflow LT
NO.1 COT S	10,259	883	9,376

9.6. Out flow Calculation method

This balance represented by the following equation:

d ×seawater = h oil × p oil + h flood + p seawater + pi

where:

d = draft

pseawater = density of seawater

h oil = height of oil in tank

p oil = density of remaining oil

h flood = height of flooded water in tank

pi = internal pressure head on top of tank

Damage leading to oil outflow can occur to either the bottom or side of the tank. There are four possible scenarios:

i. LIGHT LOAD - BOTTOM DAMAGE

The head level of oil is less than the head level of seawater there is no loss of oil. Floodwater enters the bottom of the tank until equilibrium be reached.

ii. LIGHT LOAD - SIDE DAMAGE.

Due to the equalization of the level inside and outside the tank. The Floodwater displaces the oil below the site of damage, which results in some loss of oil

iii. HEAVY LOAD - BOTTOM DAMAGE

This is the typical scenario for a heavily loaded vessel. The oil level drops until equilibrium reached. There is no ingress of flooded water, but significant oil loss occurs.

iv. HEAVY LOAD - SIDE DAMAGE

Floodwater enters up to the damage location, displacing all oil below this level. Again, significant oil loss occurs

9.7 Results analyses

Compartment	Damage level from base-line Tank bottom	Intact Status LT	Remaining Oil LT	Oil Outflow LT
NO.1 COT S	3m	10,259	7,802	2,457
NO.1 COT S	8m	10,259	5,204	5,055
NO.1 COT S	10m	10,259	3,971	6,288
NO.1 COT S	12m	10,259	2,736	7,523
NO.1 COT S	15m	10,259	883	9,376

The results obtain that the position level of the damage for the same tank give significant change for Oil Outflow from 2,457 ton if the damage position at the tank bottom to 9,376 ton if the damage position at level 15m from base line

10. CONCLUSION

Predict a system for emergency response in Suez Canal become a necessary step to protect the navigation against unexpected action. Suez Canal Emergency Response system (SCERS) ensures compliance with mandatory requirement of MARPOL Annex I, Ch.5, Reg.37(4), requiring "oil tankers have to involve in land-based calculation programs for damage stability and structural strength". OPA'90 and 33CFR155.240 are met program provides the necessary technical support required in the critical hours after a vessel is stranded.

Suez Canal Emergency Response system (SCERS) operational active mood as:

1-Suez Canal using Emergency Response system and already have prepared model for all tanker transit SC.

2- Suez Canal using Emergency Response system in the active mood by enter the actual loading condition for the tanker before enter SC.

3- In case of, oil outflow can immediately calculate the amount of oil spilled in the worst-case scenario in accurate manner and put in action the equipment for control the oil spill with the suitable capacity.

4-The Emergency Response system with the previous arrangement enable Suez Canal Authority to minimize the impact of any oil outflow accident and start to control oil spill in

accurate starting data to put in action the suitable amount from the pollution control equipment according to the calculated oil outflow.

11. RFERENCES

- Abd El-GeliL. I (1998). National Oil Spill Contingency Plan, Egyptian Environmental Affairs Agency.

-Abdel-Hameed E. Abdel Aziz, 2016. Application of Marine Environmental Monitoring in Egyptian Oil Spill Contingency Plan. Maritime Postgraduate Studies Institute. The Arab Academy for Science, Technology and Maritime Transport.

- Abdel-Razek, Sherine (2015). "Canal corridor developments". Al Ahram Weekly (4 August 2015).

- Abou El-Geit, E.N., Saad, T.T., Abdo, M.H. and Mona, S.Z., 2013. Microbial infections among some fishes and crustacean species during blooming phenomenon in Qaroun Lake-Egypt. Life Sci. J, 10(2), pp.1217-1224.

- Assilzadeh, H. and Gao, Y., 2010. Designation of an interactive oil spill management system. Disaster Prevention and Management: An International Journal, 19(2), pp.233-242.

- Authority SC, 2021. Importance of the Suez Canal, https://www.suezcanal.gov.eg.

- Barrow D (2006). Ship Emergency Response Service – Marpol Annex I Reg.37 Oil Tankers. Lloyds Register

- Dewina, R. and Yamauchi, F., 2009. Human capital, mobility, and income dynamics: Evidence from Indonesia. Japan International Cooperation Agency, Tokyo, and International Food Policy Research Institute, Washington, DC Photocopy.

- Feng, L., Li, C., Huang, J., Chang, H. and Chu, X., 2014. A sulfate control on marine mid-depth euxinia on the early Cambrian (ca. 529–521Ma) Yangtze platform, South China. Precambrian Research, 246, pp.123-133.

- Gambrell, Jon (23 March 2021). "Massive cargo ship turns sideways, blocks Egypt's Suez Canal". KARE. Associated Press. Retrieved 26 March 2021.

-Herbert-ABS.(2015).HECSALV .www.herbertsoftware.com Features:

- Li, Y., Lin, C., Wang, Y., Gao, X., Xie, T., Hai, R., Wang, X. and Zhang, X., 2017. Multi-criteria evaluation method for site selection of industrial wastewater discharge in coastal regions. Journal of Cleaner Production.

- N. A. Farid, S. A. Mahmoud and O. E. Ahmed (2014). Assessment of Contamination by Petroleum Hydrocarbons in Sediments along Discharge Basin of Suez Oil Refinery Company, Southwest of the Suez Gulf. Egypt. J. Chem. 57, No.2, pp.75-96 (2014)

- Radović, J.R., Rial, D., Lyons, B.P., Harman, C., Viñas, L., Beiras, R., Readman, J.W., Thomas, K.V. and Bayona, J.M., 2012. Post-incident monitoring to evaluate environmental damage from shipping incidents: Chemical and biological assessments. Journal of environmental management, 109, pp.136-153.

- Sobeh, H (2018). Alwattan] MAMISH: The success of the maneuver against oil pollution in East Port Said Port]. Future Media.

- Suez Canal Authority (August 2015). Navigation in Suez Canal Rules of Navigation and Passage Procedures in Suez Canal. p. 9. Suez Canal Authority website Retrieved 27 March 2021.

- Steven Dexter (2018). Merchant Shipping (Prevention of Oil Pollution) Regulations 2018. Maritime & Coastguard Agency. Department for Transport UK

https://assets.publishing.service.gov.uk

Utilization of the Innovative "Snapback Arrestor" to Decrease the Mooring Mishaps

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المستخلص:

منذ العصور القديمة، جاب الإنسان البحار والأنهار باستخدام سفن مصنوعة من مواد أولية موجودة بشكل طبيعي في البيئة وتنقل البضائع من مكان إلى آخر. كانت هذه بداية صناعة النقل البحري التي تعتبر ركيزة التنمية الاقتصادية لجميع الدول. تعتمد السفن على الحبال ومساعدات التراكي أثناء المناورة للرسو على الارصفة او الخروج من الارصفة. منذ أن بدأ البشر في الإبحار، ابتكر البحارة تقنيات مناورات مختلفة تختلف باختلاف تصميم السفينة. تعتبر عملية الإرساء من أهم المهام على متن السفن.

كما أنها واحدة من أكثر العمليات خطورة بسبب العديد من المخاطر المتعلقة باستخدام بعض معدات الإرساء؛ علاوة على ذلك، يعتبر رباط السفن من أحد الأسباب الأكثر شيوعًا للحوادث البحرية والإصابات التي تؤثر على العنصر البشري على متن السفن التي تترك الضحايا. اعتمدت المنظمة البحرية الدولية ((IMOأنظمة إدارة معينة للحد من الحوادث ووضعت قواعد لعمليات التفتيش والصيانة الدورية لجميع أجزاء السفينة، بما في ذلك معدات الرسو وحبال الرباط، بالإضافة إلى إصدار مختلف المعاهدات والأكواد التي توجه البحارة حول كيفية القيام بذلك. لإنجاز مهامهم بشكل صحيح. علاوة على ذلك، تم بذل الكثير من الجهود خلال العقود القليلة الماضية لتحسين السلامة أثناء عمليات رباط السفن. ومع ذلك، لا تزال الحوادث المتعلقة بعمليات الرباط في ازدياد. تكشف هذه الورقة الوصفية إحصائيات عن حوادث الرباط حول العالم، وأسباب حوادث الإرساء ، ومفهوم تأثير الارتداد المفاجئ. كما يوضح كيف أصبح مانع الارتداد المفاجئ لحبال الرباط هو الحل لتقليل حوادث الإرساء الخطرة.

Abstract:

Since ancient times, the human has roamed the seas and rivers using vessels made of raw material that naturally existed in the environment and transporting goods from one place to another. This was the beginning of the maritime transport industry, which is the pillar of economic development for all countries. Vessels depend on ropes and bollards during maneuvering for berthing and unberthing. Since humans have started to sail, sailors have invented various maneuvering techniques that differ according to the design of the ship. The mooring process is one of the most important tasks onboard vessels.

It is also one of the riskiest operations due to many threats related to the use of some mooring equipment; moreover, mooring is one of the most common causes for marine accidents and human injuries aboard vessels leaving victims. The International Maritime Organization (IMO) has approved certain management systems to reduce accidents, and has set rules for vital inspections and maintenance of all parts of the ship, including mooring equipment and mooring lines, in addition to issuing various publications and codes guiding seafarers on how to accomplish their tasks properly. Furthermore, there is a lot of considerable effort that has been done over the last few decades to improve safety during mooring operations. However, accidents related to mooring operations are still increasing. This descriptive paper reveals statistic on the mooring mishaps around the world, causes of mooring accidents, and the concept of snapback effect. It also illustrates how the snapback arrestor has become the solution for reducing the hazardous mooring incidents.

Keywords: Snapback – Snapback Arrestor – Mooring Mishaps.

1- Introduction

The remaining ancient Egyptian murals and drawings indicate that the Egyptians taught humanity the rules of sailing that began on the River Nile. From a marine perspective, this early seafaring would have been impossible without ropes. The mooring is any durable structure to which a vessel may be secured, for example jetties, bollards, anchor buoys, bites, and mooring buoys. Vessels are secured by moorings to prevent the free movement of the ship in the water during berthing whether alongside, open mooring or traditional ship-to-ship mooring (side to side), port or starboard.

The main function of mooring lines, whether manila ropes, fiber ropes, or wires, is to keep the vessel in position, and prevent the ship movement during resting alongside. However, lines can be used for turning the ship or for the maneuvering of the vessel, as when casting off from berth. Ropes of many different types and sizes have been indispensable for the ancient sailors and worker's onboard ships throughout history. It has been clear that the era when vessels were using cordage, in substantially every form, that could be found from anchor warps to the sail ropes was a predominant period in history for ropes fabricators. Furthermore, the use of ropes was essential for all ships to do various types of missions (Seamanship Technique, 2018).

It is difficult to make calculations to accurately specify when and how the mooring lines will react when they are suddenly cut off by the force of tension. According to statistical reports, fatal accidents still occur despite the presence of illustrative drawings and applying precautionary measures. However, there is a large percentage of up to 60% of mooring accidents occur due to the snapback of mooring lines, and about 14% of these accidents have led to death as shown in Figure (1).

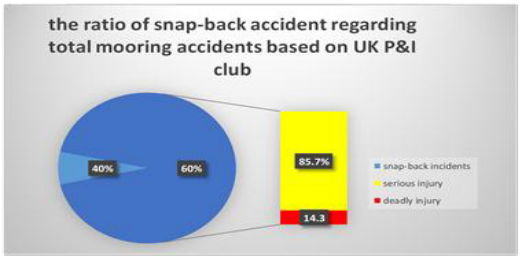

Figure (1): Ratio of snap-back accident P&I club
Source: (P&I, 2013)

One of the most important elements in mooring operation is the mooring lines and the major goal of SOLAS convention is to achieve the safety elements onboard ships. Therefore, in SOLAS Chapter II-I, Part A regulation 3-8 paragraph 2:

"Ships shall be provided with arrangements, equipment, and fittings of sufficient safe working load to enable the safe conduct of all towing and mooring operations associated with the normal operation of the ship"

Refer to Guidance on shipboard towing and mooring equipment (IMO 2020c) which is likely to become effective on 1 January 2024 (IMO, 2020d). A request has been submitted in the form of a draft to promote the safety of mooring operations by the Maritime Safety Committee (MSC) with regard to mooring operations and fatal accidents resulting from them. Whether, due to mooring equipment such as winches and mooring parts or due to the snap back of mooring lines, but the project was suspended due to Covid -19 crisis. However, the area of concern was to improve the ship's design by minimize both of the sharp edges and hard change in mooring line direction during mooring operation (IMO, 2020c).

The aim of this research paper is to request modify the current conventions and to adopt draft to MSC to adoption a draft to be submitted to MSC to generalize modern techniques of mooring lines such as SBA through which the rates of serious and fatal accidents can be reduce. In particular, some of this new innovation has proven its effectiveness through its application and employ onboard of certain scale for some large-tonnage container ships. Furthermore, this paper describes the types of vessels mooring, accidents around the world that result from the mooring process, causes of mooring accidents, and finally apply the "Snapback Arrestor" for containing the negative effects of snapback and therefore, reducing the rate of mishaps.(IMO,2020c)

2. Background

Most of the previous studies have been concerned with the safety aspect pertaining to the human behavior, and the inspection of the readiness of mooring lines, mooring winches, and deck. The previous researches concluded that mooring is a dramatically serious job;

therefore, mariners must adhere to the professional publications and guidelines, which demonstrate the safe steps that must be followed while working on deck during mooring. Melepaskan (2018) mentioned that the mooring operation needs intensive care on the part of the officer of the watch. Consequently, a safety meeting is mandatory to ascertain the safety of the vessel as well as the crewmembers involved in mooring. Best practice mooring Platform Zero Incidents, first version (2017), confirmed that a safe working environment during mooring is a crucial element in ensuring a safe mooring. Some of the safe practices include reducing the possibility of slipping by using a special type of paint (anti-slip paint) and marking the location of potential risk of tripping (snapback zone). As a result, it is creating a safe working environment by assuring good communication between crewmembers.

Tilbury (2018(found that training and knowledge effectively contribute to attaining maximum safety level. Analyses the potential risks in mooring operations in a study that he conducted claims that the Personal Protective Equipment (PPE) plays a major role in minimizing those risk; besides, the environmental components, such as wind and current must be considered during accomplishing mooring to avoid snapback (Kuzu, 2019). (Jiang and Ren 2021), assumed that incorporating simulations and models of mooring line operations into the ship design is beneficial in avoiding vulnerable circumstances that might harm the human element. They also added that accurate calculation of mooring line tension is pivotal in anticipating mooring accidents.

The majority of the previous studies stress the importance of developing the human skills by improving both, academic training and practical training onboard ships. The PPE of the ships' crew and the condition of the mooring lines during the mooring process have been highlighted without offering alternative solutions, such as a new technology that can be deployed to replace the mooring rope to minimize the risk of snapback effect.

3. Mooring Accidents Around the World

Mooring and unmooring operations provide potential circumstances that can lead to severe and serious problems. Seafarers should never stand or step over any part of the rope or near a rope under hard tension, and they should deal with ropes on the winches and bollards with special care. Additionally, working on decks, especially in enclosed mooring decks, increases the risks, which entails taking more precautions.

As per IMO Sub-Committee on Ship Design and Construction (SDC 6), 4-8 February 2019, it has been noticed that there were 402 accidents from 1997 to 2013 on board Danish ships. From 402 accidents, 42 severe injuries have been reported representing around 10 % of total accidents which illustrated in Figure (2).

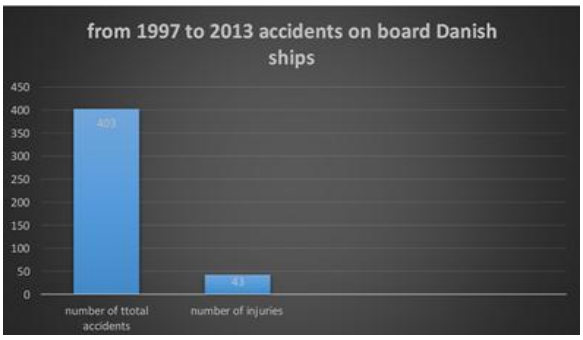

Figure (2): Danish Ships mooring accidents
Source: DSIA, (2015)

From 2010 to 2015, 227 mooring related incidents have been informed on to The Australian Maritime Safety Authority (AMSA) 51 of which caused severe injuries. These accidents represent approx. 22% of total accidents. The ratio illustrated in Figure (3). Although, there were not any deaths attributed to mooring accidents in Australia, deaths caused by mooring accidents have continued to happen around the world (AMSA, 2015 and DMAIB,2018).

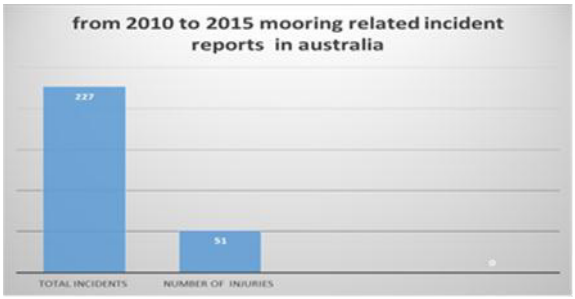

Figure (3): Mooring accidents in Australia
Source: AMSA, (2015)

Investigations results indicated that around 62% of these accidents occurred because of defective mooring equipment design. Around 51% of these accidents were due to safety reasons, or the bad condition of the mooring lines (Safety for Sea, 2020).

According to the UK P&I club report in 2016, after 373 vessels were inspected, and even though all mooring ropes and wires must be certified. It has been found that 250 ships did not apply splicing; besides the ropes were not in good condition and should be replaced by the spares. As per the European Harbors Masters' Committee it has been noticed that from all human accidents on board ships, 95% were caused by mooring operations, and 60 % of which are caused by mooring lines (P&I, 2016).

Figure (4) shows that boating activities in USA resulted in eight accidents while mooring and unmooring during 2020. Six of them caused death, which represent 75% of total mooring accidents.

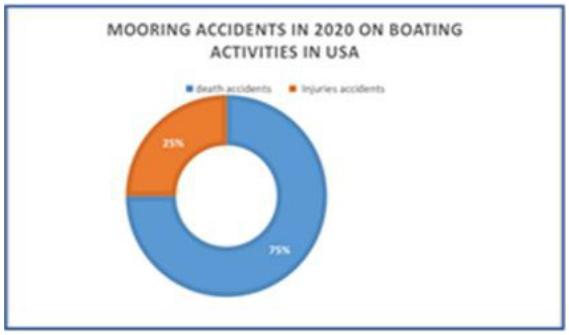

Figure (4): boating activity mooring accidents in USA
Source: (USCG, 2020)

4. The Concept of Snap-back

It simply means the distance a line/wire that is cut takes to hit someone or something. Snapback is the effect that is resulted from the high-stress rope or wire being cut when it reaches its maximum stretching limit. Snapback is potentially the deadliest of all line handling hazards during handling mooring lines, especially if the line is under too much tension. A rope can strike anything it faces with tremendous force. So that, all seafarers must pay great attention to this killing hazard (Wilhelmsen, 2019).

The high tension of the mooring ropes during berthing maneuvers will increase the amount of potential energy of the mooring line whether a manila rope, a Nailon rope or a wire. The higher the tension placed on a mooring line, the greater potential energy it stores. In case the mooring line is cut due to excessive stretching, it triggers the snapback effect.

4.1. Types of Vessels Mooring

The mooring operation mainly depends on the high skills of ship's crew and it requires both high awareness and responsiveness to the surrounding conditions of the ship while mooring. The first type of ships mooring is the traditional type, which is mooring alongside the berth that illustrated in Figure (5).

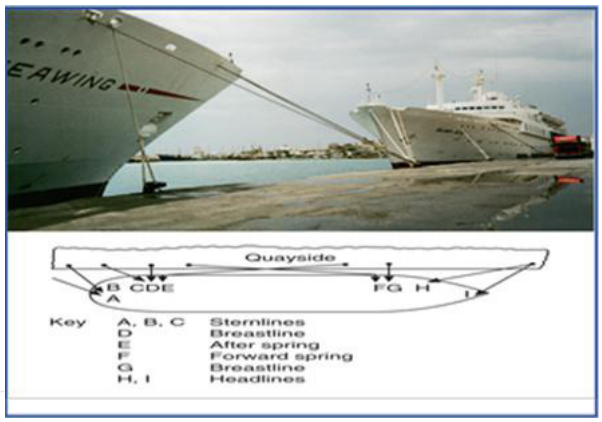

Figure (5): Shape. Alongside mooring
Source: (Seamanship techniques, 2018)

4.2. The Efficiency of Mooring Parts on Board Vessels

One of the most common reasons for mooring accidents is the friction of mooring ropes with sharp edges while handling them, especially during hard pull, which leads to the rope being cut during the berthing maneuver. Although, the ship's mooring equipment has been designed to be clear of sharp edges or corners. Not only this, but also the force of pulling according to ship displacements as per SOLAS regulation II-1/3-8 (Towing and mooring equipment) is taken into account in the design of mooring arrangements (deck fenders) on ships deck, equipment and fittings Figure (6). Additionally, most of mooring equipment has been designed to be coiled smoothly during usage to minimize mooring ropes damage resulting from hard pulling. Fairleads are used for this purpose.

Universal multi-angled fairlead and some mooring parts that have been made with a curved design to avoid having sharp angles as those of Panama lead. The roller guide is also used to rig the rope in a direction perpendicular to the windlass drum (IMO, 2020).

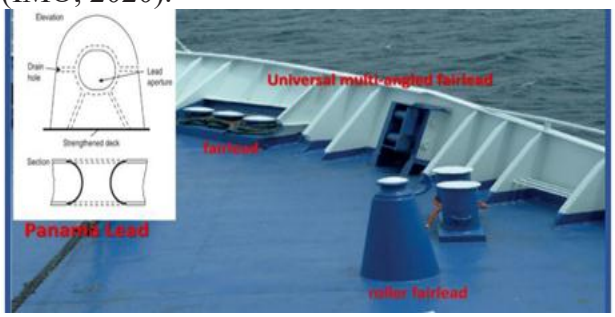

Figure (6): Shape of mooring parts
Source: Seamanship techniques, (2018)

4.3. Causes of Mooring Accidents

First, toolbox meetings to evaluate the risks are rarely held before carrying out the mooring phases. Second, poor communication or misunderstanding of mooring orders, particularly on most of the vessels with a multi-national crew contribute to mooring accidents. In spite of the many safety procedures that have been established for securing the mooring process in the International Safety Management (ISM) code and the code of safe working practices, mooring accidents still take place at a significant rate for several reasons. Furthermore, mooring accidents often happen when there is overload on the mooring equipment, i.e., if there is excessive tensile force on the mooring ropes and wires due to maneuvering, bad weather or towing operations.

One of the common causes of marine crew accidents during the routine mooring operation is the slipping of the mooring ropes from the drums of the winch, or due to the snapback effect while making fast the ropes, which has an effect that is equal to a rifle shoot that causes deadly injuries. Snapback zone Figure (7) gives the crew the opportunity to easily observe the hazard area without having to worry about the lines movement during maneuvering and mooring operation.

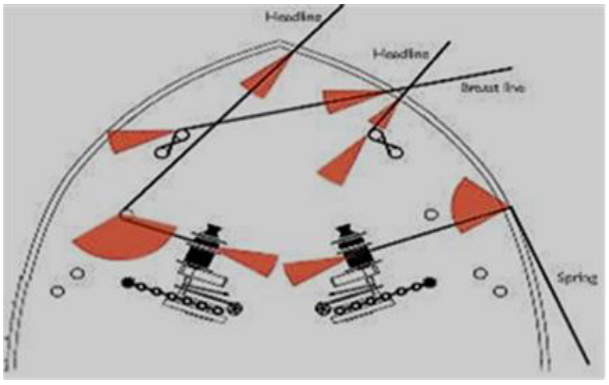

Figure (7): Shape - Snapback zone highlight marking on deck
Source: P&I, (2015)

This acts as a warning area. Despite that the mooring winch design provides some protection against snapback hazard, which relatively protects the person operating the winch. It cannot protect other crewmembers who are handling the ropes during mooring operation. Another common cause for marine crew accidents is the snapback effect. The P&I club in the UK spent around 34 million USD between 1987 and 2009 as compensation for losses caused by mooring accidents, which mostly affected humans. Furthermore, the P&I clubs reported that mooring lines are clearly considered responsible for the largest share in marine accidents regardless of the surrounding circumstances, yet one of the most common grounds for these rope tragedies is “the snapback effect”.

4.4. The Causes of Snap-back

The lack of maintenance of mooring parts, such as the rotating parts including, for example the roller guide, leads to increasing the frictional. In addition, the snapback could be attributed to neglecting mooring winch greasing. Furthermore, a snapback could result from not giving much care for properly stowing away the mooring ropes aboard vessels as per (IMO,2020b) which require that all mooring lines must be surveyed for the following:

- Overloading of the mooring winches during the mooring process.
- Excessive tension on the ropes during towing.
- Tidal movement, which causes the ship to rise sharply, which leads to an increase in tensile strength from the breaking point.

 The movement of cargo due to loading and unloading, which gives rise to the freeboard effect onboard the ship. This makes the mooring ropes of the ship in a state of maximum tension.

The traffic in the port, to illustrate, the interaction between the ship berthing alongside and the passing vessels in the vicinity. For example, the passing of deep draft ships has an impact on the vessel that is caused by the horizontal and vertical forces which might eventually lead to cutting the ship mooring lines or even damage the fenders and quay walls.

 Mooring lines must be surveyed regularly, particularly before the mooring operation as per ISM checklists. If this inspection is not carried out, some of these ropes or wires might be scratched stimulating a snapback.

 To connect a wire with a mooring rope, a thimble, or any other tool in the eyes of the ropes, must be provided to prevent uncontrolled friction at a certain point, especially when there is tension or overload, because this will bring on damage of the mooring lines. Many of the inspections in UK P&I club found that neither was there any protection, nor any connection of ropes with wires with a wooden or fiber gasket. Such practices do not conform to what is proclaimed in the code of safe working.

 The stopper, which is a small rope used to hold the mooring line till it is transferred and secured on the ship's bitts. The fiber rope should be stoppered with man-made stopper (manila) while transferring the mooring line from the winch drum to the bitts. (Kuzu, 2019)

5. Applying the Snapback Arrestor (SBA) for Covering the Glitches

The proposed solution is a new mooring innovation that reduces the snapback effect by using SBA of a traditional mooring rope. It has been recently launched in the global marine market. After seven years of experiments and trials, and many tests for a certain type of mooring ropes, it has been approved against Snapback. The common name of this type is The Snapback Arrestor (SBA) Figure (8), which is considered a revolution regarding both the mooring process and the mooring technology. This SBA prioritizes the safety of the human element, which is an urgent step toward achieving one of the major goals of the SOLAS convention.

Figure (8): Snapback arrestor rope
Source: Wilhelmsen, (2019)

The new system of SBA has been approved by DNV and GL classification society as a certified product, which reflects positively on this product and its efficiency; also encourages the consumers who are the ships operators to replace the old mooring techniques by the new SBA mooring (Wilhelmsen, 2019). Many companies around the world have substituted the traditional mooring lines on deck with the new snap back arrest. This new technology of mooring ropes represents an innovative solution with a new design of the rope that absorbs the potential energy inside the rope when exposed to tensile forces.

In addition, it is characterized by extreme flexibility, as it expands 18% more than before due to being manufactured using high-strength polyester materials; besides its design enables reusing for many times. The SBA is distinguished with highly visible colours, which is taken as a kind of visual alarm before the rope gets cut. Furthermore, its design encloses 12 strands containing a flexible and durable core which would prevent the sudden cut that causes the snapback, if the outer 12 strands casing was cut. On the other hand, in case this inner core of the mooring rope is cut, the effect of the snapback will not be fatal; since most of the potential energy, which is resulted from the high tensile strength, has been dispersed over the outer 12 strands (Wilhelmsen, 2019).

The Maersk Shipping Line, which is the largest merchant fleet all over the world, spends nearly two million dollars per year to replace around 1,000 mooring ropes and will swap all the

mooring lines for the new SBA ropes in the next few years for enhancing safety during mooring. Maersk has taken the challenge and has adopted this innovation, for the new SBA provides visual observation of the mooring line when being cut, before the effect of the snapback takes place.
This new type of mooring, dissimilar the traditional rope, is not suddenly cut. The outer cover which contains 12 strands is cut first, before the core, which is a polymer rope. This new method has numerous advantages, including buoyancy, enduring high tension compared to its lightweight. In other words, SBA offers the best strength-to-weight ratios on the market. SBA is trusted for its reliability, anti-twist deployment and highly visible colors. The new SBA product has been subjected to a trial test on board Maersk line ships in 2019 to make sure that the rope functions efficiently compared with the common traditional. The result obtained at the end of 2020 was satisfactory (Wilhelmsen, 2019).

6. Conclusion

Obviously, the mooring operation, which is handling all types of mooring lines is considered a risky mission that massively affect the human element onboard vessels. Moreover, the mooring deck is classified as an extremely dangerous one. Consequently, the P&I club worldwide, pay large fines annually making up for mooring incidents damage. No equipment that aim at protecting the personnel aboard vessels is adequate to safeguard the crew from snapback risk. Furthermore, mooring line protection is indispensable to conduct a safe mooring process. Training and risk assessment fall under the heading of very critical responsibilities, which must be attended to periodically.

Recommendations:

Although some modifications were adopted by MSC to avoid a sharp increase in mooring accidents, snapback accidents still occur because the majority of these modifications were based on modifying. The design of the mooring surface on board ships to reduce and did not adopt any technology for the manufacture of mooring ropes. Therefore, it is necessary to amend international agreements in line with the development of new technologies, which has become an urgent matter in order to avoid the steady increase in incidents resulted from snapback.

References:

Australian Maritime Safety Authority- AMSA, (2016). "Maritime Safety Awareness Bulletin" September (2016) Issue (II)
cited on net November 2016
(https://issuu.com/aust-maritime-safety-authority/docs/amsa282-marine-safety-

Australian Marine Safety Authority-AMSA. (2015). "Focus on mooring safety", report, October 6. Retrieved from: (Maritime Safety Awareness Bulletin, Issue 2, September 2015)

Buitendijk,.Mariska (2019). "New Mooring Rope Reduces Snap-back" swzmaritime.nl.
Danish Maritime Accident Investigation Board - DMAIB, (cited on net "June 2018" DMAIB - Page 3 of 3 - SAFETY4SEA)

House David, Seamanship Techniques (2016). Routledge "5th Edition,

IMO, (February 2019) "Sub-Committee on Ship Design and Construction" (SDC 6), 4-8
IMO, (2020a). Safety Of Life At Sea (SOLAS 74). London, Author

IMO, (2020b). "guidelines for inspection and maintenance of mooring equipment including lines". MSC.1/Circ.1620 24 Jun 2020. London, Author

IMO, (2020c) "REVISED GUIDANCE ON SHIPBOARD TOWING AND MOORING EQUIPMENT" MSC.1/Circ.1619 .(9 December 2020). London, Author

IMO,(2020d) "GUIDELINES ON THE DESIGN OF MOORING ARRANGEMENTS AND THE SELECTION OF APPROPRIATE MOORING EQUIPMENT AND FITTINGS FOR SAFE MOORING" MSC.1/Circ.1175/Rev.1. (11 December 2020). London, Author

Kuzua. Ali (2019). A risk analyzing of ship mooring operation, Ocean Engineering, Volume 179, 1 May 2019, Pages 128-134

Maersk Retrofitting Mooring Ropes with Snap Back Arrestors Fleet-Wide" cited on net, may (2020). https://www.motorship.com/maersk-retrofiting-mooring

P&I Club UK (2009) "focus on Moorings". Retrieved from (26/01/2009)

P&I CLUB UK. (2009). "Understanding-mooring-incidents", cited on net, (JANUARY 2009) (https://www.ukpandi.com/news-and-esources/bulletins/2009/understanding-mooring-incidents/)

The West of England Ship Owners Mutual Insurance Association- WESOMIA, (2019), cited on net October2020 , https://www.westpandi.com/getattachment

Marine Pilots (2021). "Innovative rope design improves vessel mooring safety", Cited on net,18 June 2021 from: https://www.marine-pilots.com/articles/74325-innovative-

Marine Department, Mooring Operations Manual, Version 1.8, (4 October 2018). cited on net 4 October 2018, (https://www.forthports.co.uk/wpcontent uploads/2018/11/POTLLMooringManual.pdf)

United States Coast Guards- USCG, (2020). "Recreational Boating Statistics report". Retrieved from: uscgboating.org

Wilhelmsen, Holding ASA, October, (2019). "The new era of mooring safety" Wilhelmsen Holding ASA cited on net: (https://www.wilhelmsen.com/marine-products/ropes/the-new-era-of-safer-mooring/)

Xiaobin, Jiang (2021). "Simulation of Mooring Line Operation in Ship Mooring", Journal of the institution of engineers feb 2021 –India Retrieved from: (ui.adsabs.harvard.edu)